The background features abstract green line art. In the upper right, there is a complex, starburst-like pattern of thin green lines radiating from a central point. In the lower left, there is a more structured, geometric pattern of thicker green lines forming a network of interconnected shapes.

The Pharmacy Calculations Workbook

by: Dr. Murali Ramanathan

*A problem-based approach to
better pharmacy and dosing
calculations skills.*

The Pharmacy Calculations Workbook

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CHAPTER 1
PRESCRIPTION INTERPRETATION

MEDICAL ABBREVIATIONS**Abbreviations for disease states and physiologic states**

Term	Meaning
ADHD	Attention Deficit and Hyperactivity Disorder
BM	Bowel Movement
BP	Blood Pressure
BPM	Beats per Minute
CA	Cancer, carcinoma
CAD	Coronary Artery Disease
CHF	Congestive Heart Failure
COLD/COPD	Chronic Obstructive Lung/Pulmonary Disease
CVA	Cerebral Vascular Accident, stroke
DM	Diabetes Mellitus
FBS	Fasting Blood Sugar
GERD	Gastro-esophageal Reflux Disease
GI	Gastrointestinal
ESRD	End Stage Renal Disease
HA	Headache
HBP, HTN	High Blood Pressure, Hypertension
HR	Heart Rate
MI	Myocardial Infarction, heart attack
NKA/NKDA	No Known Allergies/No Known Drug Allergies
N&V, N/V	Nausea and Vomiting
OA	Osteoarthritis
RA	Rheumatoid Arthritis
RR	Respiration Rate
SOB	Shortness of Breath
Temp	Body Temperature
URI	Upper Respiratory Infection
UTI	Urinary Tract Infection

Abbreviations for Dosage Forms in Inscription, Subscription or Signa

Term	Meaning
amp.	Ampule. A hermetically sealed glass vessel containing a sterile drug solution usually used parenteral administration. The ampule is broken and the solution drawn into a syringe under aseptic conditions just prior to administration. Ampules are always single dose units. Vials are glass containers with a rubber stopper through which a hypodermic needle can be inserted to remove its contents. Vials can be either single use or multiple use depending on whether a bacteriostatic preservative is present in the solution.
cap.	Capsule. A shell usually made of gelatin that contains the active ingredients in powder or liquid form. When the capsule is swallowed, the gelatin dissolves in the acid environment of the stomach releasing the material inside.
chart.	A divided powder, powder in a paper. The drug or drug mixture is wrapped in folded paper. The patient unfolds the paper and transfers the contents to a tablespoon or a glass and dissolves the contents in water. This solution is swallowed and washed down with water. Archaic dosage form.
cr., crm.	Cream. A semisolid preparation containing drug intended for application to body surfaces like the skin. Creams are heterogenous systems (an oil in water mixture) whose continuous phase is either aqueous or water soluble. Creams absorb into the skin leaving little oily residue.
elix.	Elixir. An oral solution containing drug, water, and some alcohol. When the active ingredients are dissolved exclusively in alcohol the dosage form is called a Spirit.
emul.	Emulsion. A liquid, heterogenous dosage form in which a liquid oil is usually dispersed in a continuous aqueous phase. Usually the drug is dissolved in the internal oil phase. When an emulsion is used topically it is frequently called a lotion. (Topical lotions may also be called suspensions)
Liq.	A solution
Lot.	A lotion.
Parenteral	The word Parenteral is used to indicate routes of administration other than the gastrointestinal tract
pulv., pulvis	A bulk powder. Applied directly to the skin from the container.
sol.	Solution. A solution of drug usually in water. May be taken by mouth or applied to skin depending on indication.
supp., sup., suppos	Suppository. Firm semisolid dosage forms that are designed to be inserted into a particular body opening. The semisolid vehicle melts at body temperature releasing the incorporated drug into the local body fluids. Rectal and vaginal suppositories are most common.
susp.	Suspension. A liquid, heterogenous dosage form in which a solid is dispersed in the liquid. Usually the drug is not dissolved in the dosage form. When the suspension is used topically it is frequently called a lotion.
syrr.	Syrup. A solution that is sweet and highly viscous. Rarely, used for syringe .

tab.	Tablet. A compressed tablet of drug and other excipients which can only be manufactured on an industrial scale. Tablets are not pills. Pills are an older type of preparation not commonly used anymore, and have a round shape (exception - colchicine is dispensed as pills). A Sublingual Tablet (tab SL. or SL) is designed to be dissolved under the tongue. A sublingually administered drug is intended to be absorbed across the oral mucosa avoiding gastrointestinal-hepatic degradation prior to entry into general circulation (Example: Nitroglycerine Sublingual Tablet). Sublingual tablets should not be swallowed.
tinc., tr., tinct.	Tincture. A solution containing a lot of alcohol, although other solvents may be present. Tinctures usually contain drug at high concentrations.
ung, unguentum, oint.	Ointment. A semisolid preparation containing drug intended for application to body surfaces like the skin. Ointments unlike creams are continuous oil based systems. Ointments generally leave an oily residue on the applied surface for a longer time than creams.
vl	Vial, a container used for sterile preparation.

Abbreviations in Directions for Pharmacist- Subscription Verbs

Term	Meaning
disp.	Dispense. Provide to the patient.
div. #	Divide. The formula refers to the total amount to be made. Divide the formula into the specified number of dosage units.
d.t.d. #	Give such doses. The formula refers to a single dose. Prepare and dispense a specified number of doses.
ex. aqua	in water
f., ft.	Make. Prepare
M	Mix the contents of the formula
N.B.	Note Well!!! Pay attention to this.
No., #	Number of units to be prepared or dispensed.
S.A., Secundum artem	According to the art. A vague phrase meaning roughly "use your skill and judgment"
tal. dos.	such doses

Directions for the patient and care providers - The Signa

Term	Meaning
Sig.	write the following directions on the label
ad	up to, don't confuse with right ear (a.d.)
appl.	apply
AAA, aaa	Apply to affected area
c, cum	with
dil.	dilute, for example: dil. 5 ml in 6 oz. OJ (orange juice)
D/C, D.C.	Discontinue
e.m.p., ut dict, u.d.	as directed, in the manner prescribed
et	and
NMT	not more than
NPO	Nothing by Mouth. The patient is to receive nothing orally
non rep, N.R.	do not repeat, (also, no refills when not in Sig.)
rep	repeat, (also, refill when not in Sig.)
s, sine	without
tg, TG, TAT	till gone, until all taken, finish all the doses supplied

Abbreviations in the Prescription Formula - The Inscription

Term	Meaning
aa., or aa	of each. Used when two or more ingredients are present in the same amount. They are listed sequentially with the symbol placed next to the last item of the group which it refers.
Agit.	Shake.
Alb.	White.
APAP	acetaminophen (N-acetyl-para-aminophenol) an analgesic
ASA	aspirin (acetylsalicylic acid) an analgesic.
aq., aqua.	water , drinking water. Never used in making prescriptions.
aq. dest.	distilled water , deionized water used in prescriptions. Prepared by distillation.
aq. pur.	purified water USP , An official deionized water used in prescription compounding.
q.s.	a sufficient quantity. Calculate and add the appropriate quantity to make the prescription. Example: the amount of lactose needed to fill capsules.
q.s. ad	a sufficient quantity up to. Add sufficient quantity to achieve a specified total weight or volume. Example: amount of water needed to make 240 ml of total solution.
aa q.s. ad	a sufficient quantity of each up to. Used when more than one substance is to be added in equal quantities to achieve a specified total weight or volume.
D5W	Dextrose Injection USP , a sterile isotonic IV Fluid (5% dextrose in water)
HC	Hydrocortisone , a steroid hormone
inj.	Injection , indicating that the injection dosage form is to be used.
IOP	In original packaging
MDI	Metered dose inhaler
MS, MSO ₄	Morphine Sulfate. A narcotic analgesic (N.B. ISMP does not recommend these abbreviations)
MOM	Milk of Magnesia , magnesium hydroxide suspension, an antacid.
NF	National Formulary , Indicates the ingredient should conform standards prescribed in the official NF compendium
NS, N.S.	Normal saline. 0.9% Sodium Chloride Solution USP , a sterile, isotonic IV fluid (0.9% NaCl in Water)
½ NS	0.45% Sodium Chloride for Injection, Half-Normal saline , a sterile IV fluid
hs, HS	Half strength (not to be confused with “at bedtime”)
NTG	Nitroglycerin , a drug to treat angina pectoris, and cardiovascular disturbances
TPN	Total Parental Nutrition , an intravenous feeding fluid containing carbohydrates, amino acids, electrolytes, and sometimes lipids.
USP	United States Pharmacopeia , Indicates the ingredient should conform standards prescribed in the official USP compendium.

Units of Measure used in the Inscription-Subscription

Term	Meaning
cc., cc	cubic centimeter , USP states 1 cc is equivalent to 1 ml
fl, fld.	specifies that the measure is a fluid measure
g., Gm.	Gram , NB don't confuse with gr.
gr., gr	Grain , NB don't confuse with g.
gtt.	Drop , In general not a rigidly standardized measure. Modern preparations are dispensed with the calibrated dropper included with the manufactured product.
℥	Minim , NB Don't confuse with ml
mcg., mcg, µg	Microgram , NB don't confuse with mg.
mEq	Milliequivalent
mg., mg	Milligram , NB don't confuse with mcg
ml., mL.	Milliliter , USP states that 1 cc is equivalent to 1 ml, NB, don't confuse with minim.
mOsm, mOsmol	Milliosmole
O.	Apothecary pint
oz.	ounce
parts	Some formulas indicate the ratio of ingredient quantities to each other. In a formula given in terms of parts by weight, any unit of weight may be used, but it must be applied to all components. In a formula given in parts by volume, any unit of volume may be used, provided that all components have the same units.
Ratio Strength	Ratio strength is a way of representing drug concentration. It is denoted in terms of total amount of preparation that contains one unit of drug. A 1:25 solution of cinnamon oil means that 1 ml of cinnamon oil is contained in each 25 ml of solution. N.B. the second number in the ratio does not describe the quantity of solvent, but the total quantity of preparation . If the solute is a liquid the solution is assumed to be a volume in volume (v/v) mixture. For solid solutes its assumed to be a weight in volume (w/v) mixture.
ss., ss	one half
tbl., tbsp., tbs.	tablespoonful , a household measure, nominal value 15 ml.
tsp.	teaspoonful , a household measure, nominal value, 5 ml
U, u, I.U.	Unit , International Unit. The potency of many antibiotics and endocrine preparations are expressed in terms of official USP units. These units are specific for each substance and determined by an official USP biological activity test

NB. Sometimes the unit abbreviations for quantities are absent in the formula. When absent, units for weight are presumed to be gram, g, and for volume presumed to be milliliter, mL.

Dose and Dosing Frequency Abbreviations used in the Signa

Term	Meaning
prn	as occasion arises, use when or as needed . Ex. 1 cap hs prn sleep
a.	before
a.c.	before meals . Take before meals. Usually used in conjunction with q.d., tid etc.
a.m.	morning, before midday
h.	hour
hold	Do not give specific dose
d.	day
q.	every
q4h	every 4 hours , Also specified by the degree symbol. Ex. q 4°
q.d.	every day , take one dose a day
q.o.d.	every other day , Take one dose every other day
bid	twice a day , Take one dose twice a day. N.B. does not mean every 12 hours. Loosely means morning and evening.
tid	three times a day , NB. Take one dose three times a day. N.B. does not mean every 8 hours. Loosely means morning, evening, and night.
qid	four times a day . NB. Take one dose four times a day. N.B. does not mean every 6 hours. Loosely means morning, afternoon, evening, and night.
t.i.w.	three times a week , Take a dose three times a week. For example M, W, F
h.s., hs	at bed time . Take at bedtime
ATC	around the clock , Doses administered at equal time intervals. Ex: q. 6 h. ATC.
m ² , M ²	square meter
BSA	body surface area
p.	after
p.c.	after meals . Take after meals. Usually used in conjunction with q.d., bid, tid etc.
p.m.	evening , afternoon, after midday
noct.	night
STAT	immediately , give at once
s.o.s.	if there is need . Administer again if required. Example: MS 2 mg IV STAT and q 30 min s.o.s. bucking ventilator
\bar{c}	with

Abbreviations for Site or Route of Administration

Term	Meaning
a.d.	right ear , (the dexter ear)
a.s.	left ear , (the sinister ear)
a.u.	both ears
Aur	ear, ears
D.	Right
i., inh.	Inhalation. As in take 2 inhalation (2i) from the metered dose inhaler
IA	intraarticular , inject into joint or, less commonly, intraarterially , inject into artery
ID	intra dermal , inject into skin
IM	intramuscular , inject into muscle
IV	intravenous , inject or infuse into vein. For intravenous fluid therapy IV also refers to the infusion fluid. IV bottles are consecutively numbered. Ex: IV #10 NS 1000 mL @ 125 cc/h, IV #11 D5W 1000 mL @ 125/hr
IVP, IV bolus	intravenous push , a rapid injection into vein
IVPB	intravenous piggy back. infuse solution into primary intravenous infusion, rate specified Ex: Ampicillin 250 mg IVPB over 30 min q 6 h
KVO	keep vein open. A slow infusion. The rate is set by institution policy or specified used to maintain an intravenous catheter patent.
via Hep Loc	Inject through heparin lock. A small indwelling intravenous cannula filled with a dilute heparin solution to maintain patency. After injection, the heparin lock needs to be flushed and refilled with a dilute heparin solution.
Ocul	eye
o.d.	right eye (the dexter eye) in the right eye
o.s.	left eye , (the sinister eye) in the left eye
o.u.	both eyes , in each eye
p	Puff. As in take 2 puffs from the metered dose inhaler
p.o., per os, PO	by mouth , take orally
R, pro rect., PR	rectal
S.	left
SL	sublingual , Place under tongue and allow to dissolve
subq., s.c., SQ	subcutaneously , inject below the skin
top	topically , apply locally to affected area
vag., PV	vaginally

NB. The oral route is always assumed if no route is specified for a drug, which can be administered orally. If it is not possible to give the drug orally, (i.e., NPO), the alternative route must be explicitly specified by the prescriber.

THE ANATOMY OF A PRESCRIPTION

Phone: 555-3752 DEA# AA1273628 **DEA Number**

Eva Adams, M.D.
298 Appleby Street
Eden, NY 14057 **Prescriber Information**

Name Laurel Hardy Age 41 **Patient Information**

Address Abel St. Eden Date 06/16/96 **Date Prescription was Written**

Rx Phenobaribital 0.075
Simethicone 0.020
Magnesium Carbonate 0.050
m. ft #12 **Inscription (Medication prescribed)**

Sig: 2 capsules tid and hs **Signa (Directions for Patient)**

Refill _____ EAdams M.D.

THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS
PRESCRIBER WRITES " d a w " IN THE BOX BELOW

Dispense as written

Superscription (Meaning Recipe)

Subscription (Instructions to Pharmacist)

Special Instructions

CHECKING THE DEA NUMBER

- All physician DEA numbers begin with **TWO LETTERS**.
- The **FIRST LETTER** is **A, B, or F** with doctors (MD, DO, etc.), **M** for midlevels (NP, PA, etc.)
- The **SECOND LETTER** is the first letter of the physicians **LAST NAME** or **MAIDEN NAME**.
- Add digits **1, 3, 5**
- Add digits **2, 4, 6** and **multiply by 2**.
- Add the two **totals**.
- The **LAST** digit of the sum is the same as the last digit of the DEA number

Example

Take DEA #

AH0354213 from Dr. Alfred K. Hall

Is the 1st letter A, B, or F?

Yes, it's **A**

Is the 2nd letter the same as 1st letter of the physician's last name? Yes, it's **H**

Add 1st, 3rd and 5th digit:

$$0 + 5 + 2 = 7$$

Add 2nd, 4th and 6th digits and multiply by two

$$(3 + 4 + 1) \times 2 = 16$$

Add the two totals

$$7 + 16 = 23$$

Is the last digit of the sum the same as the last digit of the DEA # Yes

PROBLEMS

Problem 1

Interpret the following:

1.	TID	
2.	QOD	
3.	HS	
4.	PC	
5.	PRN	
6.	STAT	
7.	IV	
8.	NIDD	
9.	QAM	
10.	QOD	

Problem 2

Interpret the following:

MOM 1 tbsp. PO TID GERD

Vancomycin 250 mg IVPB over 60 min Q 6 H

Gentamicin sol. 2 gtt OU Q3H x2d, QID x5d

Humalog 3 U SQ 10 min. AS BS >200 mg/dL

Problem 3

Transcribe the following directions into correct shorthand:

GIVE 2 MILLIGRAMS OF DILAUDID EVERY 4 HOURS IF THERE IS NEED

INHALE 2 PUFFS FROM METERED DOSE INHALER EVERY EVENING

PLACE 2 DROPS IN EACH EYE EVERY MORNING AND 1 DROP IN RIGHT EYE EVERY NIGHT AT BEDTIME

APPLY OINTMENT TO THE AFFECTED AREA EVERY DAY BEFORE SHOWER
App (appl) ung AA QD A shower

Problem 4

Interpret the following:

ASA 5 gr. II tab PO q12h PRN swelling

Zosyn 1 g Q8H IVPB in 1000 mL NS

Metaproterenol MDI disp IOP 2p PO q4h PRN SOB

Problem 5

Transcribe the following directions into medical abbreviations.

DISSOLVE ONE TABLET UNDER THE TONGUE EVERY TWO HOURS AS NEEDED FOR HEADACHE

TAKE TWO TABLETS BY MOUTH EVERY DAY 30 MINUTES AFTER BREAKFAST FOR HYPERTENSION (4 points)

GIVE 100 MICROGRAMS BY MOUTH WITH EACH LOOSE STOOL, HOLD IF NO BOWEL MOVEMENT

DISCONTINUE DEXTROSE 5% IN WATER INFUSION, START 0.45% SODIUM CHLORIDE FOR INJECTION; 10 UNITS REGULAR INSULIN VIA INTRAVENOUS PUSH IMMEDIATELY, GIVE NOTHING BY MOUTH

Problem 6

Interpret the following:

aaa Tretinoin cr 0.1% qhs

Cromolyn sodium MDI IOP 1 p in each nostril qid

NTG 0.3 mg tab sl prn

Digoxin 125 mcg 1 c bid; 1 c qd CHF

GERD

dil 0.25 g in 5 ml 1/2NS. Inj IVP hep lock stat

ASHD

Problem 7

Interpret the following:

Inj 40IU sc acb qd DM

2 c bid, 1 c qd

A NTG P qam remove hs

ii tab ASA qid HA

NKA

Agit susp, 2 goubid prn itching

Aaaptiw

2stat,qid

M ft ud IVPB N.B. Refrigerate

Problem 8

Write the following in approved medical abbreviation form.

Take two capsules at bedtime for urinary tract infection

Inject (or give) half normal saline intravenously as needed

Apply to the affected area as needed for itching

Problem 9

INTERPRET THE FOLLOWING

2gttsadqid

AGIT, 1tbsp in H2O hs

1 po stat, one po tiw hbp

2gttsadqid

AGIT, 2pq4hprnsob

aaatidprnrash

Problem 10

Write the following in approved medical abbreviation form.

Take one to two capsules at bedtime for Headache

inject 2 ml under the skin every 4 hours as needed.

Take one capsule at 7am and one at 1pm every day for Diabetes Mellitus

Insert one suppository rectally in the morning and at bedtime for 3 nights.

Insert one suppository rectally at night after supper

inject 2 ml subcutaneously every 4 hours as needed.

Take one capsule at 7am and one at 1pm every day for Attention Deficit Hyperactivity Disorder

Insert one applicatorful vaginally at bedtime for 3 nights.

Blow nose, shake inhaler well, spray one puff into nostrils twice a day as needed.

Problem 11

Interpret the following.

2gttsadqid

AGIT, 2pq4hprnsob

aaatidprnrash

Problem 12

Write the following in approved medical abbreviation form.

Insert one suppository rectally at night after supper

inject 2 ml subcutaneously every 4 hours as needed.

Take one capsule at 7am and one at 1pm every day for Attention Deficit Hyperactivity Disorder

Insert one applicatorful vaginally at bedtime for 3 nights.

Blow nose, shake inhaler well, spray one puff into nostrils twice a day as needed.

Take one tablet in the evening after supper

Atherosclerotic Heart Disease

Inject 2 ml subcutaneously every 4 hours as needed.

Problem 13

Interpret the following:

Gouqid

AGIT, 2pq4hprnsob

aaatidprnrash

1 PATCH QD TIW

AGIT, 10-20 mg MS IM INJ Q 4-6H PRN SEVERE PAIN

NTG 1/150GR. 1 SL PRN CHEST PAIN. RP Q 5 MIN PRN

Problem 14

Write the following in approved medical abbreviation form.

HEADACHE

NAUSEA AND VOMITING

CORONARY HEART DISEASE

Problem 15

Interpret the following:

1.	2sl bid	
2.	1POQ4HPRN	
3.	2GTTOUQOD	
4.	īī gtts ou tid prn allergy	
5.	2 p q 4h prn SOB URI	

Problem 16

Interpret the following:

Inject 10 units under the skin each morning for diabetes mellitus.	
Take one tablet in the morning and 2 at bedtime as needed for non-insulin dependent diabetes.	
Apply ointment four times a week.	
Take one capsule 3 times a day for upper respiratory infection.	
Ampicillin 250 mg intravenous piggy back to be given over 30 minutes every 6 hours.	

Problem 17

Interpret the following:

MOM 1 tbsp. PO TID GERD

Vancomycin 250 mg IVPB over 60 min Q 6 H

Gentamicin sol. 2 gtt OU Q3H x2d, QID x5d

Humalog 3 U SQ 10 min. AS BS >200 mg/dL

1 patch QD TIW

AGIT, 1-2 P Q 4-6H PRN SOB

1 CC QID IN H2O UTI

Problem 18

Transcribe the following directions into medical abbreviation form:

CEREBRAL VASCULAR ACCIDENT

ATTENTION DEFICIT DISORDER

1 PER RECTUM EVERY 3 HOURS AS NEEDED FOR NAUSEA AND VOMITING

SS ML IN AQ PO Q 1 H PRN AGITATION

GIVE 2 MILLIGRAMS OF DILAUDID EVERY 4 HOURS IF THERE IS NEED

INHALE 2 PUFFS FROM METERED DOSE INHALER EVERY EVENING

PLACE 2 DROPS IN EACH EYE EVERY MORNING AND 1 DROP IN RIGHT EYE EVERY NIGHT AT BEDTIME

APPLY OINTMENT TO THE AFFECTED AREA EVERY DAY BEFORE SHOWER
App (appl) ung AA QD A shower

Problem 19

Interpret each of the following:

2am1tid _____

QOD _____

HS _____

PC _____

PRN _____

STAT _____

Problem 20

Write the following in approved **medical abbreviation** form:

CONGESTIVE HEART FAILURE

2 DROPS IN THE RIGHT EYE EVERY DAY

Apply to left ear 4 times a day

One ml by mouth every 5 hours

Instill ii gtts o.s. tid

Apply patch behind a.d. 1 hr a. flight. Wash hands p. applied

i Cap 1h a. hs leg cramps

tab i q 8 h until gone

Problem 21

Translate the following hospital medication orders.

Start IV IV #1, NS 1000mL + 20mEq KCL@ 125mL/h IV #2, IV#3 NS 1000mL @ 125mL/h	
Kaopectate 30ml p. each loose BM prn	
1. D/C po Lasix 2. Lasix 20 mg IV stat and q 12 h	
Pre-OP orders: 1. Visteral 100 mg po hs. 2. NPO p. midnight 3. Visteral 50 mg + Atropine Sulfate 0.4 mg + Demerol 50 mg IM i h. a. surgery	
Is the following DEA# BW 1870256 valid for Dr. A. Wilwrioth (5 points)	

The following are prescriptions from very busy physicians that you receive. You are to interpret these prescriptions in simple layman terms so a patient would understand. Please mark your interpretations below each prescription.

Problem 22

Phone 333-232-1234

Dr. Harold Alfayad, MD, FACS
126 Rodeo Drive
Hollywood, CA 14260

Name Camilla Charles
Address 237 Rodeo Drive, Hollywood, CA

Age 36
Date 9/5/03

R ASA
APAP aa 9 g
M.ft. div. #30 caps
Sig: 1 cap PO Q 4 H PRN HA

Refill:0 x

H Alfayad, M.D.

THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES
"d a w" IN THE BOX BELOW

Dispense as written

Problem 23

Phone 333-232-1234		Dr. Paige Turner, MD, PC 126 Potboiler Street Buffalo, NY 14260		
Name	Jay Walker	Age	36	
Address	237 Crosswalk St, Buffalo, NY	Date	9/5/03	
<p><i>R</i> Tobramycin 0.3% sol. Disp: 10 mL Sig: 4 gts. AD Q 8 H ATC TG Refills: 0</p> <p style="text-align: center;"><i><u>P Turner, M.D.</u></i></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <table border="1" style="margin: auto;"><tr><td style="text-align: center;">DAW</td></tr></table> <p style="text-align: center;">Dispense as written</p>				DAW
DAW				

Problem 24

Phone 333-232-1234	Dr. Wilson Fisk, MD, PC 126 Kingpin Court Brooklyn, NY 14260		DEA BF-9345679
Name	<u>Curt Connors</u>	Age	<u>36</u>
Address	<u>237 Lizard Lane, Brooklyn, IL</u>	Date	<u>9/5/03</u>
<p><i>R</i> Nystatin 100,000 U/mL susp. Viscous Lidocaine 2% Diphenhydramine liq. aa qs ad 180 mL</p> <p>M.ft. 180 mL susp., disp. 90 mL</p> <p>Sig: Swish and spit 1 tsp. QID x3d, TID x4d</p> <p>Refills: 0</p> <p style="text-align: center;"><i><u>Dr Wilson Fisk, M.D.</u></i></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 150px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>			

Problem 25

Phone 333-232-1234		Dr. Mary Jane Watson, MD, PC 126 Parker Court Queens, NY 14260	
Name	<u>Gwen Stacy</u>	Age	<u>36</u>
Address	<u>237 Greengoblin Lane, Queens, NY</u>	Date	<u>9/9/06</u>
<p>R Trimethobenzamide 200mg Polybase qs M.ft. SA dtd #10 supp. Sig: 1 supp. pro. rect. TID PC PRN N/V</p>			
Refills: 2		<u><i>Dr M.J. Watson, M.D.</i></u>	
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW			
<div style="border: 1px solid black; width: 150px; height: 40px; margin: 0 auto;"></div>			
Dispense as written			

Problem 26

Phone 716-555-1234	DEA# AK -12736280				
Dr. Hunter Kraven, M.D. 3 Ditko Ave Queens, NY					
Name	<u>Joe Robertson</u>	Age	<u>21 yr</u>	Height	<u>5'6"</u>
Address	<u>87 Stanlee St, Queens, NY</u>	Date	<u>8/18/97</u>	Weight	<u>180 lb</u>
<div style="display: flex; align-items: flex-start;"> <div style="font-size: 2em; margin-right: 10px;">℞</div> <div> <p>Atrovent inhalation solution Disp: #60 amp.</p> <p>Sig: inhale contents of 1 amp. PO via nebulizer ut dict Q 4 H or PRN SOB Refills: 0; DAW</p> <p style="text-align: right; margin-top: 20px;"><u>H Kraven, MD</u></p> </div> </div>					

Problem 27

Phone 333-232-1234	Gwen Stacy, NP Midtown High School Queens, NY		DEA MS1394930
Name	<u>Peter Parker</u>	Age	<u>16</u>
Address	<u>237 Midtown Lane, Queens, NY</u>	Date	<u>9/5/87</u>
<p>R Camphor Menthol Salicylic acid 2 g aa White petrolatum qs <u>m.ft. SA 60 g ung</u> <u>Sig: AAA QD P shower</u></p> <p>Refill: 1x</p> <p style="text-align: center;"><u><i>Gwen Stacy, M.D.</i></u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 150px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>			

Problem 28

Phone 333-232-1234

BO-9345679

Dr. Otto Octavius, MD, FACS
126 Rodeo Drive
Hollywood, CA 14260

Name Quentin Beck

Age 36

Address 237 Rodeo Drive, Hollywood, CA

Date 9/5/03

R Omeprazole 20 mg capsules qs
Sodium bicarbonate solution qsad 240 mL
m.ft. SA 2 mg/mL susp.
Sig: agit, 1 tsp QAM AC GERD

5 x

O Octavius, M.D.

THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES
"d a w" IN THE BOX BELOW

Dispense as written

Problem 29

Phone 333-232-1234	Dr. Roderick Kingsley, MD, PC 126 Main Street Buffalo, NY 14260		DEA BK-9345679
Name	<u>Norman Osborn</u>	Age	<u>36</u>
Address	<u>237 Glider St, Buffalo, NY</u>	Date	<u>9/5/03</u>
<p><i>R</i> Gentamycin 0.3% sol. Disp: 5 mL sol. Sig: 1 gtt OD Q4H x1D, Q8H x5D</p> <p>NR <i>R Kingsley, M.D.</i></p> <p>THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="border: 1px solid black; width: 150px; height: 30px; margin: 0 auto; text-align: center;">DAW</div> <p>Dispense as written</p>			

Problem 30

Phone 333-232-1234	Dr. Gabriella Ryan, MD, PC 126 E. High Street Albuquerque, NM 14260		DEA BR-9345679
Name	<u>Hanna Bolton</u>	Age	<u>36</u>
Address	<u>237 Middle Street, Seaview, MT</u>	Date	<u>9/5/03</u>
<p><i>R</i> Human regular insulin Disp: 2 vl Sig: 3 U SQ UD TID 30min AC and 2 addl U if BS > 200 mg/dL 4 addl U if BS > 250 mg/dL 6 addl U if BS > 300 mg/dL</p> <p>Refills x2</p> <p style="text-align: right;"><i><u>Dr G Ryan, M.D.</u></i></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 150px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>			

Problem 31

Phone 333-232-1234	DEA AQ1211111	
Dr. Mary Jane Watson, MD, PC 126 Parker Court Queens, NY 14260		
Name	<u>Gwen Stacy</u>	Age <u>36</u>
Address	<u>237 Greengoblin Lane, Queens, NY</u>	Date <u>9/9/06</u>
<p>R Nystatin 1,000,000 U m.ft. div #10 troche Sig: Dissolve 1 troche PO Q 11AM et QHS UD thrush</p> <p>No Refill</p> <p style="text-align: center;"><i><u>Dr M.J. Watson, M.D.</u></i></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 150px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>		

Problem 32

Phone 716-555-1234	Dr. Hunter Kraven, M.D.			DEA# AK -12736280	
3 Ditko Ave Queens, NY					
Name	Joe Robertson	Age	21 yr	Height	5'6"
Address	87 Stanlee St, Queens, NY	Date	8/18/97	Weight	180 lb
<div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 20%;"> <p style="font-size: 2em; font-family: cursive; margin: 0;">R</p> </div> <div style="width: 60%;"> <p>Hydrochlorothiazide 25mg KCl 10mEq m.ft. SA DTD #30 caps Sig: 1 QAM w/ 8 fl.oz. aq. PO</p> </div> <div style="width: 20%; text-align: center;"> <p style="font-size: 1.2em; font-family: cursive; margin: 0;"><u>H Kraven, MD</u></p> </div> </div>					

Problem 33

The following are prescriptions from very busy physicians that you receive. You are to interpret these prescriptions in simple layman terms so a patient would understand. Please mark your interpretations below each prescription.

Phone 333-232-1234	Gwen Stacy, NP Midtown High School Queens, NY	DEA AD-1394930
Name <u>Peter Parker</u>	Age <u>16</u>	
Address <u>237 Midtown Lane, Queens, NY</u>	Date <u>9/5/87</u>	
<p style="font-size: 2em; margin-left: 20px;"><i>R</i> 2.5% HC <u>M ft SA 100 g HC ung</u> <u>AAA tid spider bite</u></p> <p>Refill: 1x</p> <p style="text-align: center; font-size: 1.2em; margin-top: 20px;"><u><i>Gwen Stacy, M.D.</i></u></p> <p style="text-align: center; font-size: 0.8em; margin-top: 10px;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; margin: 5px auto; width: 150px; height: 40px; border: 1px solid black;"></div> <p style="text-align: center; margin-top: 5px;">Dispense as written</p>		

Problem 34

Phone 333-232-1234

Dr. Sandra Cheeks, MD, PC
126 Squirrel Run
Bikini Bottom, TX 14260

Name Gary Snail
Address 237 Pineapple Drive, BB

Age 36
Date 9/5/03

R Insulin human zinc susp 100 IU/ml

Disp 3 v1

Sig: Measure BS. Inj ud 25 IU sc acb
qd dm

5 x

S Cheeks, M.D.

THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES
"d a w" IN THE BOX BELOW

DAW

Dispense as written

Problem 35

Phone 333-232-1234	Dr. Sharpay Bolton, MD, PC 126 Trojan Street Troy, NY 14260	DEA BH-9345679
Name <u>Helen Hector</u>	Age <u>36</u>	Address <u>237 Horse St, Troy, NY</u>
Date <u>9/5/03</u>	<p>R 500 mg/5 ml calcium carbonate suspension 20 mg/5ml simethicone suspension aagsad 250 ml mft SA susp Sig: agit. 1 tbsp qid pc hs</p> <p style="text-align: right;"><i>S Bolton, M.D.</i></p> <p>NR</p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="border: 1px solid black; width: 100px; margin: 0 auto; text-align: center; padding: 5px;">DAW</div> <p style="text-align: center;">Dispense as written</p>	

Problem 36

Phone 333-232-1234	Dr. Wilson Fisk, MD, PC 126 Kingpin Court Brooklyn, NY 14260		DEA BH-9345679	
Name	Curt Connors	Age	36	
Address	237 Lizard Lane, Brooklyn, IL	Date	9/5/03	
<i>R</i>	Prednisolone 0.125% Mft SA 100 ml susp 2gtt ou q1h day, q2h night; 2 gtt ou qid 3days			
NR	<u><i>Dr Wilson Fisk, M.D.</i></u>			
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW				
<table border="1"><tr><td>DAW</td></tr></table>				DAW
DAW				
Dispense as written				

Problem 37

Phone 333-232-1234	Dr. Mary Jane Watson, MD, PC 126 Parker Court Queens, NY 14260		DEA BH-9345679
Name	Gwen Stacy	Age	36
Address	237 Greengoblin Lane, Queens, NY	Date	9/5/03
<p>R Nytstatin 100,000 U DTD #28 vag tab Ins tab vag ud bid 2 weeks ud candidiasis</p> <p>No Refill</p> <p style="text-align: right;"><u>Dr M. J. Watson, M.D.</u></p> <p>THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="border: 1px solid black; width: 150px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>			

Problem 38

Phone 716-555-1234	Dr. R. Hibbert, M.D. 3 Simpson Ave Springfield, IL			DEA# AT -12736280	
Name	<u>Ned Flanders</u>	Age	<u>21 yr</u>	Height	<u>5'6"</u>
Address	<u>87 Church St, Springfield, IL</u>	Date	<u>8/18/97</u>	Weight	<u>180 lb</u>
<div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="text-align: left;"> <p>R KCl 600 mg DTD 30 extended release tablets Sig: 1 tid po pc.</p> </div> <div style="text-align: right; margin-top: 20px;"> <p><u>R Hibbert, MD</u></p> </div> </div>					

Problem 39

Phone 333-232-1234			
Terra Incognita, NP Midtown High School Queens, NY			
Name	<u>Deja Vu</u>	Age	<u>16</u>
Address	<u>237 Midtown Lane, Queens, NY</u>	Date	<u>9/5/87</u>
<p>R Estradiol powder, USP 18.75 mg Progesterone powder, USP 75 mg PLO 20% gel qs M.ft. SA 30 mL disp in 3 mL syr Sig: appl 0.5 mL inner thigh BID UD</p>			
Refill: 5x			
<i><u>Terra Incognita, M.D.</u></i>			
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW			
<div style="border: 1px solid black; width: 150px; height: 40px; margin: 0 auto;"></div>			
Dispense as written			

Problem 40

The following are prescriptions from very busy physicians that you receive. You are to interpret these prescriptions in simple layman terms so a patient would understand. Please mark your interpretations below each prescription.

Phone 333-232-1234	DEA AD-1394930
Dr. Margaret Simpson, MD, PC 24 Evergreen Terrace Springfield, IL 14260	
Name <u>Dora Boots</u> Address <u>237 Tico Lane, Fiestatrio, NY</u>	Age <u>36</u> Date <u>9/5/03</u>
<div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 10px;">℞</div> <div> <p>20% Benzocaine sol. 30 ml</p> <p style="margin-left: 40px;"><u>Gtt v au tid hs for 3 days</u></p> </div> </div> <p>Refill: 1x</p> <p style="text-align: center; margin-top: 20px;"><u>M Simpson, M.D.</u></p> <p style="text-align: center; font-size: 0.8em;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; margin: 10px auto; width: 150px; height: 40px; border: 1px solid black;"></div> <p style="text-align: center; font-size: 0.8em;">Dispense as written</p>	

Problem 41

Phone 333-232-1234

Dr. Boquilla Derrames, MD, PC
126 Cooke Hall
Buffalo, NY 14260

Name Capelli D'Angelo

Age 36

Address 237 Penne Lane, Rigatoni, NY

Date 9/5/03

R Isoproterenol hydrochloride 15mg
#XXX

I tab sl q6h arrhythmia

5 x

B Derrames, M.D.

THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES
"d a w" IN THE BOX BELOW

DAW

Dispense as written

Problem 42

Phone 333-232-1234	Dr. Frederick Hollywood, MD, PC 126 Main Street Buffalo, NY 14260	DEA BH-9345679
Name <u>Victoria Secret</u>	Age <u>36</u>	Address <u>237 Main St, Buffalo, NY</u>
Date <u>9/5/03</u>		
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>R Mineral oil qs MOMaaqsad 250 ml mft SA susp Sig: agit. 3 tbsp hs</p> </div> <div style="width: 45%; text-align: right;"> <p><i>F Hollywood, M.D.</i></p> </div> </div> <p style="margin-top: 10px;">NR</p> <p style="text-align: center; font-size: small;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; margin: 10px auto; width: 150px; height: 40px; border: 1px solid black; display: flex; align-items: center; justify-content: center;"> <p>DAW</p> </div> <p style="text-align: center; font-size: x-small;">Dispense as written</p>		

Problem 43

Look at the prescription written for Victoria Secret for on this page. Does Dr. Hollywood have a valid DEA number? (Circle one) **Show all work.**

YES

NO

Problem 44

Phone 333-232-1234		DEA BH-9345679	
Dr. Brandy Chardonnay, MD, PC 126 Merlot Court Champagne, IL 14260			
Name	<u>Margarita Bordeaux</u>	Age	<u>36</u>
Address	<u>237 Tequila Lane, Champagne, IL</u>	Date	<u>9/5/03</u>
<p><i>R</i> Minoxidil 250 mg Lactose 12.5 grams Div#100 mft SA 100 cap Sig: 1 qd HBP</p> <p>NR <u><i>Dr Chardonnay, M.D.</i></u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 100px; margin: 0 auto; padding: 5px;">DAW</div> <p style="text-align: center;">Dispense as written</p>			

Problem 45

Phone 333-232-1234	Dr. Brandy Chardonnay, MD, PC 126 Merlot Court Champagne, IL 14260		DEA BH-9345679
Name	<u>Margarita Bordeaux</u>	Age	<u>36</u>
Address	<u>237 Tequila Lane, Champagne, IL</u>	Date	<u>9/5/03</u>
<p>R Epinephrine bitartrate aerosol MDI 160 mcg/spray IOP #2 Inhale po ud 1 p prn asthma. Repeat 1 p sos after 1 min. Do not take another dose for 3 hrs.</p> <p>3 Refill</p> <p style="text-align: center;"><i><u>Dr Chardonnay, M.D.</u></i></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: fit-content; margin: 0 auto; padding: 5px;">DAW</div> <p style="text-align: center;">Dispense as written</p>			

Problem 46

Phone 716-555-1234		DEA# AT -12736280			
Dr. Curly Fries, M.D. 3 Hashbrown Ave Mayo, NC					
Name	<u>Cole Slaw</u>	Age	<u>25 yr</u>	Height	<u>5'9"</u>
Address	<u>87 Salad St, Mayo, NC</u>	Date	<u>8/18/97</u>	Weight	<u>50 kg</u>
<div style="display: flex; align-items: flex-start;"> <div style="font-size: 2em; margin-right: 10px;">℞</div> <div> <p>Paclitaxel 180 mg over 20 hours by iv infusion q3w for CA</p> <p>Prepare infusion by mixing 50 ml of 6 mg/ml parenteral concentrate & 450 ml D5W</p> </div> </div>					
<u>Curly Fries, MD</u>					

Problem 47

Phone 333-232-1234	Dr. John Depp, MD, PC 126 Cooke Hall Buffalo, NY 14260		DEA AD-1394930	
Name	<u>Hans Christian</u>	Age	<u>36</u>	
Address	<u>237 Mayflower Lane, Jamestown, NY</u>	Date	<u>9/5/03</u>	
<p><i>R</i> Vasotec 5mg 2 po qd ; hold BP < 110/70 dtd 30 Refill: 5x</p> <p style="text-align: center;"><i><u>John Depp, M.D.</u></i></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <table border="1" style="margin: auto;"><tr><td style="text-align: center;">DAW</td></tr></table> <p style="text-align: center;">Dispense as written</p>				DAW
DAW				

Problem 48

Phone 333-232-1234

Dr. John Depp, MD, PC
126 Cooke Hall
Buffalo, NY 14260

Name Hans Christian

Age 36

Address 237 Mayflower Lane, Jamestown, NY

Date 9/5/03

R Lipitor 20mg #30
QD cholesterol

5 x

John Depp, M.D.

THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES
"d a w" IN THE BOX BELOW

DAW

Dispense as written

Problem 49

Phone 333-232-1234	Dr. John Depp, MD, PC 126 Cooke Hall Buffalo, NY 14260	DEA AC-9345675
Name <u>Hans Christian</u>	Age <u>36</u>	Address <u>237 Mayflower Lane, Jamestown, NY</u>
Date <u>9/5/03</u>		
<p style="margin-left: 20px;"><i>R</i> Guaifenesin 200mg Codeine 300mg Simple Syrup H₂O aaqsad 200ml M ft syr Sig: agit. ss tbl. q 4 h prn</p> <p style="text-align: right; margin-right: 100px;"><i>John Depp, M.D.</i></p> <p style="margin-left: 100px;">NR</p> <p style="text-align: center; font-size: small;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; margin: 10px auto; width: 150px; border: 1px solid black; padding: 5px;"> <p style="margin: 0;">DAW</p> </div> <p style="text-align: center; font-size: small;">Dispense as written</p>		

Problem 50

Look at the prescription written for Hans Cristian for the cough syrup on this page. Does Dr. Depp have a valid DEA number? (Circle one) **Show all work.**

Problem 51

Interpret the medical orders (prescriptions) in the following chart that are labeled #1 through #6. Put your answers on the next page.

HEALTH COMPLEX OF AMHERST
310 HOCHSTETTER
AMHERST CAMPUS, NY

Patient Name: Tom Cruise
Date of Birth: 1/31/62
Or visit label

Date: 9/4/03 **ADULT PROGRESS NOTE (front)**

NURSING: Temp: 102° BP: 120/78 HR: 73 RR: 16 HT: 6' WT: 183

CC: Respiratory Distress -
Cough, Sputum, SOB work

Prescriptions yes no
Referral Needed
Need Form
Last Dental
Last Opto: _____

Screened By: _____
Print

Preliminary Tests: FS: U/A: Other: _____

HPI: patient complains about cough,
cough, chest congestion x 4 days. Aches
 pains, malaise

ROS: chest/rales, Rales

PE: _____ Other Exam: _____

GEN: WNWD Obese Average Thin
HEEN: NCAT PERRLA TMs Clear
T: NARES Patent Throat Clear
NECK: Supple w/o Nodes No Thyromegaly
LUNG: CTA w/o Rales Rhonchi Wheeze
CV: RRR, S1, S2 w/o murmur
ABD: +BS SNT w/o mass / organomegaly
MS: FROM w/o CCE

ICD-9	Diagnosis:	Plan:
1	<u>Pneumonia/bronchitis</u>	<u>1. Levofloxacin 500mg</u> <u>1 QD x 10d UAT</u>
	<u>Asthma</u>	<u>2. Peak flow meter</u> <u>UAT</u> <u>3. Albuterol inhaler</u> <u>1-2 p & 4-6 h per SOB</u> <u>4. Chest X-RAY STAT</u>
		<u>5. Robitussin DM</u> <u>6. 1-2 tsp QID PRN</u> <u>7. Codeine</u> <u>8. Cough</u>

ORDERS:

1.	5. Robitussin DM
2.	6. 1-2 tsp QID PRN
3.	7. Codeine
4.	8. Cough

9. In-House Referral: Addictions MH SW URGENT F/U

NURSE: Counselled patient re Medications
NKA
[Signature]

D/C Nurse Sig: _____

RTC: _____ With: _____ Schedule Dental Schedule Opto

Provider Sig/Stamp: _____
Preceptor Sig/Stamp: [Signature]

Answers to Medical Chart Problem

1.

2.

3.

4.

5.

6.

Problem 52

Phone 333-232-1234		Dr. Robert Plant, MD, PC 126 Cooke Hall Buffalo, NY 14260		
Name	<u>P.K. Floyd</u>	Age	<u>36</u>	
Address	<u>237 Optical Lane, Mt. Vernon, NY</u>	Date	<u>9/5/02</u>	
R Vasotec 5mg#60 2 qd po qam BP Refill: None				
<i>Robert Plant M.D.</i>				
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW				
<table border="1" style="margin: auto;"><tr><td style="text-align: center;">DAW</td></tr></table>				DAW
DAW				
Dispense as written				

Problem 53

Phone 333-232-1234

Dr. Sal Monella, MD, PC
126 Cooke Hall
Buffalo, NY 14260

Name Anthony Hopkins
Address 33 Clarice Rd., Hannibal, NY

Age 56
Date 9/5/02

R Nitropatch 0.4mg/24 hours #xxx
A P qam, remove hs

S Monella M.D.

THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES
"d a w" IN THE BOX BELOW

DAW

Dispense as written

Problem 54

Phone 333-232-1234	Dr. Lacy Tankini, MD, PC 126 Cooke Hall Buffalo, NY 14260	DEA AC-9345675
Name <u>Anthony Hopkins</u>	Age <u>56</u>	Address <u>33 Clarice Rd., Hannibal, NY</u>
Date <u>9/5/02</u>		
<p style="font-size: 2em; margin: 0;"><i>R</i> Nitrostat 1/150 gr #60</p> <p style="margin: 0;">Sig: 1 sl prn angina. Repeat 1 q 5 min if relief not obtained. Max 3 in 15 min</p> <p style="margin: 0;">NR <u>Lacy Tankini M.D.</u></p> <p style="text-align: center; font-size: 0.8em; margin: 0;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; margin: 5px 0;"> <div style="border: 1px solid black; padding: 5px; display: inline-block;">DAW</div> </div> <p style="text-align: center; margin: 0;">Dispense as written</p>		

Problem 55

Look at the prescription written for Anthony Hopkins for Nitrostat on this page. Does Dr. Tankini have a valid DEA number? (Circle one) **Show all work.**

YES

NO

Problem 56

Phone 333-232-1234		Dr. Robert Plant, MD, PC 126 Cooke Hall Buffalo, NY 14260		
Name	Jackie Chan	Age	50	
Address	981 Swiftkick, Bronx NY	Date	9/5/02	
R Prochlorperazine		50 mg		
Cocoa Butter		300 mg		
MSA Dtd #10				
Sig: 1 R q 4h prn NV. NPO midnight				
<i><u>Robert Plant M.D.</u></i>				
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW				
<table border="1"><tr><td style="text-align: center;">DAW</td></tr></table>				DAW
DAW				
Dispense as written				

Problem 57

Phone 333-232-1234	Dr. Robert Plant MD, PC 126 Cooke Hall Buffalo, NY 14260		DEA AM2300008	
Name	<u>Aria Soprano</u>	Age	<u>57</u>	
Address	<u>12 Wiseguys Lane, Bodabing NY</u>	Date	<u>9/05/02</u>	
<p><i>R</i> Paxil 20mg #36 Sig: one pcb and acs prn panic attacks.</p> <p>Refill: 1</p> <p style="text-align: center;"><i>Robert Plant M.D.</i></p> <p>THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <table border="1" style="margin-left: auto; margin-right: auto;"><tr><td style="text-align: center;">DAW</td></tr></table> <p style="text-align: center;">Dispense as written</p>				DAW
DAW				

Problem 58

Phone 333-232-1234	Dr. Robert Plant, MD, PC 126 Cooke Hall Buffalo, NY 14260		DEA AC-1234563	
Name	<u>Allegra Aria</u>	Age	<u>57</u>	
Address	<u>12 Wiseguys Lane, Bodabing NY</u>	Date	<u>9/05/02</u>	
R Robitussin AC		240ml		
Sig: 1-2tsp q4h prn cg				
NR		<u>Robert Plant M.D.</u>		
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW				
<table border="1" style="margin: auto;"><tr><td style="text-align: center;">DAW</td></tr></table>				DAW
DAW				
Dispense as written				

Problem 59

Phone 333-232-1234			
Dr. Clark Kent, MD, PC 126 Cooke Hall Buffalo, NY 14260			
Name	Peter Parker	Age	36
Address	237 Web Lane, Mt. Vernon, NY	Date	9/5/01
<p><i>R</i> Robitussin DM 240ml Sig: 5-10ml q4h prn cough Refill: None</p> <p style="text-align: center;"><i><u>Clark Kent M.D.</u></i></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 100px; margin: 0 auto; padding: 5px;">DAW</div> <p style="text-align: center;">Dispense as written</p>			

Problem 60

Phone 333-232-1234

Dr. Clark Kent, MD, PC
126 Cooke Hall
Buffalo, NY 14260

Name Lois Lane
Address 2827 Superman Way, Metropolis, NY

Age 56
Date 9/5/01

R Lanoxin 125 mcg #30
Sig: 1qod

Clark Kent M.D.

THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES
"d a w" IN THE BOX BELOW

DAW

Dispense as written

Problem 61

Phone 333-232-1234	Dr. Clark Kent, MD, PC 126 Cooke Hall Buffalo, NY 14260		DEA AK-1234563
Name	<u>Lois Lane</u>	Age	<u>27</u>
Address	<u>2827 Superman Way, Metropolis, NY</u>	Date	<u>090501</u>
<p><i>R</i> Vasotec 5mg 30 days Sig: 1 bid BP NR</p> <p style="text-align: right;"><u>Clark Kent M.D.</u></p> <p>THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="border: 1px solid black; width: 100px; margin: 0 auto; text-align: center; padding: 5px;">DAW</div> <p style="text-align: center;">Dispense as written</p>			

Look at the prescription written for Lois Lane for Vasotec on this page. Does Dr. Kent have a valid DEA number? (circle one) **Show all work.**

YES

NO

Problem 62

Phone 333-232-1234		Dr. Art Martial, MD, PC 126 Cooke Hall Buffalo, NY 14260		
Name	Jacqueline Chan	Age	50	
Address	981 Swiftkick, Bronx NY	Date	9/5/01	
<i>R</i> Compazine		150 mg		
Cocoa Butter		3000 mg		
MSA Div #10				
Sig: 1 R q 4h prn NV. NPO midnight				
<i>Art Martial M.D.</i>				
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW				
<table border="1"><tr><td style="text-align: center;">DAW</td></tr></table>				DAW
DAW				
Dispense as written				

Problem 63

Phone 333-232-1234	Dr. Clark Kent, MD, PC 126 Cooke Hall Buffalo, NY 14260		DEA AM2300008	
Name	<u>Tony Soprano</u>	Age	<u>57</u>	
Address	<u>12 Wiseguys Lane, Bodabing NY</u>	Date	<u>9/05/01</u>	
<p><i>R</i> Prozac 20mg #36 Sig: one acb and pcs prn panic attacks.</p> <p>Refill: 1</p> <p style="text-align: center;"><i>Clark Kent M.D.</i></p> <p>THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <table border="1" style="margin: auto;"><tr><td style="text-align: center;">DAW</td></tr></table> <p style="text-align: center;">Dispense as written</p>				DAW
DAW				

Problem 64

Phone 333-232-1234	Dr. Clark Kent, MD, PC 126 Cooke Hall Buffalo, NY 14260		DEA AC-1234563	
Name	<u>Lois Lane</u>	Age	<u>27</u>	
Address	<u>2827 Superman Way, Metropolis, NY</u>	Date	<u>090501</u>	
<p>R Nitroglycerin 1/150 gr #30</p> <p>Sig: 1 sl prn angina. Repeat 1 q 5 min if relief not obtained. Max 3 in 15 min</p> <p>NR <u>Clark Kent M.D.</u></p> <p>THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <table border="1" style="margin-left: auto; margin-right: auto;"><tr><td style="text-align: center;">DAW</td></tr></table> <p style="text-align: center;">Dispense as written</p>				DAW
DAW				

Problem 65

Phone 333-232-1234			
Terra Incognita, NP Midtown High School Queens, NY			
Name	<u>Deja Vu</u>	Age	<u>16</u>
Address	<u>237 Midtown Lane, Queens, NY</u>	Date	<u>9/5/87</u>
R Estradiol powder, USP 18.75 mg Progesterone powder, USP 75 mg PLO 20% gel qs M.ft. SA 30 mL disp in 3 mL syr Sig: appl 0.5 mL inner thigh BID UD			
Refill: 5x			
<i><u>Terra Incognita, M.D.</u></i>			
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW			
<div style="border: 1px solid black; width: 150px; height: 40px; margin: 0 auto;"></div>			
Dispense as written			

Problem 66

Phone 333-232-1234

Dr. Harold Alfayad, MD, FACS
126 Rodeo Drive
Hollywood, CA 14260

Name Camilla Charles
Address 237 Rodeo Drive, Hollywood, CA

Age 36
Date 9/5/03

R ASA
APAP aa 9 g
M.ft. div. #30 caps
Sig: 1 cap PO Q 4 H PRN HA

Refill:0 x

H Alfayad, M.D.

THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES
"d a w" IN THE BOX BELOW

Dispense as written

Problem 67

Phone 333-232-1234		Dr. Paige Turner, MD, PC 126 Potboiler Street Buffalo, NY 14260		
Name	Jay Walker	Age	36	
Address	237 Crosswalk St, Buffalo, NY	Date	9/5/03	
<p><i>R</i> Tobramycin 0.3% sol. Disp: 10 mL Sig: 4 gts. AD Q 8 H ATC TG Refills: 0</p> <p style="text-align: center;"><i><u>P Turner, M.D.</u></i></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <table border="1" style="margin: auto;"><tr><td style="text-align: center;">DAW</td></tr></table> <p style="text-align: center;">Dispense as written</p>				DAW
DAW				

Problem 68

Phone 333-232-1234	Dr. Wilson Fisk, MD, PC 126 Kingpin Court Brooklyn, NY 14260		DEA BF-9345679
Name	<u>Curt Connors</u>	Age	<u>36</u>
Address	<u>237 Lizard Lane, Brooklyn, IL</u>	Date	<u>9/5/03</u>
<p><i>R</i> Nystatin 100,000 U/mL susp. Viscous Lidocaine 2% Diphenhydramine liq. aa qs ad 180 mL</p> <p>M.ft. 180 mL susp., disp. 90 mL</p> <p>Sig: Swish and spit 1 tsp. QID x3d, TID x4d</p> <p>Refills: 0</p> <p style="text-align: center;"><u><i>Dr Wilson Fisk, M.D.</i></u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 150px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>			

Problem 69

Phone 333-232-1234		Dr. Mary Jane Watson, MD, PC 126 Parker Court Queens, NY 14260	
Name	<u>Gwen Stacy</u>	Age	<u>36</u>
Address	<u>237 Greengoblin Lane, Queens, NY</u>	Date	<u>9/9/06</u>
<p>R Trimethobenzamide 200mg Polybase qs M.ft. SA dtd #10 supp. Sig: 1 supp. pro. rect. TID PC PRN N/V</p>			
Refills: 2		<u><i>Dr M.J. Watson, M.D.</i></u>	
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW			
<div style="border: 1px solid black; width: 150px; height: 30px; margin: 0 auto;"></div>			
Dispense as written			

Problem 70

Phone 716-555-1234	DEA# AK -12736280				
Dr. Hunter Kraven, M.D. 3 Ditko Ave Queens, NY					
Name	<u>Joe Robertson</u>	Age	<u>21 yr</u>	Height	<u>5'6"</u>
Address	<u>87 Stanlee St, Queens, NY</u>	Date	<u>8/18/97</u>	Weight	<u>180 lb</u>
<div style="display: flex; align-items: flex-start;"> <div style="font-size: 2em; margin-right: 10px;">℞</div> <div> <p>Atrovent inhalation solution Disp: #60 amp.</p> <p>Sig: inhale contents of 1 amp. PO via nebulizer ut dict Q 4 H or PRN SOB Refills: 0; DAW</p> <p style="text-align: right; margin-top: 20px;"><u>H Kraven, MD</u></p> </div> </div>					

Problem 71

Phone 333-232-1234			
Dr. Clark Kent, MD, PC 126 Cooke Hall Buffalo, NY 14260			
Name	<u>Jim E. Olson</u>	Age	<u>36</u>
Address	<u>237 Optical Lane, Mt. Vernon, NY</u>	Date	<u>9/1/00</u>
<i>R</i> Ampicillin 250 mg capsule #28 Sig: one tid hs Refill: None <i>Clark Kent M.D.</i> THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW <div style="text-align: center; border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> Dispense as written			

Problem 72

Phone 333-232-1234		Dr. Clark Kent, MD, PC 126 Cooke Hall Buffalo, NY 14260	
Name	<u>JonLuc Picard</u>	Age	<u>56</u>
Address	<u>983-66 Galaxy Way, Orion, NY 11123</u>	Date	<u>9/1/00</u>
<p><i>R</i> Furosemide 40mg #30 Sig: 1 qd am acb oj</p> <p style="text-align: right;"><i><u>Clark Kent M.D.</u></i></p> <p>THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> <p>Dispense as written</p>			

Problem 73

Phone 333-232-1234	Dr. Clark Kent, MD, PC 126 Cooke Hall Buffalo, NY 14260		DEA AK1234563
Name	Lois Lane	Age	27
Address	2827 Superman Way, Metropolis, NY	Date	9/1/00
<p><i>R</i> Inderal 10mg Sig: 1 qid BP & HR for 30 days <u>Clark Kent M.D.</u></p> <p>THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> <p>Dispense as written</p>			

Problem 74

Look at the prescription written for Lois Lane for Inderal on this page. Does Dr. Kent have a valid DEA number? (circle one) **Show all work.**

YES

NO

Problem 75

Phone 333-232-1234		Dr. Clark Kent, MD, PC 126 Cooke Hall Buffalo, NY 14260	
Name	<u>Brittany Spears</u>	Age	<u>17</u>
Address	<u>28 Mime St. Megabucks, NY</u>	Date	<u>9/1/00</u>
\mathcal{R} Tigan		1500 mg	
Cocoa Butter		3000 mg	
MSA Div #10			
Sig: 1 R q 4h prn NV			
<u><i>Clark Kent M.D.</i></u>			
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW			
<div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div>			
Dispense as written			

Problem 76

Phone 333-232-1234	Dr. Clark Kent, MD, PC 126 Cooke Hall Buffalo, NY 14260		DEA AM2300008
Name	Alexander Scott	Age	36
Address	2 Enterprising Way, Orion NY	Date	9/1/00
<p><i>R</i> Dilithium 10mg #30 Sig: 1 q4-6h prn fatigue</p> <p style="text-align: center;"><u>Clark Kent M.D..</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 60px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>			

Problem 77

Phone 333-232-1234	Dr. Clark Kent, MD, PC 126 Cooke Hall Buffalo, NY 14260		DEA AM2300008
Name	<u>Thomas Cruise</u>	Age	<u>36</u>
Address	<u>2827 Main St, Buffalo, NY 14123</u>	Date	<u>9/1/00</u>
<i>R</i> Tylenol with Codeine 30mg		#24	
Sig: 1-2q4-6h wf. No ASA			
<i>Clark Kent M.D.</i>			
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW			
<div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div>			
Dispense as written			

Problem 78

Phone 333-232-1234			
Dr. Rachel Moran, MD, PC 222 Cooke Hall Buffalo, NY 14002			
Name	<u>Doug Doright</u>	Age	<u>36</u>
Address	<u>237 Stable Rd, Mt. Vernon, NY</u>	Date	<u>9/1/99</u>
<u>R</u> Amoxicillin 250 mg capsule #28 Sig: one tid ac aqua Refill: None			
<u>Rachel Moran M.D.</u>			
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW			
<div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div>			
Dispense as written			

Problem 79

Phone 333-232-1234			
Dr. Ella Grito, MD, PC 222 Cooke Hall Buffalo, NY 14002			
Name	<u>JonLuc Picard</u>	Age	<u> </u>
Address	<u>983-66 Galaxy Way, Orion, NY 11123</u>	Date	<u>9/1/99</u>
R_x Lanoxin 0.125 mg tablets #34 Sig: 1 tid qd, 1qd CHF <u>Ella Grito M.D.</u> THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW <div style="text-align: center; border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> Dispense as written			

Problem 80

Phone 333-232-1234	Dr. Rachel Moran, MD, PC 222 Cooke Hall Buffalo, NY 14002		DEA AM2300008
Name	<u>Gwyneth Paltrow</u>	Age	<u>27</u>
Address	<u>2827 Main St, Buffalo, NY 14123</u>	Date	<u>9/1/99</u>
R Fiorinal #30 Sig: 1-2 qd pcs <u>Rachel Moran M.D.</u> THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW <div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> Dispense as written			

Problem 81

Look at the prescription written for Gwyneth Paltrow for Fiorinal on this page. Does Dr. Moran have a valid DEA number? (circle one) **Show all work.** 10pts

YES

NO

Problem 82

Phone 333-232-1234		Dr. Rachel Moran, MD, PC 222 Cooke Hall Buffalo, NY 14002	
Name	<u>Gwyneth Paltrow</u>	Age	<u>27</u>
Address	<u>2827 Main St, Buffalo, NY 14123</u>	Date	<u>9/1/99</u>
Rx Tylenol		3000 mg	
Tigan		1500 mg	
MSA Div #10			
Sig: 1-2 caps q4h prn migraine			
<u>Rachel Moran M.D.</u>			
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW			
<div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div>			
Dispense as written			

Problem 83

Phone 333-232-1234	Dr. Rachel Moran, MD, PC 222 Cooke Hall Buffalo, NY 14002		DEA AM2300008
Name	<u>Thomas Cruise</u>	Age	<u>36</u>
Address	<u>2827 Main St, Buffalo, NY 14123</u>	Date	<u>9/1/99</u>
R Lipitor 20mg #30 Sig: 1 qd acs ASHD <u>Rachel Moran M.D.</u> THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW <div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> Dispense as written			

Problem 84

Phone 333-232-1234	Dr. Rachel Moran, MD, PC 222 Cooke Hall Buffalo, NY 14002		DEA AM2300008
Name	<u>Thomas Cruise</u>	Age	<u>36</u>
Address	<u>2827 Main St, Buffalo, NY 14123</u>	Date	<u>9/1/99</u>
R_x Lasix 40mg #30 Sig: one qd oj <u>Rachel Moran M.D.</u> THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW <div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> Dispense as written			

Problem 85

Phone 333-232-1234	Dr. Glen Vale, MD, PC 222 Cooke Hall Buffalo, NY 14002		DEA AM2300008
Name	<u>Dale Knoll</u>	Age	<u>37</u>
Address	<u>2827 Main St, Buffalo, NY 14123</u>	Date	<u>9/21/99</u>
R Amoxicillin 250mg Capsules #28 Sig: One tid infection ac <u>Glen Vale M.D.</u> THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW <div style="border: 1px solid black; width: 100px; height: 30px; margin: 0 auto; text-align: center; line-height: 30px;">DAW</div> Dispense as written			

Problem 86

Phone 333-232-1234	Dr. Glen Vale, MD, PC 222 Cooke Hall Buffalo, NY 14002		DEA AM2300008
Name	<u>Nina Childs</u>	Age	<u>47</u>
Address	<u>2827 Main St, Buffalo, NY 14123</u>	Date	<u>9/1/2000</u>
R Lanoxin 0.125mg tablets #34 Sig: 1 tid qd, 1 qd CHF <u>Glen Vale M.D.</u> THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW <div style="border: 1px solid black; width: 100px; height: 30px; margin: 0 auto; text-align: center; line-height: 30px;">DAW</div> Dispense as written			

Problem 87

Phone 333-232-1234	Dr. Ella Risa, MD, PC 222 Cooke Hall Buffalo, NY 14002		DEA AM2300008	
Name	<u>Alegria Mirth</u>	Age	<u>21</u>	
Address	<u>27 Main St, Buffalo, NY 14123</u>	Date	<u>9/21/2000</u>	
<p>R Auralgan Ear Suspension IOP Sig: 2-3 drops au tid prn ear ache <u>Ella Risa M.D.</u></p> <p>THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <table border="1"><tr><td>DAW</td></tr></table> <p>Dispense as written</p>				DAW
DAW				

Problem 88

Phone 333-232-1234	Dr. Ella Risa, MD, PC 222 Cooke Hall Buffalo, NY 14002		DEA AM2300008
Name	<u>Nina Childs</u>	Age	<u>21</u>
Address	<u>27 Main St, Buffalo, NY 14123</u>	Date	<u>9/21/2000</u>
<p>R Aspirin 3000mg Phenobarbital 200mg MSA Div #10 Sig: 1 to 2 caps q 4h prn migraine</p> <p style="text-align: right;"><u>Ella Risa M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 100px; margin: 0 auto; padding: 5px;">DAW</div> <p style="text-align: center;">Dispense as written</p>			

Problem 89

Phone 333-232-1234	Dr. Ella Risa, MD, PC 222 Cooke Hall Buffalo, NY 14002		DEA AM2300008
Name	<u>Ardor de Estómago</u>	Age	<u>21</u>
Address	<u>27 Main St, Buffalo, NY 14123</u>	Date	<u>9/21/2000</u>
<p>Rx Tagamet 300mg</p> <p>Sig: one qid ac GERD 10 days. NPO midnight</p> <p style="text-align: center;"><u>Ella Risa M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 100px; height: 30px; margin: 0 auto;">DAW</div> <p style="text-align: center;">Dispense as written</p>			

Problem 90

Phone 333-232-1234	Dr. Cascara Picazon, MD, PC 222 Cooke Hall Buffalo, NY 14002		DEA AM2300008
Name	Sarna Picar	Age	21
Address	27 Main St, Buffalo, NY 14123	Date	9/21/2000
<p>R HC 1% Aquaphor 240gm MSA ALB Cr</p> <p>Sig: aaa hs prn itch</p> <p style="text-align: center;"><u>Cascara Picazon M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 100px; margin: 0 auto; padding: 5px;">DAW</div> <p style="text-align: center;">Dispense as written</p>			

Problem 91

Phone 716-555-1234	DEA# AR -12736280
Dr. Ricky Ricardo 33 State Street Arbordale, NY 14002	
Name <u>John Jones</u>	Age <u>47</u>
Address <u>1023 Smith Rd, Arbordale, NY</u>	Date <u>8/28/96</u>
R Amoxicillin 250 mg	
#30 Sig: i tid uri	
Refill: None	
<u>RRicardo M.D.</u>	
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW	
<div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div>	
Dispense as written	

Problem 92

Phone 716-555-1234	Dr. Ricky Ricardo 33 State Street Arbordale, NY 14002		DEA# AR -12736280
Name	<u>Lucy Arnez</u>	Age	<u>12</u>
Address	<u>123 Desilu Rd, Hollywood, NY</u>	Date	<u>9/28/97</u>
R Ritalin 10 mg			
#XC			
Sig: 2 am, 1hs ADD			
Refill: None			
<u>RRicardo M.D.</u>			
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW			
<div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div>			
Dispense as written			

Problem 93

Phone 716-555-1234	Dr. Ricky Ricardo 33 State Street Arbordale, NY 14002		DEA# AR -12736280
Name	Frederick Mertz	Age	12
Address	123 Desilu Rd, Hollywood, NY	Date	9/8/97
R_x Pepcid 40 mg			
#30 Sig: 1hs qd			
Refill:			
<u>RRicardo M.D.</u>			
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW			
<div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div>			
Dispense as written			

Problem 94

Phone 716-555-1234	Dr. Ricky Ricardo 33 State Street Arbordale, NY 14002		DEA# AR -12736280
Name	Ethel Mertz	Age	_____
Address	124 5th Avenue, New York, NY	Date	8/18/97
R_x Hydrodiuril 50 mg			
m ft#lx			
Sig: i am with OJ for HBP. Hold if BP < 120/80			
Refill:			
<u>RRicardo M.D.</u>			
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW			
<div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div>			
Dispense as written			

Problem 95

Phone 716-555-1234	Dr. Ricky Ricardo 33 State Street Arbordale, NY 14002		DEA# AR -12736280
Name	Ethel Mertz	Age	12
Address	123 Desilu Rd, Hollywood, NY	Date	9/8/97
R_x Lanoxin 7.5 mg			
div 60			
Sig: 2bid 2d, 1qd CHF. Hold if HR<50 bpm			
Refill:			
<u>RRicardo M.D.</u>			
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW			
<div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div>			
Dispense as written			

Problem 96

Phone 333-232-1234	Dr. Cascara Picazon, MD, PC 222 Cooke Hall Buffalo, NY 14002		DEA AM2300008
Name	John Jones	Age	21
Address	27 Main St, Buffalo, NY 14123	Date	8/28/2000
R AMOXICILLIN 250MG #30			
Sig: 1 tid uri			
<u>Cascara Picazon M.D.</u>			
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW			
<div style="border: 1px solid black; width: 100px; height: 40px; margin: 0 auto;"></div>			
Dispense as written			

Problem 97

Phone 333-232-1234	Dr. Al Corazon, MD, PC 222 Cardiac Center Buffalo, NY 14002		DEA AM2300008
Name	John Jones	Age	21
Address	27 Main St, Buffalo, NY 14123	Date	8/28/2000
<p>R LANOXIN 0.25MG DTD #100 Sig: 2TID ONE DAY, THEN 1QD CHF <u>Cascara Picazon M.D.</u></p> <p>THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="border: 1px solid black; width: 100px; height: 40px; margin: 0 auto;"></div> <p>Dispense as written</p>			

Problem 98

Phone 333-232-1234	Dr. Al Corazon, MD, PC 222 Cardiac Center Buffalo, NY 14002		DEA AM2300008
Name	John Jones	Age	21
Address	27 Main St, Buffalo, NY 14123	Date	8/28/2000
<p>R Phenobarbital 600mg Lactose 1000mg M SA Caps Div #10 Sig: 2qam one tid HR</p> <p style="text-align: center;"><u>Cascara Picazon M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 100px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>			

Problem 99

Phone 333-232-1234	Dr. Victoria Hollywood, MD, PC 222 Prurita Street Buffalo, NY 14002		DEA AM2300008
Name	Frederick Secret	Age	27
Address	27 Comezon St, Buffalo, NY 14123	Date	8/8/2000
<p>Rx HC 0.1% Aquaphor qsad M SA 30g alb cr Sig: Apply q4-6h itch</p> <p style="text-align: center;"><u>V Hollywood M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 100px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>			

Problem 100

Phone 333-232-1234	Dr. Angina Pectoris, MD, PC 222 Prurita Street Buffalo, NY 14002		DEA AM2300008
Name	Dolor DePecho	Age	57
Address	27 Comezon St, Buffalo, NY 14123	Date	8/8/2000
<p>R NTG 1/150 gr dtd #100 Sig: one sl prn CHF</p> <p style="text-align: center;"><u>A Pectoris M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 100px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>			

Problem 101

Phone 333-232-1234	Dr. George Plant, MD, PC 222 Hedge Street Buffalo, NY 14002		DEA AM2300008
Name	Jorge Shrub	Age	57
Address	27 Arbusto St, Buffalo, NY 14123	Date	8/8/2000
<p>R Zantac 600mg Div #6</p> <p>Sig: 2am, 3pm, 1hs prn GERD or GI symptoms NO ASA or Hep</p> <p style="text-align: center;"><u>George Plant M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 100px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>			

Problem 102

Phone 333-232-1234	Dr. Asco Plant, MD, PC 222 Hedge Street Buffalo, NY 14002		DEA AM2300008
Name	<u>Vela de Cera</u>	Age	<u>57</u>
Address	<u>27 Arbusto St, Buffalo, NY 14123</u>	Date	<u>8/8/2000</u>
<p>R Phenobarbital 50.0mg. Paraffin Wax 1200mg. SA mft #6 Supp. Sig: 1 R hs prn N/V. NPO midnight.</p> <p style="text-align: center;"><u>Asco Plant M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 100px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>			

Problem 103

Phone 333-232-1234	Dr. Ben Adryl, MD, PC 222 Hedge Street Buffalo, NY 14002		DEA AM2300008
Name	<u>D. De Garganta</u>	Age	<u>28</u>
Address	<u>27 Arbusto St, Buffalo, NY 14123</u>	Date	<u>8/12/1997</u>
<p>R Benadryl Elixir Maalox aa 60 ml M. et. ft. susp Sig: swish and swallow i tsp q 4 h prn sore throat Refill -0-1-2-3-4-<u>PRN</u></p> <p style="text-align: center;"><u>B Adryl M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 100px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>			

Problem 104

Phone 333-232-1234	Dr. Ben Adryl, MD, PC 222 Hedge Street Buffalo, NY 14002		DEA AM2300008
Name	<u>D. De Garganta</u>	Age	<u>58</u>
Address	<u>27 Arbusto St, Buffalo, NY 14123</u>	Date	<u>8/12/1997</u>
<p>R ft. 5% HC in Aquaphore ung. Disp 60 g Sig: Apply + wrap affected area c occlusive dressing ut. dict TID Refill: None</p> <p style="text-align: center;"><u>B Adryl M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 100px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>			

Problem 105

Safe medication practices: you're newly licensed and it's your first day on the job. Make sure the drug, directions and instructions to the patient in the PRESCRIPTION match those in the LABEL on the patient's bottle. **Identify and correct** the errors on the label in the space provided if there is an error. If there is no error, **write "no error"** in the space provided.

PRESCRIPTION

Phone 716-555-1234		DEA# AK -12736280			
Dr. Cayenne Serrano, M.D. 3 Chipotle Ave Queens, NY					
Name	Mirasol Habanero	Age	21 yr	Height	5'6"
Address	87 Pepper St, Queens, NY	Date	8/18/97	Weight	180 lb
<div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="text-align: center;"> <p style="font-size: 2em; font-family: cursive;">℞</p> <p style="font-family: cursive;">Sulfacetamide sodium 10% solution</p> <p style="font-family: cursive;">Disp: 10 ml</p> <p style="font-family: cursive;">1 gtt OS QID x7D</p> </div> <div style="text-align: right; margin-top: 20px;"> <p style="font-size: 1.2em; text-decoration: underline;">C Serrano, MD</p> </div> </div>					

LABEL

UBSoPPS Pharmacy

(716) 645-2825

SoPPS NEVER STOPS!

Rx# 000001

MIRASOL HABANERO

SULFACETAMIDE SODIUM 10% SOLUTION

#10 ML

PLACE 1 DROP IN LEFT EAR FOUR TIMES DAILY FOR 7 DAYS

Problem 106

Safe medication practices: you're newly licensed and it's your first day on the job. Make sure the drug, directions and instructions to the patient in the PRESCRIPTION match those in the LABEL on the patient's bottle. **Identify and correct** the errors on the label in the space provided if there is an error. If there is no error, **write "no error"** in the space provided.

PRESCRIPTION

Phone 716-555-1234	Dr. Hunter Kraven, M.D.			DEA# AK -12736280	
3 Ditko Ave Queens, NY					
Name	Joe Blogs	Age	21 yr	Height	5'6"
Address	87 Stanlee St, Queens, NY	Date	8/18/97	Weight	180 lb
<p><i>R</i> Effexor 75mg Disp: 60 1 PO BID</p> <p style="text-align: right;"><u>H Kraven, MD</u></p>					

LABEL

UBSoPPS Pharmacy

(716) 645-2825

SoPPS NEVER STOPS!

Rx# 000002

JOE BLOGS

EFFEXOR XR 75MG

#60

TAKE ONE CAPSULE BY MOUTH TWICE DAILY

Problem 107

Safe medication practices: you're newly licensed and it's your first day on the job. Make sure the drug, directions and instructions to the patient in the PRESCRIPTION match those in the LABEL on the patient's bottle. **Identify and correct** the errors on the label in the space provided if there is an error. If there is no error, **write "no error"** in the space provided.

PRESCRIPTION

Phone 716-555-1234		DEA# AK -12736280			
Dr. Cayenne Serrano, M.D. 3 Chipotle Ave Queens, NY					
Name	Mirasol Habanero	Age	21 yr	Height	5'6"
Address	87 Pepper St, Queens, NY	Date	8/18/97	Weight	180 lb
<div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 10px;">℞</div> <div> <p><i>Sulfacetamide sodium 10% solution</i></p> <p><i>Disp: 10 ml</i></p> <p><i>1 gtt OS QID x7D</i></p> </div> </div>					
<u>C Serrano, MD</u>					

LABEL

UBSoPPS Pharmacy
 (716) 645-2825
SoPPS NEVER STOPS!

Rx# 000001

MIRASOL HABANERO

SULFACETAMIDE SODIUM 10% SOLUTION

#10 ML

PLACE 1 DROP IN LEFT EAR FOUR TIMES DAILY FOR 7 DAYS

Problem 108

Safe medication practices: you're newly licensed and it's your first day on the job. Make sure the drug, directions and instructions to the patient in the PRESCRIPTION match those in the LABEL on the patient's bottle. **Identify and correct** the errors on the label in the space provided if there is an error. If there is no error, **write "no error"** in the space provided.

PRESCRIPTION

Phone 716-555-1234	Dr. Hunter Kraven, M.D. 3 Ditko Ave Queens, NY			DEA# AK -12736280	
Name	Joe Blogs	Age	21 yr	Height	5'6"
Address	87 Stanlee St, Queens, NY	Date	8/18/97	Weight	180 lb
<p><i>R</i> Effexor 75mg Disp: 60 1 PO BID</p> <p style="text-align: center;"><u>H Kraven, MD</u></p>					

LABEL

UBSoPPS Pharmacy (716) 645-2825 <i>SoPPS NEVER STOPS!</i>
Rx# 0000002 JOE BLOGS
EFFEXOR XR 75MG #60 TAKE ONE CAPSULE BY MOUTH TWICE DAILY

Problem 109

Safe medication practices: you're newly licensed and it's your first day on the job. Make sure the drug, directions and instructions to the patient in the PRESCRIPTION match those in the LABEL on the patient's bottle. **Identify and correct** the errors on the label in the space provided if there is an error. If there is no error, **write "no error"** in the space provided.

PRESCRIPTION

Phone 716-555-1234	Dr. Cayenne Serrano, M.D. 3 Chipotle Ave Queens, NY			DEA# AK -12736280	
Name	Mirasol Habanero	Age	21 yr	Height	5'6"
Address	87 Pepper St, Queens, NY	Date	8/18/97	Weight	180 lb
<p style="font-size: 2em; margin-left: 20px;"><i>R</i></p> <p style="margin-left: 40px;"><i>Amoxicillin 200mg/5ml</i></p> <p style="margin-left: 40px;"><i>Disp: 150ml</i></p> <p style="margin-left: 40px;"><i>Sig: agit, 1 tsp PO TID x 10D</i></p> <p style="text-align: right; margin-right: 20px;"><u>C Serrano, MD</u></p>					

LABEL

UBSoPPS Pharmacy
(716) 645-2825
SoPPS NEVER STOPS!

Rx# 000001

MIRASOL HABANERO

AMOXICILLIN 250mg/5mL

SHAKE WELL AND GIVE MIRASOL 1 TEASPOONFUL BY MOUTH THREE TIMES DAILY FOR 10 DAYS

Problem 110

Safe medication practices: you're newly licensed and it's your first day on the job. Make sure the drug, directions and instructions to the patient in the PRESCRIPTION match those in the LABEL on the patient's bottle. **Identify and correct** the errors on the label in the space provided if there is an error. If there is no error, **write "no error"** in the space provided.

PRESCRIPTION

Phone 716-555-1234	Dr. Hunter Kraven, M.D. 3 Ditko Ave Queens, NY				DEA# AK -12736280
Name	Joe Blogs	Age	21 yr	Height	5'6"
Address	87 Stanlee St, Queens, NY	Date	8/18/97	Weight	180 lb
<p style="font-size: 2em; margin: 0;"><i>R</i> <i>Hyoscyamine 0.125 mg tabs</i> <i>Disp: #30</i> <i>Sig: 1 po tid ac</i></p> <p style="text-align: right; margin: 0;"><u>H Kraven, MD</u></p>					

LABEL

UBSoPPS Pharmacy (716) 645-2825 <i>SoPPS NEVER STOPS!</i>
Rx# 000002 JOE BLOGS HYOSCYAMINE 0.125 SUBLINGUAL TABLETS DISSOLVE 1 TABLET UNDER THE TONGUE 3 TIMES DAILY BEFORE MEALS

CHAPTER 2
SIGNIFICANT FIGURES

NOTES

Outline

- Rules for determining significant figures
- Arithmetic with Significant figures
- Measurement errors

Rules For Significant Figures

- A significant figure conveys an estimate of **measurement accuracy** to the reader. It lets you say what you mean and mean what you say about numbers.
- In the significant figures convention, measurements are always expressed with enough digits so that **only the last digit has any uncertainty**.
- You must discriminate between decimal places and significant figures. For example, the number 12.34 has four significant figures but only two decimal places.
- Remember, your calculator knows more about decimal places and YOU know more about significant figures.
- For example, consider the value 12; if it is expressed as 1.2×10^1 or 12, the author implies that the actual value is greater than 11.5 and less than 12.5. It has two significant figures. If the same number is written as 1.20×10^1 or 12.0, the author implies that the actual value is greater than 11.95 and less than 12.05. This representation has three significant figures.
- Zeroes to the left of the first non zero digit are not significant. Thus, 0.00123 and 0.123 both have three significant figures
- Zeroes to the right of the decimal point are significant if the decimal point is preceded by a non zero integer.
- Zeroes to the right of the last non zero digit in a whole number can be ambiguous. For example, it is hard to tell whether 123000 has three significant figures or six. To clear up problems like this, use exponential notation – Write 1.23×10^5 if you want the number to have three significant figures; 1.230×10^5 for four and so on.

Arithmetic with Significant Figures

- When **adding or subtracting**, round off the result to the number with **least number of DECIMAL places**.
- When **multiplying or dividing**, round off the result to the number with **least number of SIGNIFICANT figures**.

VIGNETTES

Significant Figures or Significant Nonsense

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LETTER TO THE EDITOR

Significant figures or significant nonsense?

To the Editor:

When a scientific study is reported to have been performed on 92 subjects, it is quite clear that there were more than 91 and fewer than 93 subjects in the study. But what should one make of recent reports that the mean AUC(0-24) of morphine in human subjects was 1006.83 ng · hr/ml and that the mean C_{max} of atracurium was 17,894 µg/L (both published in 1995 in different clinical pharmacology journals)? Was the AUC(0-24) really more than 1006.82 and less than 1006.84 ng · hr/ml? More important, how can some of our colleagues measure plasma sample volumes and perform analytical manipulations with a precision of 99.999%? As a reviewer of scientific manuscripts for this and other journals, I have had the opportunity to ask many authors to disclose to the rest of us the secrets of their technique but all declined, preferring instead to reduce their data to three significant figures.

Further reading of the literature revealed what appears to be the solution to this mystery. The authors of a study on alfentanil published in 1994 reported individual clearance values for 14 subjects. The values ranged from 170 to 632 ml/min (not 170.00 or 632.01 ml/min) but the mean was reported as 359.36 ml/min! Apparently something happened between the input of the data into a calculator or computer and the output that miraculously enhanced the precision of the data more than one-hundredfold! Nor is this phenomenon limited to pharmacokinetics; similar "enhancements" are evident in reports of clinical measures such as blood pressure and heart rate. Another frequent "enhancement" in clinical reports occurs when the number of subjects with certain characteristics in a larger group of examined subjects is converted to percentages. Thus (from a 1994 report in a leading journal) two of seven subjects becomes 28.6% and one of nine subjects becomes 11.1%. It is true that a frequency of one in nine is closer to 11.1% than to 11.0% or 11.2%, but a summary of the data expressed as a percentage would surely be misleading to readers.

Apparently many authors have forgotten the meaning of significant figures. The significant figures of a number include all certain digits plus the first uncertain digit. As such, they provide the reader with important information about the precision of the reported data. Increasing the number of significant figures in the course of averaging and reporting of that average without appropriate rounding off is usually an unintended careless error, but its consequences may not be distinguishable from the intentional and therefore unethical alteration of data. A C_{max} value of 17,894 µg/L is more appropriately rounded off to 17,900 µg/L (assuming that the precision of the individual measurements in the assay procedure justifies expression of the results in three significant figures), but this leaves an uncertainty about the zero digits. Readers could question if the zeros are used merely to locate the decimal point or if one or both are significant figures. Several methods are available for clarification. The 17,900 µg/L could be converted to 17.9 mg/L. They can be presented in decimal notation: 17.9×10^3 or 1.79×10^4 µg/L, for example. Some textbooks suggest underlining the significant figures: 17,900 µg/L. For clinical journals, it may be easiest to state in the Methods section that all data are rounded off to and reported in three significant figures unless stated otherwise. Textbooks such as Martin's *Physical Pharmacy*¹ provide useful guidance for those concerned about proper presentation of data in significant figures.

Gerhard Levy, PharmD
Department of Pharmaceutics
School of Pharmacy
State University of New York at Buffalo
Amherst, N.Y.

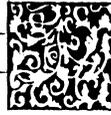
Reference

1. Martin AN. Physical pharmacy. Philadelphia: Lea & Febiger, 1960:2-19.

13/8/68999

Medical Calculation

Science, August 18, 1995



Vignettes: Medical Calculation

Consider a precise number that is well known to generations of parents and doctors: the normal human body temperature of 98.6° Fahrenheit. Recent investigations involving millions of measurements have revealed that this number is wrong; normal human body temperature is actually 98.2° Fahrenheit. The fault, however, lies not with Dr. Wunderlich's original measurements—they were averaged and sensibly rounded to the nearest degree: 37° Celsius. When this temperature was converted to Fahrenheit, however, the rounding was forgotten, and 98.6 was taken to be accurate to the nearest tenth of a degree. Had the original interval between 36.5° Celsius and 37.5° Celsius been translated, the equivalent Fahrenheit temperatures would have ranged from 97.7° to 99.5°. Apparently, dyscalculia can even cause fevers.

—John Allen Paulos, in *A Mathematician Reads the Newspaper* (BasicBooks)

How About Real Heavy?

THE WALL STREET JOURNAL FRIDAY, JANUARY 12, 1996

How About 'Real Heavy'?

In response to your page one Dec. 26 article "Kaboom!": I was fascinated by the Polish method of tank destruction. What precision, to design and drop "a 17,637-pound ball." Not even our own National Institute of Standards and Technology could distinguish a 17,637-pound ball from a 17,636-pound ball. Then I pulled out my pocket calculator. Sure enough, it was really an 8,000-kilogram ball. What sort of metric phobia causes you, with your cosmopolitan readership, to make bad translations into English units instead of simply reporting an "eight-ton ball," which would have been instantly understood? After all, your editorial on fossil fuels, fearlessly and correctly reported global warming data in degrees Celsius.

BRUCE B. BARROW
Chair, Metric Practice Committee
Institute of Electrical and Electronics
Engineers

Bethesda, Md.

PROBLEMS

Problem 1

Use the **mathematical** rules relating to significant figures for this problem. (3 points each)

a. What is the mathematical rule for subtracting 2 numbers with differing significant figures?

b. State the rule for dividing numbers using significant figures.

Problem 2

The answers in the following computations are arithmetically correct. In each case, if the answer does not contain the proper number of significant figures, rewrite it so that all the figures retained are significant: You may present your answer in exponential form, if you wish.

a. $20.0 \text{ ml} \times 1.543 = 30.86 \text{ ml}$

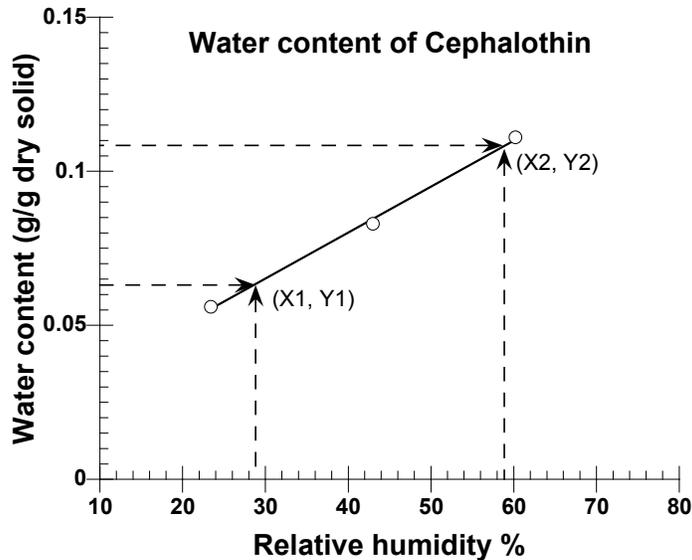
b. $2.330 \text{ g} + 15.2904 \text{ g} + 0.232 \text{ g} = 17.8524 \text{ g}$

c. $73.35 \text{ L}/0.23 = 318.91304 \text{ L}$

Problem 3

Use the MATHEMATICAL RULES for significant figures for all parts of this problem.

A pharmaceutical scientist measures the water content of the drug cephalothin as a function of humidity and plots the data on graph paper.



- a. Read the x-axis and y-axis values corresponding to the point X1, Y1. For your convenience, the dashed line is drawn to the axes from the points. Do not use a ruler to increase accuracy.

X1 = _____ **Y1 =** _____

- b. Read the x-axis and y-axis values corresponding to the point X2, Y2. For your convenience, the dashed line is drawn to the axes from the points. Do not use a ruler to increase accuracy.

X2 = _____ **Y2 =** _____

- c. The scientist calculates the slope of the line from the points (X1, Y1) and (X2, Y2) using the formula below and the numerical value obtained from a calculator is also indicated.

$$\text{Slope} = \frac{Y2 - Y1}{X2 - X1} = 0.0014919$$

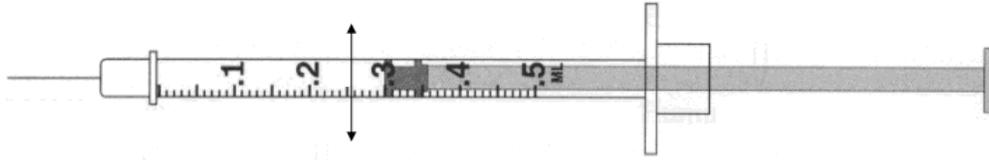
Round off the slope value to the appropriate number of significant figures and write your answer in the space below. Be sure to indicate the correct units.

Slope = _____

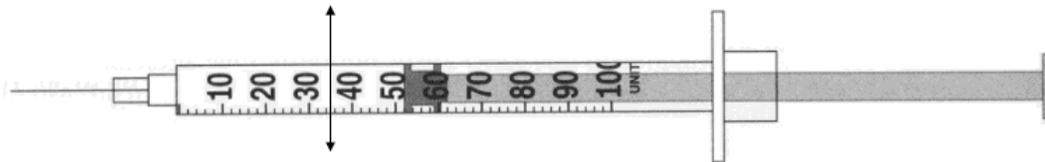
Problem 4

Use the **mathematical rules** for determining the significant figures in your answer for this question.

a.



b.



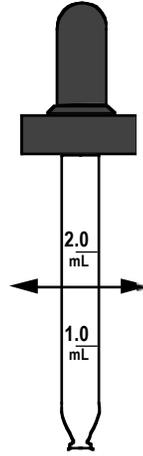
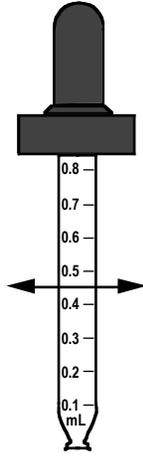
c.



For each of these devices read the volume at the line with the arrows (DO NOT read at the barrel of the syringe).

Problem 5

Two droppers, Dropper A and B are shown below. Assume they are full of medication from the tip up to the line with the arrowheads. Read the measurements to the **correct number of significant figures** and provide your answers in the space provided. **Be sure to indicate units.**

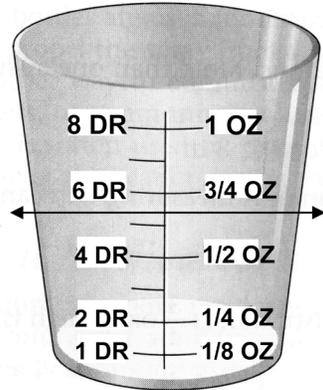


Dropper A:

Dropper B:

Problem 6

A medication cup is shown below. Assume it is full of medication up to the line with the arrowheads. Read the measurements to the **correct number of significant figures** and provide your answers to the questions below in the space provided. **Be sure to indicate units.**



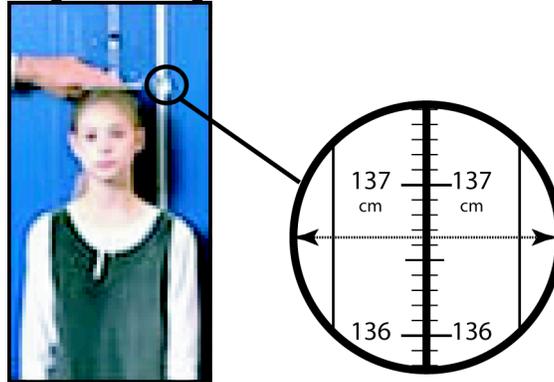
a. What is the volume in drams?

b. What is the volume in ounces?

Problem 7

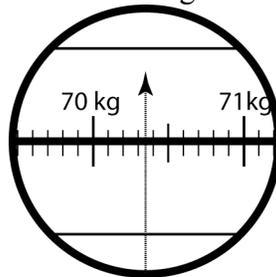
Use the MATHEMATICAL RULES for significant figures for all 3 parts of this problem.

- a. The stadiometer is a device used to measure height of patients in caregivers' offices. The following images summarize a measurement situation. Please read the height of the patient to the correct number of significant figures.



Height = _____

- b. The same patient is weighed on a scale. The table shows the readout on the scale. Read the weight of the patient to the correct number of significant figures.



Weight = _____

- c. The caregiver's office computes the body mass index (BMI), a measure of obesity from the height and weight measurements. The BMI is computed using the formula below and the numerical value obtained from a calculator is also indicated.

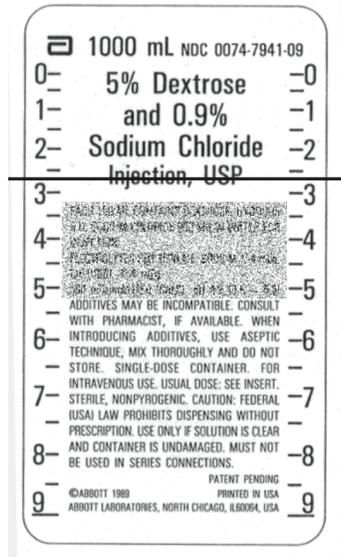
$$BMI = \frac{\text{Weight in kg}}{(\text{Height in meters})^2} = 37.674269 \text{ kg/m}^2$$

Round off the BMI value to the appropriate number of significant figures and write your answer in the space below. Be sure to indicate the correct units.

BMI = _____

Problem 8

Use the mathematical rules for significant figures to answer all parts of this problem. Please read the measurements on the following at the line. Indicate the answers below each figure.



a. Read the measurement on the cup at the line.

b. Read the measurement on the 5% dextrose and 0.9% sodium chloride intravenous injection bag at the line. Assume that the numbers are marked in 100 ml intervals. Read measurement from top down.

Problem 9

- a. A pharmaceutical scientist measures the rate of drug release from a nitroglycerin patch by determining the mass of drug release over a period of time. She finds that 423. mg of drug are released over 24.55 hours and uses the following formula and obtains the indicated answer from the calculator:

$$\text{Rate} = \frac{423. \text{ mg}}{24.55 \text{ hours}} = 17.23014257 \text{ mg/hour}$$

Express the rate to correct number of significant figures.

- b. The area of a nitroglycerin patch is computed from its radius using the formula

$$\text{Area} = \pi(\text{radius})^2$$

The radius of the patch, expressed to the correct number of significant figures, is 3.2 cm. Using a calculator, the area is computed to be 32.16990877 cm². Express the area to the appropriate number of significant figures. Assume that the value of π is known with considerable accuracy.

- c. A toxicologist is computing the molar concentration of a 1.84 mg/ml solution of a compound (molecular weight 280.32 daltons) using the formula:

$$\text{Molar Concentration} = \frac{\text{Concentration}}{\text{Molecular weight}}$$

She obtains the numerical value of $6.599600457 \times 10^{-3}$ moles/Liter. Express her answer to the correct number of significant figures.

- d. The density of a polylactic acid microsphere formulation is 1.057 g/cm³. The mass of the drug formulation in a capsule is accurately measured on a balance and found to be 102.06 mg. The pharmacist uses the following formula to calculate the volume of the drug formulation:

$$\text{Volume} = \frac{\text{Mass}}{\text{Density}}$$

The pharmacist obtains the numerical value 0.0965562913 cm³ from her calculator. Write the answer to appropriate number of significant figures.

Problem 10

The following Table summarizes demographic data obtained for a geographical area in New York in 1995. **Answer the questions that follow using the rules that apply to significant figures.**

Estimated Total Population	5.980×10^5
Fetal Deaths	299

a. State the rule used for determining the number of significant figures after addition or subtraction.

b. State the rule used for determining the number of significant figures after multiplication or division.

c. How many significant figures are present in the number provided for estimated total population?

d. If the number of fetal deaths is known to **completely accurate**, how many significant figures are present in the number provided in the Table?

e. Calculate the number of **fetal deaths per 1000 people** in the total population. Round your answer to the appropriate number of significant figures.

Problem 11

The following Table summarizes data obtained in drug treated rats. **Answer the questions that follow using the rules that apply to significant figures.**

Rat #	Energy Gain, calories
#1	740.3
#2	331.42
#3	-116
#4	1113.28

- a. Calculate the total energy gained or lost by this group of rats. Round your answer to the appropriate number of significant figures.

- b. Using the sum from (a), above, calculate the average energy gained by this group of rats. Round your answer to the appropriate number of significant figures.

Problem 12

The base of the natural logarithm, denoted by e , occupies a central position in pharmacokinetics and in the analysis of biological growth, decay and death processes. **Answer the questions that follow using the rules that apply to significant figures.**

- a. The value of e to 9 decimal places is 2.718281828. Express e as a number with 3 significant figures.
-

- b. The numerical value of e^2 computed using a value of e correct to **four** significant figures is 7.387524. Round this result to the appropriate number of significant figures.
-

- c. A pharmaceutical scientist discovers that the concentration (C) of an investigational new drug is described by the following exponential function of time (t):

$$C = 0.95e^{-0.0347t}$$

Assuming that e (the base of the natural logarithm) is 2.718281828, how many significant figures should be used when expressing the concentration at $t = 1200$. minutes

CHAPTER 3
UNITS AND CONVERSIONS

NOTES**Metric System**

- The metric system is the official system for weights and measures. This workbook assumes that you are familiar with the metric system.
- You should also be familiar with suffixes such as pico (10^{-12}), nano (10^{-9}), micro (10^{-6}), milli (10^{-3}), centi (10^{-2}), deci (10^{-1}), deka (10), kilo (10^3), mega (10^6), giga (10^9) and tera (10^{12})

Apothecary and Avoirdupois Systems

In the United States, the Apothecary and Avoirdupois systems are occasionally used in the pharmacy and in commercial practice.

WEIGHT UNITS IN THE APOTHECARY SYSTEM

UNIT A	UNIT B
1 scruple (℥)	= 20 grains (gr)
1 dram or drachm (℥)	= 3 scruples = 60 grains
1 apothecary ounce (℥)	= 8 drams = 24 scruples = 480 grains
1 apothecary pound (℔)	= 12 apothecary ounces = 96 drams = 5760 grains

WEIGHT UNITS IN THE AVOIRDUPOIS SYSTEM

UNIT A	UNIT B
1 avoirdupois ounce (oz)	= 437 ½ grains
1 avoirdupois pound (lb)	= 16 ounces (oz) = 7000 grains

- Note that the apothecary grain and the avoirdupois grain are equal. However, the apothecary ounce and apothecary pound are not equal to the avoirdupois ounce and the avoirdupois pound, respectively. Confusing enough?
- The apothecary pound is sometimes denoted with lb symbol with a slash through it: ℔.
- The pound used in the United States to obtain patient's body weight and on commercial items in the grocery store is the avoirdupois pound.

VOLUME UNITS IN THE APOTHECARY SYSTEM

UNIT A	=	UNIT B
1 fluid dram (f℥)	=	60 minims (℥)
1 fluid ounce (f℥)	=	8 fluid drams = 480 minims
1 pint (O.)	=	16 fluid ounces = 128 fluid drams
1 quart (qt)	=	2 pints = 32 fluid ounces = 256 fluid drams
1 gallon (Cong or gal)	=	4 quarts = 8 pints = 128 fluid ounces = 1024 fluid drams

- To distinguish between the ounce on the weight measuring scale and the fluid ounce, the latter is often prefixed with fl. or f. to denote fluid measure. However, if it is obvious that a liquid is being measured, the prefix is often not included.
- The pound used in the United States to obtain patient's body weight and on commercial items in the grocery store is the avoirdupois pound.
- The table above is for the United States gallon. The Imperial gallon used in the United Kingdom and elsewhere in its former colonies differs from the US Gallon.

Temperature Conversions

- Temperature conversions should be familiar.
- Here are familiar conversions from Fahrenheit (°F) to Celsius (Centigrade, °C) and from Kelvin (K) to Celsius.

$$\frac{F - 32}{9} = \frac{C}{5}$$

$$K = 273.16 + C$$

UNITS OF CONVERSION TO FOUR SIGNIFICANT FIGURES

UNIT A	UNIT B	CONVERSION TYPE
1 inch	= 2.540 centimeters	Exact
1 meter	= 39.37 inches	Approximate
1 milliliter	= 16.23 minims	Approximate
1 minim	= 0.06161 milliliters, 61.61 μ L	Approximate
1 fluid drachm	= 3.697 milliliters	Approximate
1 fluid ounce	= 29.57 milliliters	Approximate
1 O., Pint	= 473.2 milliliters	Approximate
1 gallon	= 3785 milliliters, 3.785 L	Approximate
1 gram	= 15.43 grains	Approximate
1 grain	= 0.06480 grams, 64.80 mg	Approximate
1 kilogram	= 2.205 pounds avoirdupois	Approximate
1 ounce avoirdupois	= 28.35 grams	Approximate
1 ounce apothecary	= 31.10 grams	Approximate
1 pound avoirdupois	= 453.6 grams, 0.4536 kilograms	Approximate
1 pound apothecary	= 373.2 grams	Approximate
1 grain avoirdupois	= 1 grain apothecary	Exact
1 ounce avoirdupois	= 437.5 grains	Exact
1 ounce apothecary	= 480 grains	Exact
1 pound avoirdupois	= 7000 grains	Exact
1 pound apothecary	= 5760 grains	Exact
1 gallon	= 128 fluid ounces	Exact

VIGNETTES

Two Teams, Two Measures Equaled One Lost Spacecraft

Two Teams, Two Measures Equaled One Lost Spacecraft

By ANDREW POLLACK

LOS ANGELES, Sept. 30 — Simple confusion over whether measurements were metric or not led to the loss of a \$125 million spacecraft last week as it approached Mars, the National Aeronautics and Space Administration said today.

An internal review team at NASA's Jet Propulsion Laboratory said in a preliminary conclusion that engineers at Lockheed Martin Corporation, which had built the spacecraft, specified certain measurements about the spacecraft's thrust in pounds, an English unit, but that NASA scientists thought the information was in the metric measurement of newtons.

The resulting miscalculation, undetected for months as the craft was designed, built and launched, meant the craft, the Mars Climate Orbiter, was off course by about 60 miles as it approached Mars.

"This is going to be the cautionary tale that is going to be embedded into introductions to the metric system in elementary school and high school and college physics till the end of time," said John Pike, director of space policy at the Federation of American Scientists in Washington.

Lockheed's reaction was equally blunt.

"The reaction is disbelief," said Noel Hinners, vice president for flight systems at Lockheed Martin Astronautics in Denver, Colo. "It can't be something that simple that could cause this to happen."

The finding was a major embarrassment for NASA, which said it was investigating how such a basic error could have gone through a mission's checks and balances.

"The real issue is not that the data was wrong," said Edward C. Stone, the director of the Jet Propulsion Laboratory in Pasadena, Calif., which was in charge of the mission. "The real issue is that our process

did not realize there was this discrepancy and correct for it."

Some experts also wondered how something so basic could have gone undetected so long.

"Last time I checked I could sort of visually detect the difference between a foot and a meter," Mr. Pike said. "This is kind of the very first thing in Physics 101 or Engineering 101. This is the only significant program failure that anyone's ever heard of that's due to this."

The failure could raise questions about whether NASA and its contractors are skimping on safety in order to cut costs. The Mars Climate Orbiter, the first spacecraft designed to study the climate of another planet, was exceedingly inexpensive by NASA's standards. It is part of a new strategy to fly more but less expensive, missions to Mars.

That limits the damage done by the failure of any single mission. "There is not a single mission in the program that is critical to the overall

An undetected basic flaw loses a satellite sent to Mars.

program," said Dr. Stone, the Jet Propulsion Laboratory director.

But Mr. Pike said "Obviously the question they are going to have to ask is maybe it was a little too cheap. The question that will have to be asked here is whether in cutting costs, they cut corners."

The failure is also another black eye for Lockheed, the nation's largest military contractor, which in the last year or so has suffered several failures of rockets and missiles it has developed. These failures led the company to restructure its operations and change management in its space business.

NASA officials said they are checking to make sure the same error does not occur in the Mars Polar Lander, which is now en route to

Mars and scheduled to reach the planet on Dec. 3.

Two separate review committees have already been formed to investigate the loss of the Mars Climate Orbiter — the internal Jet Propulsion Laboratory peer review team, which made today's preliminary findings, and a special review board of experts from the laboratory and elsewhere. An independent NASA failure review board will be formed shortly.

It is not known with certainty what happened to the Mars Climate Orbiter. At first there was speculation that it crashed on Mars or burned up in the atmosphere.

But the review team now tends to think that the spacecraft might have never left Mars' orbit and is now orbiting the sun, a Jet Propulsion Laboratory spokesman said. Under this theory, the spacecraft approached too close to Mars and got too hot, causing the engine that was burning to bring the craft into orbit to stop functioning, so the Orbiter went back into space.

NASA and Lockheed officials said the full details of how the mistake occurred are not known. But, basically, Lockheed was providing the Jet Propulsion Laboratory with data on the amount of energy imparted to the spacecraft by its thrusters that are fired periodically. This was measured in pound-seconds, Dr. Hinners said.

But scientists at the Jet Propulsion Laboratory assumed the figure was in newton-seconds and incorporated it into computer models that are used to calculate the spacecraft's position and direction. These models supplement other data about the spacecraft's position, Dr. Stone said.

Since one pound equals about 4.4 newtons, it would seem that such an error would be readily detected, but Dr. Hinners said this was not the case because the thrusters contributed only a little to the orbit. "The firings would have been a very small piece of a larger number," he said.

The miscalculations put the spacecraft off course by only about 60 miles out of a journey of roughly 416 million miles, Dr. Stone said.

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PROBLEMS

Problem 1

Fill in the missing blanks, and/or circle the correct answer in parentheses.

- a. One μg is (exactly, approximately) _____ times (smaller/larger) than one mg.
- b. 1×10^{-3} Liter is equivalent to 1 _____ (exactly, approximately).
- c. There are (exactly, approximately) _____ fluid ounces in a pint.
- d. Water boils at _____ $^{\circ}\text{F}$.
- e. The apothecary pound represents (more than, less than, the same as) the avoirdupois pound.
- f. The apothecary ounce is (approximately, exactly) equivalent to _____ g.
- g. Two and one half scruples is (approximately, exactly) equivalent to _____ gr.
- h. 4 fluid drams represents (more than, less than, exactly the same as) 30 ml.
- i. 1 mg represents (more than, less than, exactly the same as) 1/10 grain.
- j. 3/4 grain of codeine sulfate is (more than, less than, exactly the same as) 30 mg of codeine sulfate.

Problem 2

There is really no alternative to memorization for remembering conversion factors. The following problems will test your ability to remember these conversion factors. Fill in the blanks with the correct answer and circle one choice in the parenthesis.

a. 1 fl oz = _____ ml (exact approximate)

b. 1 lb. avoird = _____ kg (exact approximate)

c. 10 oz avoird = _____ gr (exact approximate)

d. 1 ℥ apoth. = _____ gr (exact approximate)

e. 1 lb apoth = _____ kg (exact approximate)

f. 100 ml = _____ minim (exact approximate)

g. 1 g = _____ gr (exact approximate)

h. 1/4 f ℥ = _____ minims (exact approximate)

i. 1 gallon = _____ f ℥ (exact approximate)

j. 2 gr = _____ mg (exact approximate)

Problem 3

Fill in the blanks with the correct answer.

- a. 1 m = _____ in (exact approximate)
- b. 2 oz. avoird = _____ g (exact approximate)
- c. gr i = _____ mg (exact approximate)
- d. f ℥i = _____ ml (exact approximate)
- e. 1 kg = _____ lb avoird. (exact approximate)
- f. f ℥xvi = _____ O (exact approximate)
- g. 1 lb avoird = _____ gr (exact approximate)
- h. 8 f ℥ = _____ minim (exact approximate)
- i. 1 lb apoth = _____ gr (exact approximate)
- j. ℥v = _____ gr (exact approximate)

Problem 4

Fill in the blanks with the correct answer AND circle one correct choice in the parenthesis. Full credit will be awarded for correct answers to both parts. No credit will be awarded for incorrect response(s) on either or both parts.

a. 1 O = _____ ml (exact approximate)

b. 10 oz. avoird = _____ gr (exact approximate)

c. f ℥ i = _____ minims (exact approximate)

d. f ℥ i = _____ ml (exact approximate)

e. 1 Cong = _____ f ℥ (exact approximate)

f. lb. X apoth = _____ g (exact approximate)

g. 1 lb avoird = _____ kg (exact approximate)

h. 1 lb avoird = _____ gr (exact approximate)

i. 0.1 pint = _____ f ℥ (exact approximate)

j. i ℥ = _____ gr (exact approximate)

Problem 5

Fill in the blanks with the correct answer AND circle one correct choice in the parenthesis. Full credit will be awarded for correct answers to both parts. No credit will be awarded for incorrect response(s) on either or both parts.

a. 1/2 in = _____ cm (exact approximate)

b. 1 oz. avoird = _____ kg (exact approximate)

c. gr v = _____ mg (exact approximate)

d. f ℥ x = _____ ml (exact approximate)

e. gr iv avoird = _____ gr apoth (exact approximate)

f. f ℥ xxiv = _____ pints (exact approximate)

g. 1 lb apoth. = _____ gr. (exact approximate)

h. 1 lb avoird. = _____ oz avoird. (exact approximate)

i. 1 ℥ apoth. = _____ ℥ (exact approximate)

 scruples

j. 1 ml = _____ minims (exact approximate)

Problem 6

Fill in the blanks with the correct answer AND circle one correct choice in the parenthesis. Full credit will be awarded for correct answers to both parts. No credit will be awarded for incorrect response(s) on either or both parts.

a. 1 lb apoth = _____ grams (exact approximate)

b. 1 lb apoth = _____ grains (exact approximate)

c. ℥ i = _____ ℥ (exact approximate)

d. f ℥ x = _____ minims (exact approximate)

e. 1 lb avoird = _____ kg (exact approximate)

f. minim i = _____ ml (exact approximate)

g. ℥ i apoth = _____ gram (exact approximate)

h. 15 inches = _____ cm (exact approximate)

i. ℥ iv = _____ gr (exact approximate)

j. f ℥ x = _____ ml (exact approximate)

Problem 7

Fill in the blanks with the correct answer AND circle one correct choice in the parenthesis. Full credit will be awarded for correct answers to both parts. No credit will be awarded for incorrect response(s) on either or both parts.

a. 1 lb avoirdupois = _____ kilograms (exact approximate)

b. 1 lb avoirdupois = _____ grains (exact approximate)

c. f ʒ x = _____ ml (exact approximate)

d. f ʒ x = _____ minims (exact approximate)

e. 1 mg = _____ grains (exact approximate)

f. 100 minims = _____ ml (exact approximate)

g. ʒ i apoth = _____ gram (exact approximate)

h. 10 meters = _____ inches (exact approximate)

i. ʒ v = _____ gr (exact approximate)

j. ʒ x apoth = _____ grams (exact approximate)

Problem 8

Fill in the blanks with the correct answer to 4 significant figures.

- a. 1 grain avoirdupois = _____ grain apothecary
- b. 1 kg = _____ grains
- c. 1 grain = _____ grams
- d. 200 cm = _____ meters
- e. 1 lb avoirdupois = _____ kilograms
- f. 1 lb avoirdupois = _____ grains
- g. ℥ i apoth = _____ grains
- h. ℥ i avoirdupois = _____ grains
- i. ℥ i apoth = _____ grams
- j. f℥ i = _____ ml
- k. f℥ x apoth = _____ ml
- l. 1 ml = _____ liters
- m. 20°C = _____ °F

Problem 9

Fill in the blanks with the volumes corresponding to each of the following household measures.

- a. 1 teaspoonful = _____ ml
- b. 1 teaspoonful = _____ Fluid drams
- c. 1 tablespoonful = _____ ml
- d. 1 tablespoonful = _____ Fluid ounces
- e. 1 glassful = _____ ml
- f. 1 glassful = _____ Fluid ounces
- g. 1 drop = _____ milliliters

Problem 10

Fill in the blanks with the correct answer to 4 significant figures.

a. 10 mg = _____ micrograms

b. 10 mg = _____ grains

c. 1/100 grain = _____ milligrams

d. 10 cm = _____ meters

e. 10 lb avoirdupois = _____ kilograms

f. 10 kg = _____ lb avoirdupois

g. 10 feet = _____ cm

h. 10 ml = _____ minim

i. 10 apothecary ounces = _____ grams

j. 10 fluid ounces = _____ ml

k. 10 minims = _____ ml

l. 10 ml = _____ liters

m. -20°C = _____ °F

Problem 11

Fill in the blanks with the volumes corresponding to each of the following household measures.

- a. 1 teaspoonful = _____ ml
- b. 1 fluid ounce = _____ teaspoonsful
- c. 1 fluid ounce = _____ tablespoonsful
- d. 1 teaspoonful = _____ Fluid drams
- e. 1 glassful = _____ ml
- f. 1 glassful = _____ Fluid ounces
- g. 1 drop = _____ milliliters

Problem 12

Fill in the blanks with the correct answer to 4 significant figures.

- a. 10 mcg = _____ milligrams
- b. 10 gm = _____ grains
- c. 1 grain apoth = _____ grains avoird
- d. 10 cm = _____ decimeters
- e. 20 kg = _____ lb avoird
- f. 20 fl. dr.= _____ minims
- g. 120 gr = _____ sc
- h. 12 oz (apoth) = _____ lb (apoth)
- i. 12 oz (avoird) = _____ lb (avoird)
- j. 20 fluid ounces = _____ ml
- k. 30 minims = _____ fl. dr.
- l. 1 fl. oz. = _____ liters
- m. 20°C = _____ °F
- n. 37°C = _____ K

Problem 13

Fill in the blanks with the correct answer and circle one correct choice in the parenthesis.

a. 1 O. = _____ ml (exact approximate)

b. 1 lb. avoird = _____ g (exact approximate)

c. 1 oz avoird = _____ gr (exact approximate)

d. 0.1 oz apoth. = _____ g (exact approximate)

e. 10 lb apoth = _____ g (exact approximate)

f. 1 lb apoth = _____ gr (exact approximate)

g. 100 ml = _____ minims (exact approximate)

h. 1 g = _____ gr (exact approximate)

i. 0.1667 fl oz = _____ minims (exact approximate)

j. 0.3333 sc = _____ gr (exact approximate)

k. 2 mg = _____ gr (exact approximate)

l. 1920 minims = _____ fl pint (exact approximate)

m. 1920 gr = _____ lb apoth (exact approximate)

Problem 14

Unit Analysis. What units would result from the following calculations. Do not perform the calculations, just report the units.

a)
$$\frac{0.0500 \text{ g} \times 23.76 \text{ } \mu\text{g/g} \times \frac{50 \text{ parts}}{250 \text{ parts}}}{3.5 \text{ cm} \times 0.5 \text{ cm}}$$

b)
$$\frac{20 \text{ mEq.}}{1000 \text{ ml} + 20 \text{ ml}} \times \frac{2.5 \text{ ml/hr}}{67 \text{ kg}} =$$

c)
$$\$0.65/\text{bottle} \times \frac{38.5 \text{ bottle/day}}{\text{hospital}} \times 30 \text{ day/month} =$$

Problem 15

a. What is the sum, in fluid drams. of: fl oz xiiss, fl dr iv, min xxxix

b. What is the sum, in \mathfrak{D} of: 1 lb, 1 \mathfrak{A} , 3 \mathfrak{B} and 5 grains.

c. What is the sum, in f \mathfrak{C} , of: 1 pt + 1/2 \mathfrak{A} + 3 f \mathfrak{C} + 90 minims

d. What is the sum, in \mathfrak{C} , of: 1 lb + 1 \mathfrak{A} + 7 \mathfrak{B} + 2 \mathfrak{D} + 20 gr

Problem 16

- a. How many milligrams of codeine sulfate was administered to a patient whose chart shows that she received gr. $\frac{1}{8}$, gr. $\frac{1}{4}$, and gr. $\frac{2}{3}$?

- b. How many milligrams of aspirin was administered to a patient whose chart indicates that in the past 24 hours, he received: gr. xx , gr. $\frac{1}{3}$ and gr. ss

- c. How many milligrams of morphine was administered to a patient whose chart shows that in the past week, he received: gr v , gr i ss , and gr $\frac{1}{4}$

Problem 17

- a. A prescription calls for the preparation of 1620 mg of phenobarbital. Circle the apothecary weights that will be used to weigh out the total amount of phenobarbital. A typical weight box consists of the following units.

℥ii, ℥i, ℥ss, ℥ii, ℥i, ℥ss, ℥ii, ℥i, ℥ss, gr v, gr iv,
gr iii, gr ii, gr i, and gr ss

- b. A prescription calls for the preparation of aspirin: 10 doses of 750 mg aspirin per dose. Circle the apothecary weights that will be used to weigh out the total amount of aspirin. A typical weight box consists of the following units.

℥ii, ℥i, ℥ss, ℥ii, ℥i, ℥ss, ℥ii, ℥i, ℥ss, gr v, gr iv,
gr iii, gr ii, gr i, and gr ss

- c. A prescription calls for the preparation of 900 mg of phenobarbital. Circle the apothecary weights that will be used to weigh out the total amount of phenobarbital. A typical weight box consists of the following units.

℥ii, ℥i, ℥ss, ℥ii, ℥i, ℥ss, ℥ii, ℥i, ℥ss, gr v, gr iv,
gr iii, gr ii, gr i, and gr ss

Problem 18

a. A reconstituted thiotepa solution was stored in a refrigerator/freezer set to 5°C . What is the temperature in $^{\circ}\text{F}$ of a refrigerator that is 5°C ?

b. Insulin preparations should not be frozen. An insulin suspension was stored in a refrigerator/freezer at 14°F . What is the temperature in $^{\circ}\text{C}$ of a refrigerator that is 14°F ? Based on your calculations, is the preparation usable?

c. Will water **freeze** in a refrigerator that is at 263K ? Show work.

d. Infants with a fever of 105°F should be seen by medical professional immediately. You are in Europe and the thermometer you have is marked in Celsius. What is the temperature in Celsius corresponding to 105°F ?

e. You are visiting Chicago in January and the forecasted minimum temperature is 0°F . What is the corresponding temperature in Celsius?

f. At what temperature are the values on the Fahrenheit and Centigrade scales the same?

g. The temperature of 0°K equals -273.15°C and represents the theoretical limit for the coldest temperature possible temperature. Convert this to Fahrenheit.

Problem 19

Phone 714-321-1234	DEA# AB0365420	
<p>Dr. Kirstie Jared, M.D. 3 Ally Way Slender, CT</p>		
Name <u>Liposa Stout</u>	Age <u>7 yr</u>	Height <u>4'</u>
Address <u>87 Hefty Lane, Portly, NY</u>	Date <u>8/18/97</u>	Weight <u>58 lb</u>
<p>R Phenobarbital Elixir 20 mg / 5 mL Disp: 1 pint Sig: 15 ml bid</p> <p style="text-align: right;"><u>K. Jared, MD</u></p>		

A review of Ms. Stout's medication profile chart reveals that a week ago, your pharmacist coworker filled a prescription order for Ms. Stout, written by another neurologist for Dilantin (phenytoin 100 mg with phenobarbital ½ gr), i cap tid.

a. Which is larger ½ grain or 30 mg?

b. What is the total volume of elixir dispensed in milliliters.

c. What is the daily dose of phenobarbital, in mg, if Ms. Stout takes both medications as directed?

Problem 20

Phone 714-321-1234	DEA# AB0365420	
<p>Dr. Suet Flaxseed, M.D. 10W-40 Lard Ave Codliver, NC</p>		
Name <u>Canola Hazelnut</u>	Age <u>16 y</u>	Height <u>5'2"</u>
Address <u>87 Mustard Lane, Codliver, NY</u>	Date <u>8/18/97</u>	Weight <u>128 lb</u>
<p>R Codeine sulfate Papverine HCl aa 0.0150 mg Lactose ad 0.2000 mg M.ft. cap DTD xv Sig: Capsule i qid pc and hs</p> <p style="text-align: right;"><u>F. Flaxseed, MD</u></p>		

a. How many milligrams of codeine sulfate would be contained in each capsule?

b. How many grams of lactose should be used in compounding the prescription?

c. What is the total daily dose of papaverine hydrochloride?

Problem 21

Phone 714-321-1234	DEA# AB0365420	
<p>Dr. S. Forthright, M.D. 3 Bylarge Ave Axiom, NC</p>		
Name <u>Eve Wally</u>	Age <u>16 mo</u>	Height <u>2'</u>
Address <u>87 McRea Lane, Axiom, NY</u>	Date <u>8/18/97</u>	Weight <u>28 lb</u>
<p>R Atropine sulfate gr. 1/3 Morphine sulfate gr. iii Lactose qs. \ominus ss M.ft. DTD cap xv Sig: i cap q3h</p> <p style="text-align: right;"><u>S. Forthright, MD</u></p>		

- a. What is the total weight of atropine sulfate required to compound this prescription?

- b. The minimum weighable quantity for a prescription balance is 120 mg. Is the total weight of atropine sulfate amount greater than, equal or less than the minimum weighable quantity?

- c. What is the total amount of lactose needed to compound this script?

- d. What apothecary weights will be used to weigh out the total amount of morphine sulfate? Your apothecary weight set has the following weights:
 \mathfrak{z}_{ii} , \mathfrak{z}_i , \mathfrak{z}_{ss} , \mathfrak{z}_{ii} , \mathfrak{z}_i , \mathfrak{z}_{ss} , \mathfrak{D}_{ii} , \mathfrak{D}_i , \mathfrak{D}_{ss} , gr v, gr iv, gr iii, gr ii, gr i, and gr ss

Problem 22

Phone 714-321-1234	DEA# AB0365420	
<p>Dr. Robert Sponge, M.D. 3 Pineapple Ave Bikini Bottom, NC</p>		
Name Gary Snail	Age 26 yr	Height 5'8"
Address 87 Patrick Lane, Bikini Bottom	Date 8/18/97	Weight 128 lb
<p>R Acetophenetidin gr. ii Aspirin gr. iii Lactose qsad. $\text{\textcircled{D}}$ ss DTD cap xxx Sig: ii cap q4h</p> <p style="text-align: right;"><u>R. Sponge, MD</u></p>		

a. What is the total weight (in grains) of aspirin required to compound this prescription?

b. The minimum weighable quantity for a prescription balance is 120 mg. Is this amount greater than, less than or equal to the minimum weighable quantity for a legal prescription balance?

c. How many grains of lactose are needed to compound this script?

d. Which apothecary weights should be used to weigh the total powder mass? Your apothecary weight set has the following weights:

$\text{\textcircled{3}}$ ii, $\text{\textcircled{3}}$ i, $\text{\textcircled{3}}$ ss, $\text{\textcircled{3}}$ ii, $\text{\textcircled{3}}$ i, $\text{\textcircled{3}}$ ss, $\text{\textcircled{D}}$ ii, $\text{\textcircled{D}}$ i, $\text{\textcircled{D}}$ ss, gr v, gr iv,
 gr iii, gr ii, gr i, and gr ss

Problem 23

Phone 714-321-1234	DEA# AB0365420	
<p>Dr. Albert Goldfine, M.D. 3 Wisteria Ave Fairview, AL</p>		
Name <u>Bree Van de Kamp</u>	Age <u>16 mo</u>	Height <u>65 cm</u>
Address <u>87 Wisteria Ave, Fairview, AL</u>	Date <u>8/18/97</u>	Weight <u>22 lb</u>
<p>R Acetaminophen suspension 80 mg/0.8 ml Disp. f3 viii Sig. 20 mg/kg qid</p> <p style="text-align: right;"><u>A. Goldfine, MD</u></p>		

a. How much acetaminophen (in mg) is in each dose?

b. How many milliliter of suspension should the patient take for each dose?

c. Express the volume dispensed in milliliters.

d. If the patient takes the medication as directed, estimate how many full doses are dispensed?

Problem 24

Phone 714-321-1234	DEA# AB0365420
<p>Dr. Maisy Gibbons, M.D. 3 Transit Road Amherst, NY</p>	
Pet Rex	Animal Dog
Owner Libby Collins	Age 18 mo Weight 20 lb
Address 87 Transit Rd, Amherst, NY	Date 8/18/97
<p>R Diazepam gr. 1/3. Lactose qs ad gr. ii DTD. 10 caps Sig. 1 cap qd with food for epilepsy</p> <p style="text-align: right;"><u>M. Gibbons, MD</u></p>	

a. What is the total weight (in grains) of diazepam required to compound this prescription?

b. What is the total weight (in mg) of diazepam required to compound this prescription?

c. What is the total weight (in grains) of lactose required to compound this prescription?

d. Circle the apothecary weights that will be used to weigh out the total amount of titrated powder mass: A typical weight box consists of the following units.

\mathfrak{z} ii, \mathfrak{z} i, \mathfrak{z} ss, \mathfrak{z} ii, \mathfrak{z} i, \mathfrak{z} ss, \mathfrak{D} ii, \mathfrak{D} i, \mathfrak{D} ss, gr v, gr iv,
 gr iii, gr ii, gr i, and gr ss

Problem 25

Phone 714-321-1234	DEA# AB0365420
<p>Dr. Edie McLain, M.D. 4362 Wisteria Lane Amherst, NY</p>	
Owner <u>Austin McCann</u>	Age <u>3 yr</u> Weight <u>34 lb</u>
Address <u>87 Applewhite Rd, Amherst, NY</u>	Date <u>9/18/02</u>
<p>R Daunorubicin 25 mg / kg q week Sig: IV drip over 8 hours for acute lymphocytic leukemia</p> <p style="text-align: center;"><u>E. McLain, MD</u></p>	

- a. How many mg of daunorubicin should be dispensed each week?

- b. Daunorubicin is supplied as a sterile powder that is reconstituted with sterile water for injection. If the final reconstituted solution concentration is 5 mg/ml, how many ml is needed for one dose?

- c. What is the final concentration of danuorubicin if the dose is added to an i.v. bag containing 500 ml of sterile dextrose?

Problem 26

Phone 716-555-1234	DEA# AT -12736280	
<p>Dr. Carrie Blatch, M.D. 3 Brownstone Manor Ave Upper East Side, New York, NY</p>		
Name <u>Miranda Brady</u>	Age <u>16 mo</u>	Height <u>2'</u>
Address <u>87 Misandric Lane, Brooklyn</u>	Date <u>8/18/97</u>	Weight <u>28 lb</u>
<p>R Lanoxin Pediatric Elixir 0.05 mg/ml 60 mcg /kg body weight Sig: Take as three divided doses daily <div style="text-align: right;"><u>C. Blatch, MD</u></div></p>		

a. What is the total daily dose in mg?

b. How many mg of Lanoxin is administered in each dose?

c. What is the volume (in ml) of each dose?

d. If a 30-day supply is dispensed, how many ml of Lanoxin are dispensed?

e. If a 30-day supply is dispensed, what volume (in apothecary units) of Lanoxin Pediatric elixir is dispensed? (Hint: You may need to use multiple apothecary units).

Problem 27

Phone 555-3784	DEA# BS0365420
Grasa Saturada 407 Hierro St. Azucars, TX 90210	
Name <u>Limon De Campo</u>	Age <u>23</u> Wt <u>80 kg</u>
Address <u>Sal St, Azucars, TX 90210</u>	Date <u>1/10/95</u> Height <u>5 ft 10 in</u>
<div style="display: flex; justify-content: space-between;"> <div style="text-align: center;"> <p>R_x</p> <p>THYROGLOBULIN</p> <p>M FT SA TABL DTD #50</p> <p>SIG: I TAB QD</p> </div> <div style="text-align: right;"> <p>Gr ii ss</p> </div> </div>	
Refill	<u>Grasa Saturada</u> <u>M.D.</u>

A typical weight box consists of the following units.

\mathfrak{z}_{ii} , \mathfrak{z}_i , \mathfrak{z}_{ss} , \mathfrak{z}_{ii} , \mathfrak{z}_i , \mathfrak{z}_{ss} , \mathfrak{D}_{ii} , \mathfrak{D}_i , \mathfrak{D}_{ss} , gr v, gr iv,
 gr iii, gr ii, gr i, and gr ss

- a. Pick out the weights required to weigh the total amount of drug required for compounding all the thyroglobulin tablets.

- b. Express the single dose of thyroglobulin in milligrams.

- c. Express the patient's height in centimeters.

Problem 28

Phone 716-555-1234		DEA# AT -12736280			
Dr. Abierto Cerreo, M.D.					
Name	Sayonara Ciao	Age	14 yr	Height	
Address	8 Adieu Street, Farewell	Date	8/18/02	Weight	100 lb
Rx	Codeine sulfate	gr vi			
	Ammonium chloride	℥ iii			
	Cherry syrup				
	Water aa qs ad	f ℥ viii			
	Sig: Take i ℥ syrup three times a day prn cough				

- a. What is the patient's body weight in kilograms?

- b. What instructions would you give the patient?

- c. How much syrup is administered in a single dose? Answer in the **metric system**.

- d. How much preparation (a cough syrup) is dispensed? Answer in the **metric system**.

- e. How many **grains** of **ammonium chloride** are needed for compounding this prescription?

- f. How many **grams** of **codeine sulfate** are needed for compounding this prescription?

- g. Assume that codeine sulfate and ammonium chloride dissolve and do not contribute volume to the final preparation and that the volumes of cherry syrup and water are additive on mixing (i.e., no shrinkage or expansion occurs). What is the volume of cherry syrup required for compounding this prescription in **fluid ounces**.

Problem 29

Phone 555-3784	DEA# BS0365420
Grasa Saturada 407 Hierro Street, Azucares, TX 90210	
Name <u>Giallo Limon</u>	Age <u>23</u> Wt <u>200 lb</u>
Address <u>Guineos Street</u>	Date <u>1/10/95</u> Height <u>5 ft 10 in</u>
Rx Phenytoin 300 grains Div caps #200; Sig: i c tid	
Refill	<u>Grasa Saturada</u> <u>M.D.</u>

A typical weight box consists of the following units.

\mathfrak{z}_{ii} , \mathfrak{z}_i , \mathfrak{z}_{ss} , \mathfrak{z}_{ii} , \mathfrak{z}_i , \mathfrak{z}_{ss} , \mathfrak{D}_{ii} , \mathfrak{D}_i , \mathfrak{D}_{ss} , gr v, gr iv,
 gr iii, gr ii, gr i, and gr ss

a. Pick out the weights required to weigh the total amount of drug required for compounding all the phenytoin capsules.

b. Express the single dose of phenytoin in milligrams.

c. Express the patient's weight in kilograms.

d. A patient's body surface area is 1.73 m². Express the body surface area in cm².

e. Here is a formula for body surface area. Re-write the formula so that the Body Surface Area is in m², the height is in inches and the weight is in avoirdupois pounds.

$$BSA \text{ in } m^2 = \sqrt{\frac{\text{Height in cm} \times \text{Weight in kg}}{3600}}$$

Problem 30

Phone 716-555-1234		DEA# AT -12736280			
Dr. Rubella Scabies, M.D.					
Name	Varicella Zoster	Age	24 yr	Height	
Address	8 Rosacea Street, Lyme	Date	8/18/02	Weight	100 kg
Rx		Morphine sulfate solution		2 mg/ml	
		Sig: Take ii \mathfrak{z} q4h prn pain			
R. Scabies, MD					

a. What instructions would you give the patient?

b. What is the route of administration?

c. Express the amount of a single dose of the drug in milligrams?

d. Express the amount of a single dose of the drug in grains?

e. Express the dose of morphine sulfate in **micrograms/kilogram**.

Problem 31

Phone 555-3784	Cameron Caiman	DEA# BS0365420
El Gato, TX 90210		
Name Marmota Loro	Age 23	Wt 200 lb
Address Perro Street, El Gato	Date 1/10/95	Height 5 ft 10 in
R Aspirin Div caps #200. Sig: i c tid		1000 grains
Refill	Cameron Caiman M.D.	

A typical weight box consists of the following units.

\mathfrak{z}_{ii} , \mathfrak{z}_i , \mathfrak{z}_{ss} , \mathfrak{z}_{ii} , \mathfrak{z}_i , \mathfrak{z}_{ss} , \mathfrak{D}_{ii} , \mathfrak{D}_i , \mathfrak{D}_{ss} , gr v, gr iv,
 gr iii, gr ii, gr i, and gr ss

a. Pick out the weights required to weigh the total amount of aspirin for all capsules.

b. Express the single dose of aspirin in milligrams.

c. Express the patient's weight in kilograms.

d. Express the patient's height in centimeters.

e. The body mass index is used to assess whether a patient is obese or underweight. Use the formula below to calculate the patient's body mass index.

$$Body\ mass\ index = \frac{Weight\ in\ kg}{(Height\ in\ meters)^2}$$

Problem 33

Phone 555-3784					
Robert Bruce Banner Desert Base, NM 90210					
Name	Jennifer Walters-Jameson	Age	23	Wt	100 kg
Address	Perro Street, Elhulko	Date	1/2/95	Height	6 ft 3 in
Rx Phenytoin sodium gr. iss Phenobarbital gr. ss DTD 90 caps. Sig: 1 tid					

A typical weight box consists of the following units.

\mathfrak{z}_{ii} , \mathfrak{z}_i , \mathfrak{z}_{ss} , \mathfrak{z}_{ii} , \mathfrak{z}_i , \mathfrak{z}_{ss} , \mathfrak{D}_{ii} , \mathfrak{D}_i , \mathfrak{D}_{ss} , gr v, gr iv,
 gr iii, gr ii, gr i, and gr ss

- a. Pick out the weights required to weigh the **total** amount of **phenytoin sodium** required for compounding **all the capsules**.

- b. Calculate the amount of **phenobarbital** required for compounding **all the capsules**.

- c. Express the patient's weight in pounds.

- d. Express the patient's height in centimeters.

- e. Calculate the patients body mass index. The body mass index is the ratio:

$$Body\ mass\ index = \frac{Weight\ in\ kg}{(Height\ in\ meters)^2}$$

Problem 34

Phone 716-555-1234		DEA# AT -12736280			
Dr. Venus Flytrap, M.D.					
Name	Goldie Butterwort	Age	24 yr	Height	
Address	Sundew Street, Cobralily, TX	Date	8/18/02	Weight	100 kg
<p>Rx Phenytoin sodium 1.5 grains Phenobarbital 0.5 grains DTD 40 caps Sig: 1 tid</p> <p style="text-align: right;">V. Flytrap, MD</p>					

- a. How much phenytoin sodium is present in a single dose. Express your answer in **milligrams**.

- b. How much phenobarbital is present in a single dose? Express your answer in **milligrams**.

- c. What is the route of administration? What is the dosage form? (You have to get both questions right for credit!)

- d. The optimum **daily** dose of phenytoin sodium varies considerably but is usually in the range 6-7 mg/kg. Calculate the daily dose in mg/kg.

- e. Express the **total amount of phenytoin sodium** required for compounding the all capsules in scruples?

Problem 35

Phone 716-555-1234		DEA# AT -12736280			
Dr. Ballena Calamar, M.D.					
Salt Lake City, UT					
Name	Medusa Cangrejo	Age	24 yrs	Height	5' 10"
Address	8 Estrella del Mar, Tiburon	Date	8/18/02	Weight	200 lb
<p>Rx Acetaminophen elixir: 325 mg/5 ml Dispense 100 ml Sig: 2 ℥ q4-6 h prn fever.</p> <p style="text-align: right;"><u>B Calamar, MD</u></p>					

a. What instructions would you give the patient?

b. What is the dosage form? What is the route of administration?

c. What is the patients weight in kilograms?

d. Calculate the single dose of acetaminophen

Problem 36

Phone 716-555-1234		DEA# AT -12736280			
Dr. Neuvo Lanina, M.D.					
Salt Lake City, UT					
Name	Diana Rhea	Age	3 yrs	Height	2' 10"
Address	8 Wisteria Lane, Tiburon	Date	8/18/02	Weight	22 lb
<p>Rx <u>Paregoric</u></p> <p>Morphine 2 mg</p> <p>Anise oil 0.02 ml</p> <p>Benzoic acid 20 mg</p> <p>Camphor 20 mg</p> <p>Glycerin 0.2 ml</p> <p>Alcohol qsad 5 ml</p> <p>mft paregoric SA with formula. Dispense 3-day supply</p> <p>Sig: 0.5 ml/kg QID prn diarrhea</p>					

Paregoric is a potent alcoholic antidiarrheal agent.

a. What conversion factor (to four significant digits) is needed to convert the weight of this child to kilograms for dosage calculations with a simple multiplication.

b. How many **ml** of paregoric would this child take as a single dose? Round off the volume to the nearest household measure.

c. How much morphine would a patient receive in a single dose?

d. How many ml should you dispense?

e. You have prescription bottles that of various sizes in apothecary ounces. What is the nearest size prescription bottle?

Problem 37

Phone 716-555-1234		DEA# AT -12736280			
Dr. Dino Saura, M.D.					
Jurassic City, UT					
Name	Diana Rhea	Age	3 yrs	Height	2' 10"
Address	8 Wisteria Lane, Tiburon	Date	8/18/02	Weight	22 lb
Rx Phenytoin sodium gr ss DTD 1 month supply Sig: 3 caps tid					

Phenytoin sodium, a drug used to control epileptic seizures, was originally prescribed as gr. ss and gr. iss capsules. Phenytoin sodium is now commercially available as 30 and 100 mg capsules and yet some physicians, out of tradition, still prescribe it in grains. "According to the art", prescriptions for Phenytoin sodium gr. iss are now dispensed as 100 mg capsules. Prescriptions for Phenytoin sodium gr. ss are now dispensed as the smaller pediatric 30 mg capsules.

a. Dr. Saura has been effectively controlling a patient's epilepsy with a prescription for Phenytoin sodium gr iss TID for over a year. You have been correctly filling this prescription with 100 mg capsules. The doctor now reports to you that his patient is having difficulty swallowing the larger gr iss capsules and wants you to refill the prescription using three gr. ss capsules TID (after all, he believes that "3X gr ss" = "gr iss"). If you dispense three, 30 mg capsules per dose what is the difference, **in mg/dose**, between the original 100 mg capsules and this new prescription?

b. How many grains are there in a milligram?

c. What is the difference, **in grains/dose**, between three, 30 mg pediatric capsules and the original 100 mg capsule

d. You decide to call Dr. Saura back and recommend phenytoin oral suspension, (phenytoin sodium 33 1/3 mg/5ml) instead of the smaller capsules. What volume of this suspension, in ml, would be equivalent to the 100 mg capsules?

Problem 38

Phone 246-135-7890	DEA# BA -12736280	
<p>Dr. Jasmine Alladin, M.D. 22 W. Sultan Blvd Agrabah, OR</p>		
Name Ariel Flounder	Age 15 yr	Height 5 ft 8 in
Address 1 Triton Ave, Sebastian, OR	Date 8/18/97	Weight 90 kg
<p>R Phenacetin gr. xxiv ASA gr. xxxvi Caffeine gr. vi Codeine sulfate gr. vi Mft div caps 12 Sig: 1 cap q4h prn pain. Max dose 6 caps daily <u>Jazzie Alladin, MD</u></p>		

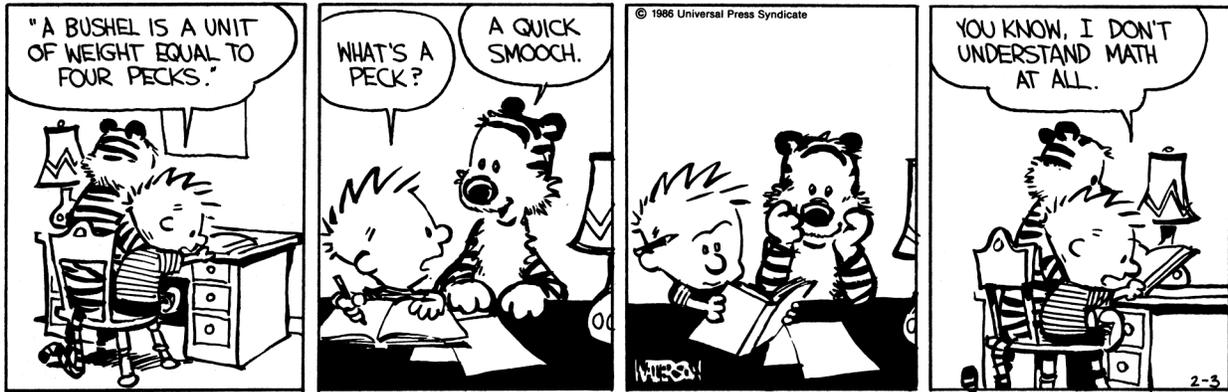
- a. Calculate the weight **in grains** of the **total contents** of each capsule.

- b. It is important to limit the maximum daily dose of this medication because phenacetin can cause kidney damage. What is the maximum daily dose of phenacetin in **mg**.

- c. **Without converting units**, determine how many **pounds** (avoirdupois) of phenacetin are required to prepare 18 **pounds** (avoirdupois) of the formula?

- d. How many **scruples** of phenacetin are required to prepare 144 **scruples** of the formula?

- e. How many **grams** of phenacetin are required for preparing 3.6 **kg** of product?



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CHAPTER 4
DOSING

NOTES

Outline

- Definitions
- Determinants of dosing
- Why bother about dosing?
- Parenteral routes of administration?
- Household measures
- Approximate & Exact equivalents
- Calculating drug dosage
- Dosing for children
- Body surface area method

Some Formalism

- DOSE refers to the AMOUNT of drug administered, expressed as a mass.
 - Single dose
 - Total dose
 - Daily dose
- Usual adult dose is the amount that may be expected produce the intended effect in adults.
- Usual pediatric dose is similarly defined for children.
- Usual dosage range represents the amounts that may be prescribed within the guidelines of medical practice.
- Distinguish between DOSE and DOSAGE FORM. A given dose may be administered in a variety of dosage forms. For example a dose of 100 mg can be given as solution, as a tablet, as capsules etc.
- For clarity, we will use the word “amount” to refer to the drug and the word “quantity” to refer to the preparation.

Determinants Of Dosing

- As a health care professional, dosing is among most critical and frequent decisions you will be involved with.
- There are numerous factors that are important in determining the drug choice and dose of a given drug. These factors are summarized in the Figure 4.1 below (Adapted from M. Rowland and T.N. Tozer, *Clinical Pharmacokinetics: Concepts and Applications*). Pharmaceutical calculations, the subject matter of this Workbook are important because they

enable integration of the many pathophysiological, pharmacological, physicochemical and other factors to be considered.

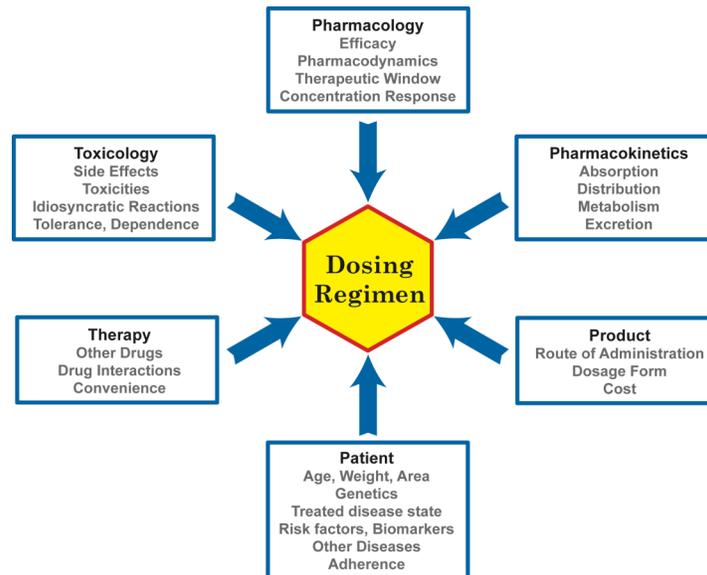


Figure 4.1. Determinants of a dosing regimen.

Why Bother About Dosing?

- The dose is the primary determinant of the concentration of drug in blood. The concentration in blood determines the drug concentration at the site of action. The drug concentration at the site of action determines the magnitude of effect.
- Dose → Blood Concentration → Concentration at Site of Action → Effect
- Minimum Effective Concentration (MEC) → Blood serum concentration that produces desired effect.
- Minimum Toxic Concentration (MTC) → Blood serum concentration that produces toxic effects.
- You want to maintain concentrations between MEC and MTC for the desired period of time.
- As drug concentration in plasma increases, the likelihood of effectiveness increases and the likelihood of ineffectiveness decreases. However, larger increases in drug concentration results in an increase in minor and then major toxicities. There is also a risk of hypersensitivity reactions, which can occur even at very low concentrations and are shown as relatively concentration independent. Figure 4.2 is a schematic that illustrates the dependence of drug effects on concentration. The green curve represents the difference between effectiveness and toxicity. Notice there is an optimum drug concentration that is preferred so that net effectiveness can be maximized. The schematic is adapted from a Figure for the cardiac drug procainamide (J. Koch-Weser, *Pharmacology and the Future: Problems in Therapy*, G.T. Okita and G.H. Archeson eds. Karger, Basel, 1973, 3, 69-85).

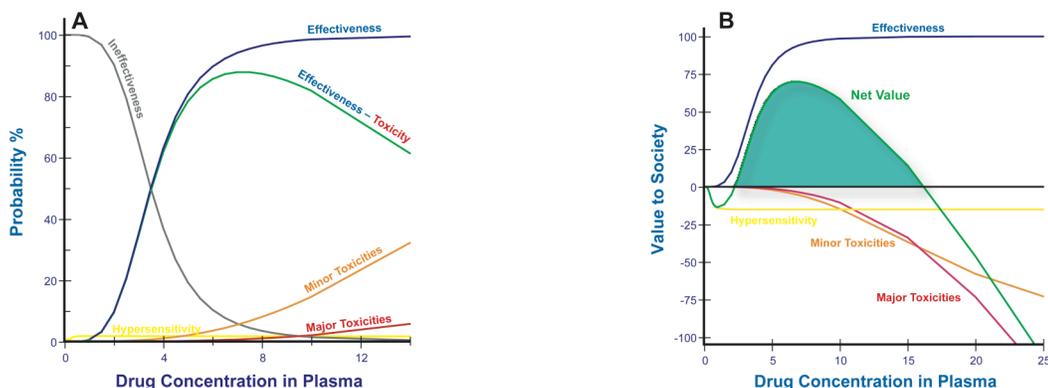


Figure 4.2. Figure 4.2A is schematic of the dependence of drug effects and side effects on plasma concentration. Figure 4.2B is a qualitative assessment of drug therapy to society. On both graphs, the effectiveness curve is in blue, the ineffectiveness curve is in gray, the minor and major toxicities are in orange and red, respectively, and the hypersensitivity curve is in yellow. In Figure 4.2A, the difference between effectiveness and toxicity is in green whereas in Figure 4.2B, the net value curve is in green. The drug concentrations on the x-axis are in arbitrary units on both Figures. The drug concentration region with positive value to society is filled in green.

- Figure 4.2B shows that for drug therapy to be useful to society at large, drug concentrations have to be maintained within the window of concentrations filled in green. The calculations are in arbitrary units with positive values being beneficial to society. The value calculations were based on Figure 4.2A and a weighted sum was obtained after assigning a value of +1 to effective treatment, -1 to minor toxicities and -5 to both hypersensitivity reaction and major toxicities. Note that both low and high concentrations are potentially harmful to society at large.

Parenteral Routes Of Administration

- Routes of administration can be classified as *Topical*, *Enteral* or *Parenteral*.
- *Parenteral* routes involve drug administration at sites other than the gastrointestinal tract whereas the *enteral* routes involve the gastrointestinal tract. Topical routes involve direct application of drug at a surface where effect is desired.
- Examples of topical routes include:
 - *Epicutaneous*: On the surface of the skin. Sunscreen, ointments, creams, lotions containing various drugs are often applied directly where needed on the skin.
 - *Vaginal*: Into the vagina. Antifungal agents used to treat yeast infections, estrogens and progesterone and douches are examples.
 - *Eye or Ear*: Application on the outside of the eye or ear. Examples are antibiotic-containing eye drops for treating conditions such as conjunctivitis.
- Oral and rectal dosing are enteral routes. Feeding tubes and gastrostomy tubes, which provide direct stomach access, are also enteral routes.

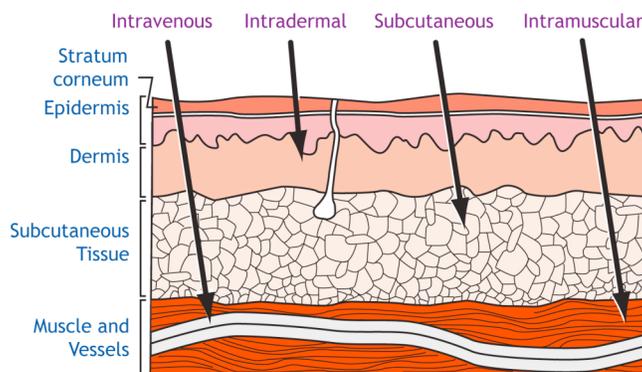


Figure 4.3. An illustration of human skin highlighting the sites of administration of intravenous, intradermal, subcutaneous and intramuscular injection.

- *Parenteral injections* can be administered at various locations. These include:
 - *Intravenous*: Into the vein. Intravenous administration can be either central or peripheral. In peripheral administration, a vein in the forearm, hand, leg or foot is used. In central administration a large vein connecting to the superior vena cava, such as the basilic, cephalic, subclavian, femoral jugular veins, or the femoral vein connecting to the inferior vena cava, is used. Central sites offer large veins that can enable rapid infusion of large volumes of fluid. What is the difference between an IV bolus or push and an IV infusion? When the drug is administered all at once, it is a bolus or push, whereas infusions are administered over a longer period of time.
 - *Intrasosseus*: Into the bone marrow. It is used as an alternative to intravenous administration because the bone marrow is continuous with the venous circulation. It is used in young children when an intravenous site is difficult to locate.
 - *Intraarterial*: Into the artery. Anti-thrombolytic drugs used to clear arterial blockage caused by clots in the brain resulting from stroke are administered intraarterially.
 - *Intramuscular*: Into the muscle. Many antibiotics, biologicals and proteins drugs, hormones are administered intramuscularly.
 - *Subcutaneous*: Under the skin, into the subcutaneous layer. The subcutaneous layer is below the dermis. Insulin and interferon-beta are examples of drugs administered subcutaneously.
 - *Intradermal*: Into the dermis. The epidermis is the outermost layer of the skin and dermis underlies the epidermis. The tuberculin test and testing for allergens are example of intradermal administration. Direct administration of drugs into the cerebrospinal fluid within ventricles of the brain (*intraventricular* route) is considered intrathecal administration.
 - *Intrasynovial, Intrarticular*: Both involve injections into joint. In intrasynovial administration, the drug is administered into the synovial cavity of the joint. For example, corticosteroids are injected into joints for treating conditions such as carpal tunnel syndrome and arthritis.
 - *Intraperitoneal*: Into the peritoneal cavity of the abdomen. Peritoneal access is used for peritoneal dialysis, for treatment of ovarian cancer and in veterinary medicine.

- *Epidural*: Outside the dura of the spinal cord. It is used to administer pain medicine because locally around the spinal nerves while minimizing undesirable side effects on the central nervous system. Epidural anesthetics are used during labor.
- *Intrathecal*: Into the cerebrospinal fluid within the spinal canal of the spinal cord. Intrathecal administration can be used to improve drug availability in the central nervous system because the cerebrospinal fluid bathes the brain and spinal cord. It is used in cancer chemotherapy to prevent or treat cancer that has spread into the central nervous system.
- *Intravitreal*: Into the vitreous body of the eyes. Used to treat conditions such as glaucoma.
- Parenteral routes not requiring injection include:
 - *Transdermal*: Drug is delivered through skin. Transdermal patches are used for many drugs, including scopolamine patches treating motion sickness, nicotine patches for smoking cessation.
 - *Sublingual*: Under the tongue. Used with sublingual nitroglycerin tablets.
 - *Buccal*: Between the cheek and the gums. Oral tobacco users employ this route.
 - *Inhalational*: Treatment with aerosols and other dosage forms that deliver drug to the systemic circulation via the respiratory tract or the alveolar surfaces. Examples include inhaled anesthetics and inhaled insulin.

Table 4.1. Advantages and disadvantages of different routes of administration.

Route	Absorption	Limitations & Advantages
Intravenous	Absorption barriers bypassed Immediate effects possible Large volumes Dose and effect can be titrated	No particulates, oily preparations Increased risk of adverse effects Trained personnel needed
Subcutaneous	Prompt absorption from solution Slow and sustained release possible from special formulations Okay for some insolubles and solid pellets, and oily preparations	Small volumes Pain, irritation, necrosis
Intramuscular	Same as subcutaneous	Moderate volumes (2.5 ml max for adults) Some irritating drugs can be dosed
Oral	Slower and more variable	Convenient, economical Safer Cannot be used for protein drugs, drugs that are highly metabolized by the liver

Sources Of Dosing Information

- U.S. Pharmacopoeia Dispensing Information, Volume I. Contains drug descriptions called monographs that contain information on the therapeutic category, pharmacology, precautions, side effects...
- Pediatric Dosage Handbook of the American Pharmaceutical Association.

Household Measures

- 1 teaspoonful = 5 mL = 1 1/3 f℥
- 1 tablespoonful = 15 mL = 4 f℥
- Traditionally, the f℥ symbol is used to prescribe a teaspoonful. Interpret this as a teaspoonful if dispensing PRE-FORMED products.
- Interpret this as a f℥ if dispensing compounded medication and dispense a DRAM SPOON
- 1 fluid ounce = 6 teaspoonsful

The Drop

- The standard dropper has an opening 3 mm diameter.
- Each drop of water is 45 – 55 mg
- How many drops to a mL?
- Dosage from a dropper depends on physicochemical factors such as density, surface tension.
- Always calibrate a dropper with the drug of interest.

Approximate Equivalents

- Use approximate equivalents for **prepared** dosage forms e.g. tablets, capsules etc. When prepared dosage forms are prescribed in the apothecary system the pharmacist may dispense the approximate equivalent in the metric system and *vice versa*.
- **Do not** use approximate equivalents for compounding. Use exact conversion factors.
- **Do not** use approximate equivalents for converting pharmaceutical formulas. Use exact conversion factors
- **Do not** use approximate equivalents for labeling.

Table 4.2. Approximate Equivalents**Liquid Measure**

METRIC	APOTHECARY	METRIC	APOTHECARY
1000 ml	1 quart	3 ml	45 minims
750 ml	1 1/2 pints	2 ml	30 minims
500 ml	1 pint	1 ml	15 minims
250 ml	8 fluid ounces	0.75 ml	12 minims
200 ml	7 fluid ounces	0.6 ml	10 minims
100 ml	3 1/2 fluid ounces	0.5 ml	8 minims
50 ml	1 3/4 fluid ounces	0.3 ml	5 minims
30 ml	1 fluid ounce	0.25 ml	4 minims
15 ml	4 fluid drams	0.2 ml	3 minims
10 ml	2 1/2 fluid drams	0.1 ml	1 1/2 minims
8 ml	2 fluid drams	0.06 ml	1 minim
5 ml	1 1/3 fluid drams	0.05 ml	3/4 minims
4 ml	1 fluid dram	0.03 ml	1/2 minim

Weight

METRIC	APOTHECARY	METRIC	APOTHECARY
30 g	1 ounce	30 mg	1/2 grain
15 g	4 drams	25 mg	3/8 grain
10 g	2 1/2 drams	20 mg	1/3 grain
7.5 g	2 drams	15 mg	1/4 grain
6 g	90 grains	12 mg	1/5 grain
5 g	75 grains	10 mg	1/6 grain
4 g	60 grains (1 dram)	8 mg	1/8 grain
3 g	45 grains	6 mg	1/10 grain
2 g	30 grains (1/2 dram)	5 mg	1/12 grain
1.5 g	22 grains	4 mg	1/15 grain
1 g	15 grains	3 mg	1/20 grain
750 mg	12 grains	2 mg	1/30 grain
600 mg	10 grains	1.5 mg	1/40 grain
500 mg	7 1/2 grains	1.2 mg	1/50 grain
400 mg	6 grains	1 mg	1/60 grain
300 mg	5 grains	800 µg	1/80 grain
250 mg	4 grains	600 µg	1/100 grain
200 mg	3 grains	500 µg	1/120 grain
150 mg	2 1/2 grains	400 µg	1/150 grain
125 mg	2 grains	300 µg	1/200 grain
100 mg	1 1/2 grains	250 µg	1/250 grain
75 mg	1 1/4 grains	200 µg	1/300 grain
60 mg	1 grain	150 µg	1/400 grain
50 mg	3/4 grain	120 µg	1/500 grain
40 mg	2/3 grain	100 µg	1/600 grain

Dose Calculations

- Most dose calculation use simple ideas involving ratios and proportions.
- Amount in each dose × Number of doses = Total amount
- Quantity in each dose × Number of doses = Total Quantity
- $$\frac{\text{Amount of Drug in each Dose}}{\text{Quantity of Preparation corresponding to each Dose}} = \frac{\text{Total Amount of Drug in Preparation}}{\text{Total Quantity of Preparation}}$$

Doses For Children

Pediatric definitions

Premature	< 38 wks gestation
Newborn, neonate	Birth to 1 month
Infant, baby	1 – 12 months
Young child	1 – 5 years
Older child	6 – 12 years
Adolescent	13 – 18 years

- ✘ Children are not miniature adults, i.e. drug absorption, distribution, metabolism and excretion may differ. Example: Chloramphenicol can cause gray baby syndrome
- ✘ Age is a poor basis for dose estimation. Nonetheless there are several formulas that employ age. The use of these formulas is infrequent.

Young's Rule	$\text{Child's Dose} = \text{Adult Dose} \left[\frac{\text{Age in years}}{\text{Age} + 12} \right]$	Not used for > 12 years
Cowling's Rule	$\text{Child's Dose} = \text{Adult Dose} \left[\frac{\text{Age at next birthday in years}}{24} \right]$	
Fried's Rule	$\text{Child's Dose} = \text{Adult Dose} \left[\frac{\text{Age in months}}{150} \right]$	For infants up to 24 months old
Clark's Rule	$\text{Child's Dose} = \text{Adult Dose} \left[\frac{\text{Weight in pounds}}{150} \right]$	Weight is a better basis for dose estimation

Body Surface Area Method

- The body surface area method may be the best method for children and adults.
- Average adult surface area 1.73 m².

$$\text{Child's Dose} = \text{Adult Dose} \left[\frac{\text{Child's Body Surface Area in } m^2}{1.73 m^2} \right]$$

Body Surface Calculation

- The body surface area method is usually obtained from nomograms to avoid calculation errors. The majority of calculations in this workbook use the nomogram based on the formula of Dubois D. and Dubois DF (Dubois D. and Dubois *DF A formula to estimate the approximate surface area if height and weight be known. Arch Int Med* 1916;17:863-71). This formula, however, it was based on measurements of only 9 individuals, one of whom was a child.
- However, if you do not have a nomogram handy you should use the Mosteller formula (Mosteller RD: Simplified Calculation of Body Surface Area. *N Engl J Med* 1987 Oct 22;317(17):1098), which is relatively easy to remember. Note units in the formula.

$$\text{Body Surface Area in } m^2 = \sqrt{\frac{\text{Height in cm} \times \text{Weight in kg}}{3600}}$$

BODY SURFACE AREA OF CHILDREN

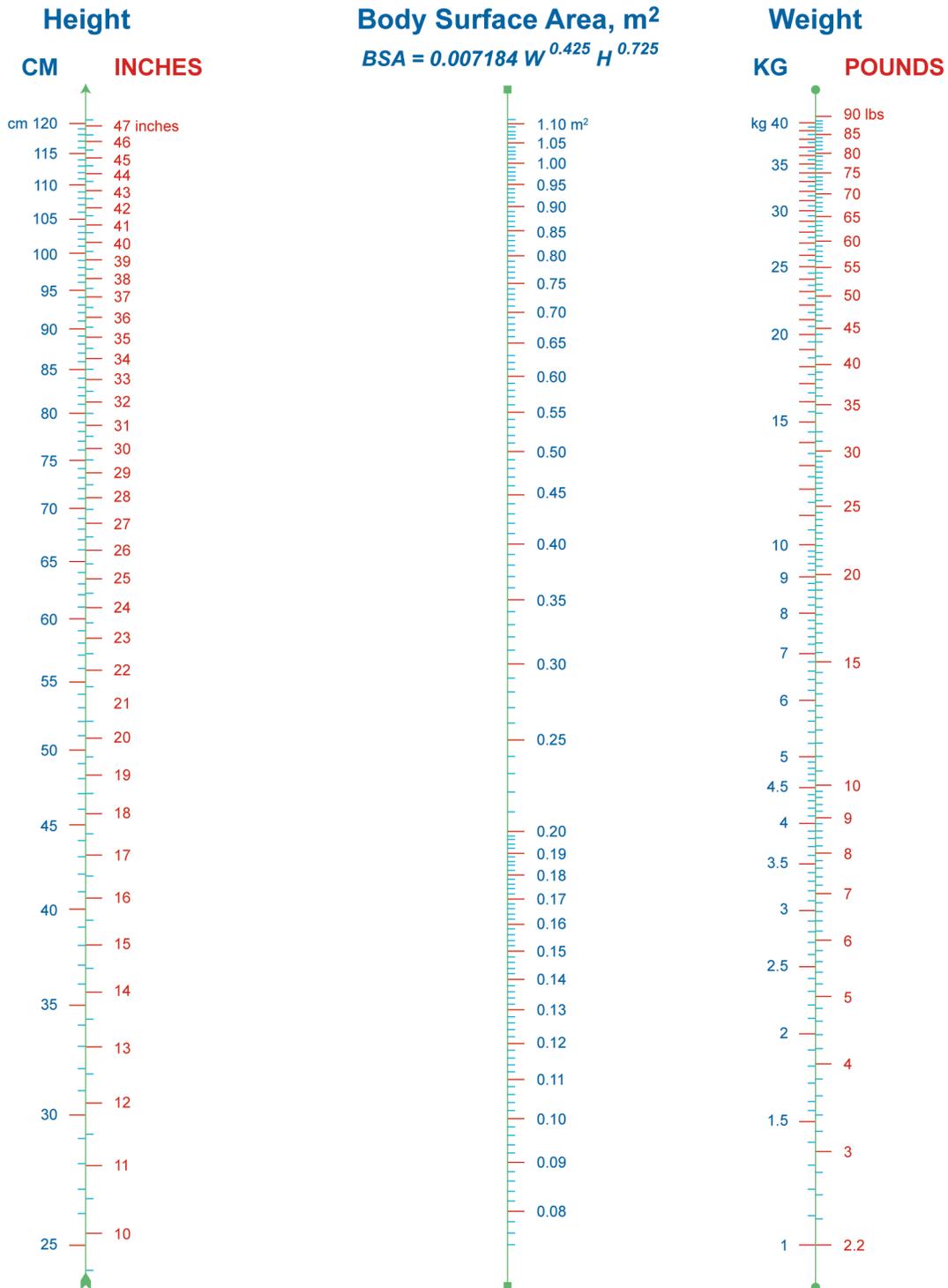


Figure 4.4. Body surface area of children based on the formula *Body Surface Area in m² = 0.007184 (Weight in kg)^{0.425} (Height in cm)^{0.725}*, from Dubois D. and Dubois DF, *Arch Int Med* 1916;17:863-71. Draw a straight line joining the height and weight scales and read off the body surface area.

BODY SURFACE AREA OF ADULTS

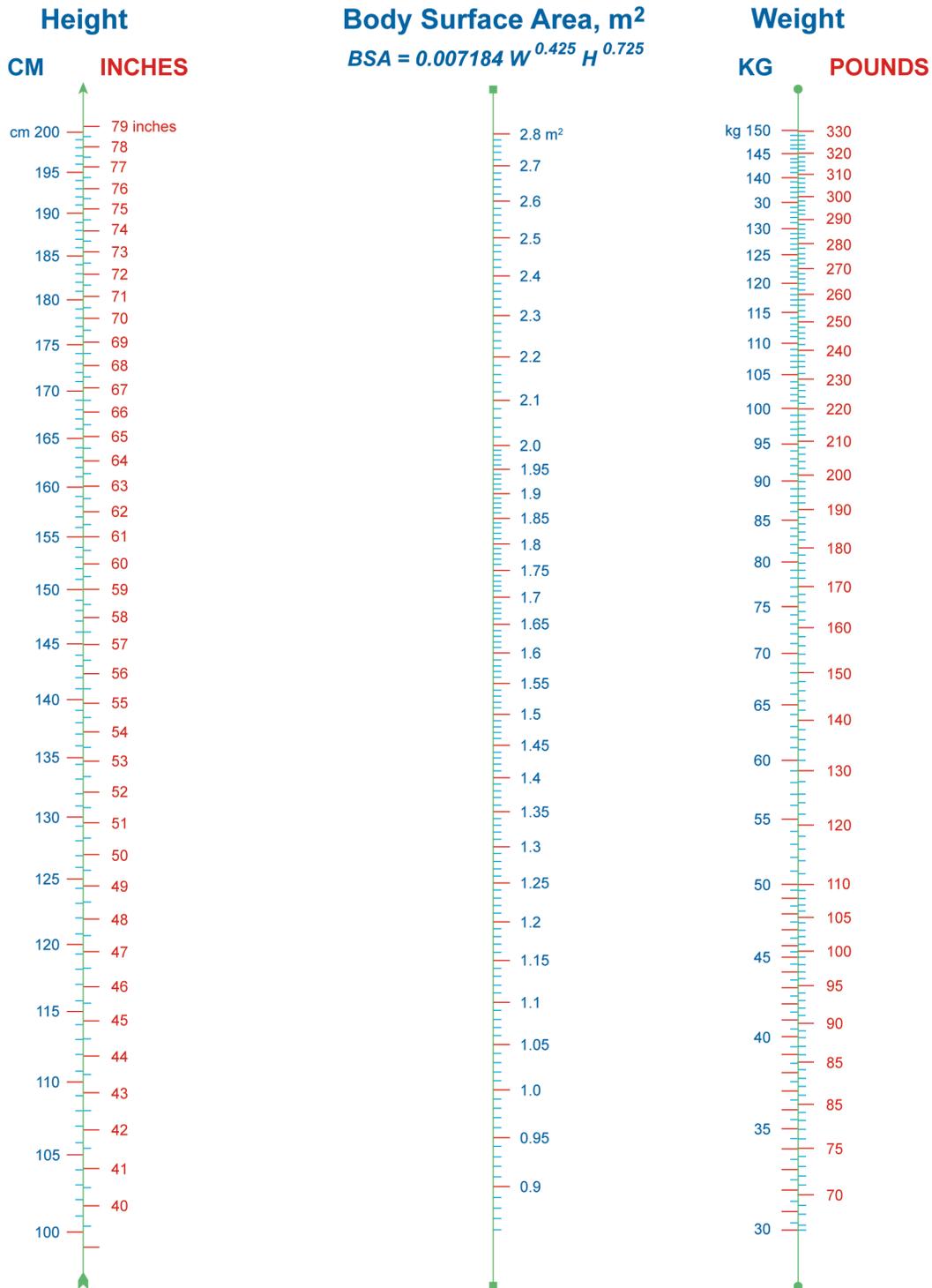


Figure 4.4. Body surface area of adults based on the formula $Body\ Surface\ Area\ in\ m^2 = 0.007184 (Weight\ in\ kg)^{0.425} (Height\ in\ cm)^{0.725}$, from Dubois D. and Dubois DF, *Arch Int Med* 1916;17:863-71. Draw a straight line joining the height and weight scales and read off the body surface area.

Rule Of Nine

- Devised by EJ Pulaski and CW Dennis and estimates the percentage of total body surface area in the various parts of the body.
- The picture below is self-explanatory. The rule derives from the fact that the areas for each region of the body are multiples of nine. The head is 9% (4.5% in front and 4.5% back), the front of the body and the back are each 18%, each arm is 9% (4.5% in front and 4.5% back), each leg is 18% (9% in front and 9% back).

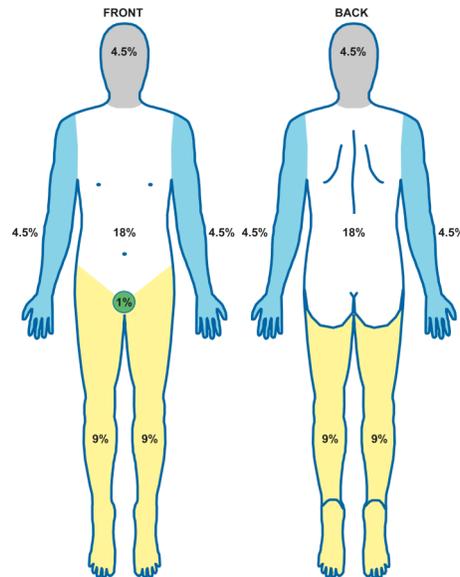


Figure 4.4. Illustration of the rule of nine.

- Rule of nines is a widely accepted method for estimating percentage of body surface burned. For example, an adult with one arm (9%), back (18%) and one half of a leg burned (9%) would have a 36% burn.

Adherence or Compliance

- Medication non-compliance is the failure to adhere to a prescribed dosing regimen. Adherence is also used to refer to compliance.
- Non-adherence can involve:
 1. Omission and addition of doses
 2. Deviations in dosage timing
 3. Failure to adhere to instructions such food, water etc.
- Non-adherence is a significant public health problem: It is estimated to cause 5.5% of all hospitalizations (estimated 2.2 million hospitalizations), cost more than \$100 billion per year in hospital costs, lost wages and productivity.

- Non-adherence may involve patterns such as:
 1. Occasional missed doses
 2. Drug holidays (drugs not taken for 3 days or more).
 3. Overdosing
 4. Premature discontinuation and drop out
 5. Toothbrush pattern (Resuming drug shortly before visit to caregiver)
 6. Not filling prescriptions
- The reasons for non-compliance may vary from patient to patient. They may involve:
 1. Adverse effects
 2. Cost
 3. Lack of confidence in caregiver
 4. Forgetfulness or lack of motivation

PROBLEMS

Problem 1

Phone 555-3784	DEA# AC0365420
<p>Lois Clark 101 Kryptonite St. Gotham City, CA 90210</p>	
Name <u>Betty Barney</u>	Age <u>47</u>
Address <u>Cave St, Bedrock, CA 90210</u>	Date <u>1/10/95</u>
<p>Rx Phenobarbital 600 mg Lactose qs M ft SA div caps #40 Sig: 2 caps tid Refill</p>	
<p><u>L.Clark M.D.</u></p> <p>THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> <p>Dispense as written</p>	

a. How much is phenobarbital is in a single dose?

b. How much is the daily dose of phenobarbital?

Problem 2

Phone 110-220-4400		DEA# BU -12736280																		
Dr. Ursa Major, M.D. 3 Galaxy Ave Andromeda, NM																				
Name	<u>Virgo Stellar</u>	Age	<u>32</u>	Height	<u>5 ft 8 in</u>															
Address	<u>87 Milky Way, Andromeda</u>	Date	<u>1/10/05</u>	Weight	<u>90 kg</u>															
<table style="width: 100%; border: none;"> <tr> <td style="width: 10%; vertical-align: middle;">R</td> <td style="padding: 5px;">Hydrocortisone</td> <td style="padding: 5px;">0.6 g</td> </tr> <tr> <td></td> <td style="padding: 5px;">Sodium salicylate</td> <td style="padding: 5px;">30 g</td> </tr> <tr> <td></td> <td colspan="2" style="padding: 5px;">Div in caps #60</td> </tr> <tr> <td></td> <td colspan="2" style="padding: 5px;">Sig: 1 cap q8h</td> </tr> <tr> <td colspan="3" style="text-align: right; padding: 10px;"><u>Ursa Major, MD</u></td> </tr> </table>						R	Hydrocortisone	0.6 g		Sodium salicylate	30 g		Div in caps #60			Sig: 1 cap q8h		<u>Ursa Major, MD</u>		
R	Hydrocortisone	0.6 g																		
	Sodium salicylate	30 g																		
	Div in caps #60																			
	Sig: 1 cap q8h																			
<u>Ursa Major, MD</u>																				

a. Interpret this prescription.

b. How many doses are there?

c. What is the daily dose of hydrocortisone?

d. What is the daily dose of sodium salicylate?

Problem 3

Richard Hariz, M.D. 250 Main St. Exam City, N.Y. (518) 555-6640		License #13467
Name	James Basil	Age 70
Address	735 Acorn St., Exam City, N.Y. 13456	Date 6/9/93
Rx 3		
Tetracycline 150 mg/5 ml Cherry Syrup total 120 ml Sig: 300 mg qid		
Refill:	Richard Hariz, M.D.	
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS PRESCRIBER WRITES "g & w" IN THE BOX BELOW.		
<input type="checkbox"/>		
Dispense as written		

a. What instructions would you give the patient?

b. What is the single dose of tetracycline?

c. How many doses are dispensed?

d. How many days will the preparation last if used as prescribed?

Problem 4

DEA# AP3276587		Lic# 21495	
P.D. ATRICIAN, M.D. 15 KIDDY WAY EXAM CITY NY (518) 474-3000			
Name	ELSIE T. BOVINE	Age	3/17/95
Address	1 Nursery Place, Exam City, NY	Date	6/7/95
		Wt.	14 lbs
Rx 2			
Levothyroxine			
5 mcg / Kg po daily			
M. It caps #12			
Sig: Contents of 1 capsule			
in formula daily in			
the AM			
Refill:	P.D. Atrician M.D.		
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS PRESCRIBER WRITES "d.u." IN THE BOX BELOW.			
<input type="checkbox"/>			
Dispense as Written			

a. What is the route of administration?

b. What instructions would you give the patient?

c. What is the single dose of levothyroxine?

Problem 5

The image shows a product label for Lactulose Syrup USP. The label is divided into two main sections. The left section contains the product name 'Lactulose Syrup USP' in large, bold letters, followed by the concentration '10 g/15 mL' and a horizontal line. Below this, it states 'FOR ORAL OR RECTAL ADMINISTRATION' and provides storage instructions: 'Store between 2°- 30°C (36°- 86°F). Do not freeze. Keep tightly closed. Dispense in a tight, light-resistant container as defined in the USP, with child-resistant closure. When ordering this product, include the NDC number in the description. Distributed by Schiapparelli Searle Chicago IL 60680 Mfd. by Inalco S.p.A. 20139 Milano, Italy Packaged by Barre-National Inc. Baltimore MD 21207'. The right section also features the product name 'Lactulose Syrup USP' and concentration '10 g/15 mL' with a horizontal line. Above this, it lists '16 Fl Oz' and 'NDC 0905-3036-16 • NSN 6505-01-132-4609'. Below the product name, it says 'FOR ORAL OR RECTAL ADMINISTRATION'. A white box contains the text: 'Indications and Dosage: For the prevention and treatment of portal-systemic encephalopathy. See insert labeling for full information.' At the bottom right, it states: 'Each 15 mL of syrup contains: 10 g lactulose (and less than 1.6 g galactose, less than 1.2 g lactose, and 0.1 g or less of fructose). Some patients have found that lactulose syrup may be more acceptable when mixed with fruit juice, water or milk.'

a. What is the dose of lactulose in a tablespoonful?

b. What is the dose of lactulose in a teaspoonful?

c. How many tablespoonful are in the package?

d. What is volume of syrup in the package in milliliters?

Problem 6

Phone 246-135-7890	DEA# BO -12736280	
<p>Dr. Sienna Odyssey, M.D. 3 Caravan Ave Sedona, AZ</p>		
Name <u>Previa Windstar</u>	Age <u>45 yr</u>	Height <u>5 ft 8 in</u>
Address <u>87 Lumina Lane, Sedona</u>	Date <u>8/18/97</u>	Weight <u>90 kg</u>
<p>R Aluminium hydroxide suspension 600 mg/5 ml Sig: 30 ml qid for hyperphosphatemia for 2 weeks <div style="text-align: right;"><u>S Odyssey, MD</u></div></p>		

a. What instructions would you give the patient?

b. How much drug is in a single dose?

c. What is the route of administration?

d. What is the dosage form?

e. Determine the **daily** dose in **mg/kg**.

Problem 7

Phone 246-135-7890		DEA# AR -12736280			
Dr. Ira Roth, M.D. 401K Exempt Ave Taxhaven, CA					
Name	<u>Penny Bond</u>	Age	<u>45 yr</u>	Height	<u>5 ft 8 in</u>
Address	<u>87 Hedge Lane, Stockton, CA</u>	Date	<u>8/18/92</u>	Weight	<u>90 kg</u>
R Phenytoin sodium gr iss Phenobarbital gr ¼ Dtd caps #100 Sig: 1 cap qid					
<u>Ira Roth, MD</u>					

DILANTIN DOSAGE FORMS

N 0071-0362 (Kapseal362, transparent #3 capsule with an orange band) – Dilantin 100 mg; in 100's, 1,000's, and unit dose 100's and in a Memo Pack containing 84 unit dose capsules (28 days dosage regimen).

N 0071-0365 (Kapseal 365, transparent #4 capsule with a pink band) – Dilantin 30 mg; in 100's, 1,000's and unit dose 100's.

N 0071-2214 – Dilantin-125[®] Suspension 125 mg phenytoin/5 ml with a maximum alcohol content not greater than 0.6 -percent, available in 8-oz bottles and individual unit dose foil pouches which deliver 5 ml (125 mg phenytoin). The minimum sales unit is 100 pouches.

N 0071-2315 – Dilantin-30[®] Pediatric Suspension 30, mg phenytoin/5 ml with a maximum alcohol content not greater than 0.6 percent; available in 8-oz bottles and individual unit dose foil pouches which deliver 5 ml (30 mg phenytoin). The minimum sales unit is 100 pouches.

N 0071-0375 (Kapseal 375) – Dilantin with Phenobarbital each contain 100 mg phenytoin sodium with 16 mg (1/4 gr) phenobarbital; in 100's and 1,000's.

N 0071-0531 (Kapseal 531) – Dilantin With Phenobarbital each contain 100 mg phenytoin sodium with 32 mg (1/2 gr) phenobarbital; in 100's, 1,000's and unit dose 100's.

N 0071-0007 (Tablet 7) – Dilantin Infatabs[®] each contain 50 mg phenytoin, 100's and unit dose 100's.

For Parenteral Use:

N 0071-4488-05 (Ampoule 1488) – Dilantin ready-mixed solution containing 50 mg/ml phenytoin sodium in 2-ml ampoules. Packages of ten.

N 0071-4488-41 (Steri-Dose[®] 4488) – Dilantin ready-mixed solution containing 50 mg/ml phenytoin sodium in a 2-ml sterile disposable syringe (22 gauge × 1 1/4 inch needle). Packages of ten individually cartoned syringes.

N 0071-4475-35 (Ampoule 1475) – Dilantin ready-mixed solution containing 50 mg/ml phenytoin sodium in 5-ml ampoules with one 6-ml sterile disposable syringe (22 gauge × 1 1/4 inch needle). Packages of ten.

N 0071-4475-08 (Ampoule. 1475) – Dilantin ready-mixed solution containing 50 mg/ml phenytoin sodium in packages of ten 5-ml ampoules without syringes.

N 0071-4488-45 Dilantin ready-mixed solution containing 50 mg/ml phenytoin sodium in 2-mL SteriVials[®]. Packages of twenty-five.

N 0071-4475-45 Dilantin ready-mixed solution containing 50 mg phenytoin sodium per milliliter 5-mL Steri-Vials[®]. Packages of twenty-five.

Problem (continued)

a. DILANTIN® is commercially available phenytoin sodium. Some of the dosage forms available from Parke-Davis at the time prescription was written are listed in the table ‘**DILANTIN DOSAGE FORMS**’ (adapted from *Physicians’ Desk Reference*, 46th Edition, 1992). Select the dosage form that would be best suited for this prescription. Indicate the supplier’s reference number, e.g., "N 0071-####..." in the space provided, i.e., complete the sentence: In my opinion, the appropriate commercially available product is N 0071-

b. What instructions would you give the patient?

c. How long will the medication last?

d. In the remaining questions, assume that a commercial product has been dispensed. How much phenytoin sodium does the patient receive per day?

e. How much phenobarbital does the patient receive per day?

Problem 8

Phone 246-135-7890	DEA# AR -12736280	
<p>Dr. Landrace Saddleback, M.D. 22 Red Wattle Ave Trotter, IA</p>		
Name <u>Sandy Oxford</u>	Age <u>45 yr</u>	Height <u>5 ft 8 in</u>
Address <u>87 Pietrain Lane, Trotter, CA</u>	Date <u>8/18/97</u>	Weight <u>90 kg</u>
<p>R Hydrocortisone 0.5 Sodium salicylate 24.5 Div caps #L Sig: 1 cap q8h</p> <p style="text-align: right;"><u>Landrace Saddleback, MD</u></p> <p style="font-size: small; text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; margin: 10px 0;"> <div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> <p>Dispense as written</p> </div>		

a. How many capsules should be dispensed?

b. What dose of sodium salicylate will the patient receive each day?

c. Official formulas in the United State Pharmacopoeia (USP) are written in terms of 1000 grams of product for solids and 1000 ml of product for liquids. Rewrite the formula in the manner it would be presented in the USP? Indicate the units.

Problem 9

Phone 555-3784	DEA# AM0365420
<p>Surabi Mufasa 101 King St. Anaheim, CA 14003</p>	
Name <u>Timon Poomba</u>	Age <u>47</u>
Address <u>Mane St, Pride Rock, CA 90210</u>	Date <u>1/10/95</u>
<p>R_x Cefprozil Suspension (Cefzil®) 125 mg/5 ml Sig: 5 ml bid 10 days Refill</p> <p style="text-align: center;"><u>SMufasa M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>	

a. What instruction would you give the patient?

b. What is the daily dose of cefprozil?

c. How much cefprozil suspension would you dispense?

Problem 10

Phone 555-3784	DEA# BR0365420
T. Rex 101 Asteroid St. Jurassic Park, CA 90210	
Name <u>Maya Soros</u>	Age <u>47</u>
Address <u>Triassic St, Cambria, CA 90210</u>	Date <u>1/10/95</u>
<p>R_x Sucralfate Suspension (Carafate[®]) qs</p> <p>Sig: ii tsp qid ac and hs for 4 weeks</p> <p>Refill</p> <p style="text-align: center;"><u>T. Rex M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>	

a. What instruction would you give the patient?

b. How much suspension should you dispense?

Problem 11

Phone 716-555-1234		DEA# AT -12736280			
Dr. Gateau De Frommage, M.D.					
Name	Bebida De Mangue	Age	9 yr	Height	
Address	8 Poppyside, Brandon	Date	8/18/02	Weight	44.1 lb
<p>Rx Diazepam syrup qs 250 mcg/kg body weight. Dispense 30 day supply Sig: Take i 3 three times a day</p> <p style="text-align: right;"><u>G. DeFrommage, MD</u></p>					

a. What is the patient's body weight in kilograms?

b. What is a single dose of diazepam?

c. What is the volume of a single dose?

d. How much diazepam syrup is dispensed?

e. What is the dosage form? What is the route of administration?

f. What instructions would you give the patient?

Problem 12

Phone 716-555-1234		DEA# BS -12736280			
Dr. Orion Scorpius, M.D.					
Name	Aries Coalsack	Age	52 yr	Height	
Address	8 Monoceros St, Dipper, DE	Date	8/18/02	Weight	100 kg
<p>Rx Prochlorperazine 250 mg Cocoa Butter 1.5 g msa div #10 Sig: ii R q12h prn N/V</p> <p style="text-align: right;"><u>O. Scorpius, MD</u></p>					

a. What is the dosage form? What is the route of administration?

b. How much **cocoa butter** does each unit of this preparation contain?

c. How much **prochlorperazine** does each unit of this preparation contain?

d. How much **prochlorperazine** is present in a single dose?

Problem 13

Phone 555-3784			
Cook County General Hospital 1900 Polk St. Chicago, IL 60612			
Name	<u>Elaine Kramer</u>	Age	<u>67</u>
Weight	<u>70 kg</u>	Date	<u>9/6/96</u>
Address	<u>George St, Queens, NY 12205</u>	Height	<u>150 cm</u>
R_x Infuse 2500 ml of D5W in 24 hours.			
<u>Peter Benton</u> M.D.			

- a. Interpret the prescription. Be sure to expand the abbreviation and specify the route of administration.

- b. What is the dose of dextrose over 24 hours?

Problem 14

Prescription A

Phone 246-135-7890	Dr. Palmera La Mancha, M.D.	DEA# AR -12736280			
22 Kinder Blvd San Clemente, NY					
Name	<u>Pashmina Rove</u>	Age	<u>45 yr</u>	Height	<u>5 ft 8 in</u>
Address	<u>7 Guernsey Ln, Goat Island, NY</u>	Date	<u>8/18/97</u>	Weight	<u>90 kg</u>
<p>R Atropine sulfate 0.0004g Phenobarbital 0.015 g Lactose q.s. a.d. 0.4 g Dtd caps#12 Sig: 1 q6h</p> <p style="text-align: right;"><u>Palmera LaMancha, MD</u></p>					

Prescription B

Phone 246-135-7890	Dr. Catalana Cornish, M.D.	DEA# AR -12736280			
22 Delaware Ave Sussex, NY					
Name	<u>Holland Leghorn</u>	Age	<u>25 yr</u>	Height	<u>5 ft 3 in</u>
Address	<u>87 Wyandotte Lane, Sussex, NY</u>	Date	<u>8/18/97</u>	Weight	<u>45 kg</u>
<p>R Atropine sulfate 0.0064g Phenobarbital 0.24 g Lactose q.s. sa Div caps#16 Sig: 1 tid</p> <p style="text-align: right;"><u>Catalana Cornish, MD</u></p>					

- a. You have compounded the Prescription A and have excess capsules prepared. Soon afterward, you are asked to attend to Prescription A. Could you dispense the previously compounded capsules from Prescription A for the patient Prescription B, all other considerations allowing? Justify your answer with calculations.

Problem 15

Phone 555-3784			
Roswell Park Cancer Institute			
101 High St.			
Buffalo, NY 14210			
Name	<u>Tweety Bird</u>	Age	<u>67</u>
		Weight	<u>70 kg</u>
Address	<u>Warner St, Sylvester, NY 12205</u>	Date	<u>9/6/96</u>
		Height	<u>150 cm</u>
R_x Cytarbine continuous IV at 200 mg/(m ² day) for 5 days.			
<u>SpeedyGonzales M.D.</u>			

a. Determine the body surface area of the patient.

b. Determine the daily dose of cytarbine.

Problem 16

Phone 716-555-1234	Dr. Violet Green 33 Tint Street White Plains, NY 14002	DEA# AR -12736280
Name <u>Rose Gray</u>	Age <u>12</u>	
Address <u>123 Shades Rd, Blackpool, NY</u>	Date <u>9/28/97</u>	
<p style="margin-left: 40px;">R Ritalin 1 g Div caps #100 Sig: 2 am, 1hs ADHD</p> <p>Refill: None</p> <p style="text-align: right; margin-right: 40px;"><u>V.Green M.D.</u></p>		

a. Interpret this prescription.

b. Calculate the **largest single** dose of Ritalin?

c. Calculate the daily dose of Ritalin

d. How long will the medication last?

Problem 17

Dr. Lily Flowers 33 Bloomberg Street Bouquet, NY 14002					
Name	Daisy Blossom	Age	32	Weight	200 lbs
Address	123 Posy Rd, Flora, NY	Date	9/8/97	Height	5' 2"
R_x	Ticarcillin 75 mg / (kg day)				
	m ft 200 mg/ml sol with D5W				
	Sig: Inj. iv q8h				
Refill:					
<u>Lflowers M.D.</u>					
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW					
<div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div>					
Dispense as written					

a. Interpret the term D5W.

b. How many kg are there in an avoirdupois pound?

c. How much is a single dose of ticarcillin?

d. What is daily dose of ticarcillin?

Problem 18

Phone 716-555-1234	DEA# BF -12736280	
<p>D. Fayad Kensington Avenue Buffalo, NY 14226</p>		
Name <u>Chuck Windsor</u>	Age <u>50</u>	Height <u>5 ft 8 in</u>
Address <u>124 Bowles Ave, New York,</u>	Date <u>8/18/07</u>	Weight <u>100 kg</u>
<p>R_x NTG 1/200 gr #100 Sig: 1 tab sl angina.</p> <p style="text-align: center;"><u>D. Fayad</u> <u>M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; margin: 10px 0;"> <div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> <p>Dispense as written</p> </div>		

a. How many mg are there to a grain?

b. How much is a single dose of nitroglycerin in mg?

c. Sublingual nitroglycerin is commercially available as 0.15 mg, 0.3 mg, 0.4 mg, and 0.6 mg tablets. Assuming you are going to dispense the most appropriate commercial product, which one would you select?

Problem 19

Phone 216-666-6969	DEA# BJ -12736280
Dr. Kira St John-Wort 33 Herb Street Creatine, NY 14002	
Name <u>Ephedra Ginseng</u>	Age <u>63</u>
Address <u>13 White Willow Rd, Creatine, NY</u>	Date <u>9/28/97</u>
<p style="text-align: center;">R_x Cimetidine hydrochloride oral 300 mg/ 5 ml solution</p> <p>Disp. 2 weeks supply Sig: 900 mg po hs Refill: None</p> <p style="text-align: center;"><u>Kira Wort</u> <u>M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>	

a. What is the volume of a single dose?

b. What instructions would you give the patient?

c. How much product should be dispensed?

d. How much cimetidine hydrochloride is needed to compound the product?

Problem 20

Phone 716-555-1234	Dr. Camilla Bowles-Windsor	DEA# BB -12736280
33 Buckingham Street		
Sing Sing, NY 14002		
Name	Diana Dodee	Age 35
Address	12 Kensington Rd, Queens, NY	Date 9/8/97
		Weight 220.5 lbs
		Height 5' 7"

R_x Erythromycin 30 mg/kg daily

Disp 4 week supply for Lyme disease.
 Give equal doses qid ac and hs

Refill:

CBW M.D.

a. What is the route of administration?

b. Determine the patient's body surface area.

c. What is the daily dose of erythromycin

d. Erythromycin is available in your pharmacy as 250 mg film coated tablets. What instructions would you give the patient?

e. How many 250 mg film-coated tablets would you dispense?

Problem 21

Phone 716-555-1234	DEA# AT -12736280	
<p>Dr. Allen Key, M.D. 3 Starhead Ave Screwdriver, NC</p>		
Name Philip Hex	Age 25 yr	Height 5'9"
Address 87 Flat St, Screwdriver, NC	Date 8/18/97	Weight 50 kg
<p>\mathcal{R} Crush forty 2mg chlorambucil tablets and resuspend in syrup containing 1% methylcellulose to a final volume of 40 ml. Sig: 0.2 mg/kg/day qd</p> <p style="text-align: right;"><u>Allen Key, MD</u></p>		

- a. What is the daily dose of chlorambucil?

- b. What is the concentration of the drug in the suspension in mg of drug per ml of final suspension?

- c. What is the route of administration?

- d. What instructions would you give the patient?

- e. What is the patient's body surface area?

- f. Express the dose of chlorambucil in mg/m².

Problem 22

Phone 555-3784		DEA# BC0365420	
Cameron Caiman El Gato, TX 90210			
Name	Marmota Loro	Age	23
		Wt	200 lb
Address	Perro Street, El Gato	Date	1/10/95
		Height	5 ft 10 in
	Rx Aspirin Div caps #200 Sig: i c tid		1000 grains
Refill		<u>Cameron Caiman M.D.</u>	

a. Express the single dose of aspirin in milligrams.

b. Express the patient's weight in kilograms.

c. Express the patient's height in centimeters.

d. Use the nomogram to determine the patient's body surface area.

f. Write the Mosteller formula for body surface area. Be sure to indicate units of all variables. No calculations, just provide formula.

Problem 23

Phone 716-555-1234		DEA# AC -12736280	
Dr. Cardia Tamponade, M.D.			
Name	Angina Pectoris	Age	12 yr
Address	8 Ischemia St, Asystole	Date	8/18/02
		Height	
		Weight	35 kg
<p>Rx Nitroglycerin 1/500 gr #60 ii tab sl prn chest pain</p> <p style="text-align: right;"><u>C. Tamponade, MD</u></p>			

a. What is the dosage form?

b. What is the route of administration?

c. How much nitroglycerin in **milligrams** does each unit of this preparation contain?

d. How much nitroglycerin in **micrograms** does each unit of this preparation contain?

e. What is the dose of nitroglycerin?

Problem 24

Phone 716-555-1234		DEA# AT -12736280			
Dr. Rubella Scabies, M.D.					
Name	Varicella Zoster	Age	24 yr	Height	
Address	8 Rosacea Street, Lyme	Date	8/18/02	Weight	100 kg
Rx Morphine sulfate solution		2 mg/ml			
Sig: Take ii \mathfrak{z} q4h prn pain		<u>R. Scabies, MD</u>			

a. What instructions would you give the patients?

b. What is the route of administration?

c. Express the amount of a single dose of the drug in milligrams?

d. Express the amount of a single dose of the drug in grains?

e. Express the dose of morphine sulfate in **micrograms/kilogram**.

Problem 25

Phone 716-555-1234		DEA# AT -12736280			
Dr. Abierto Cerreo, M.D.					
Name	Sayonara Ciao	Age	14 yr	Height	
Address	8 Adieu Street, Farewell	Date	8/18/02	Weight	100 lb
<p>Rx Codeine sulfate gr vi Ammonium chloride ℥ iii Cherry syrup Water aa qs ad f℥ viii Sig: Take i ℥ syrup three times a day prn cough</p> <p style="text-align: right;"><u>A. Cerreo, MD</u></p>					

- a. What instructions would you give the patient?

- b. How much syrup is administered in a single dose? How much preparation (a cough syrup) is dispensed? Answer in the **metric system**.

- c. How many **grains** of **ammonium chloride** are needed for compounding this prescription?

- d. How many **grams** of **codeine sulfate** are needed for compounding this prescription?

- e. Assume that codeine sulfate and ammonium chloride dissolve and do not contribute volume to the final preparation and that the volumes of cherry syrup and water are additive on mixing (i.e., no shrinkage or expansion occurs). What is the volume of cherry syrup required for compounding this prescription in **fluid ounces**.

Problem 26

Phone 444-555-6666	DEA# AT -12736280	
<p>Elmo Ticklemee Poppyseed Avenue Point Arthur, NY 14226</p>		
Name <u>Barney Purple</u>	Age <u>50</u>	Height <u>5 ft 8 in</u>
Address <u>124 Sesame St, Pt. Arthur,</u>	Date <u>8/18/07</u>	Weight <u>100 kg</u>
<p>Rx Tetrahydrozoline 0.5 mg/ml Preservatives qs Borate buffer qs M ft istic solution with sodium choride ii gtt ou qid for 4 days conjunctivitis</p> <p style="text-align: right;"><u>E. Ticklemee M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>		

- a. How many mg are there in a standard drop?

- b. Assuming that 1 ml of water weighs 1 gram, what is the volume of a drop in ml?

- c. How many ml are there to a fluid ounce?

- d. This is a formula for something like Visine™. Assuming the flow properties of the solution are similar to water, how much tetrahydrozoline is in a single dose?

Problem 27

Phone 101-202-2020	Dr. Clair Voyant 66 Omen Street Salem, MA 14002	DEA# BV -12736280
Name Crystal Ball	Age _____	Height 160 cm
Address 15 Prescient Ave, Salem	Date 8/18/97	Weight 110 lbs
<p>R Phenylephrine hydrochloride 0.12 g/100 ml m ft isotonic solution ii gtt ou q4h prn</p> <p style="text-align: center;"><u>Clair Voyant M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>		

- a. What instructions would you give the patient?

- b. What is the drug dosage form?

- c. What is the route of administration?

- d. What is the mass of a standard drop? What is the volume of a standard drop of water in cm³?
Assume that the volume of 1 g of water is 1 cm³.

- e. How much is a single dose? Assume that the preparation has properties similar to water.

Problem 28

Phone 716-555-1234		DEA# AT -12736280			
Dr. Otis Media, M.D.					
Name	Iris Cornea	Age	2 yr	Height	
Address	8 Pinna Pl, London	Date	8/18/02	Weight	10 kg
<p>Rx Chloramphenicol 5 mg/ml M ft sa sol 9 ml Sig: 3 gtt au tid</p> <p style="text-align: right;"><u>Otis Media, MD</u></p>					

a. What is the dosage form?

b. What is the route of administration?

c. What instructions would you give the patient?

d. What is the dose of chloramphenicol administered?

e. How much solution is administered for each dose?

Problem 29

Phone 256-128-1024		Dr. Tilde Colon, M.D.		DEA# BC -12736280	
		Hyphen Ave, Ellipsis, CA			
Name	Câret Umlaüt	Age	25 yo	Weight	85 kg
Address	Comma Ave, Breve	Date	8/18/07	Height	160 cm
Rx					
		Cromolyn sodium ophthalmic sol		40 mg/ml	
		Disp: 10 ml			
		Sig: ii gtt ou qid			

a. What is the dosage form?

b. What instructions will you give the patient?

c. How much drug is present in a single gtt?

d. How much is a single dose?

e. How many days will the preparation last if used continuously?

Problem 30

Phone 716-555-1234	DEA# AT -12736280	
<p>Dr. Jimmy Crowbar, M.D. 3 Chisel Ave Pry, NC</p>		
Name <u>Jack Hammer</u>	Age <u>7 yr</u>	Height <u>3'</u>
Address <u>87 Sledge Lane, Mallet, NC</u>	Date <u>8/18/97</u>	Weight <u>69 lb</u>
<p>R Dexamethasone suspension 0.5 mg/ml Disp 4 day supply Sig: Instill ii gtt ou q4h ud</p> <p style="text-align: right;"><u>Jimmy Crowbar, MD</u></p>		

a. Interpret the prescription

b. What is the dosage form?

c. What is the route of administration?

d. How much is drug is present in a single dose?

e. How much preparation should be dispensed?

Problem 31

Phone 716-555-1234	DEA# AT -12736280	
<p>Dr. Otis Media, M.D. 3 Stapes Ave Malleus, NC</p>		
Name Cochlea Pinna	Age 2 yr	Height 2'
Address 87 Incus Lane, Malleus, NY	Date 8/18/97	Weight 69 lb
<p>R Carbamide peroxide solution 65 mg/ml Disp 7 day supply Sig: Instill iv gtt au bid ud</p> <p style="text-align: right;"><u>O. Media, MD</u></p>		

a. Interpret the prescription

b. What is the dosage form?

c. What is the route of administration?

d. How much is drug is present in a single dose?

e. How much preparation should be dispensed?

Problem 32

Phone 716-555-1234		DEA# AT -12736280	
Dr. Gallina Huevo, M.D.			
Name	Cerdo Elconejo	Age	24 yr
Address	8 Lagranja Street, El Pato, TX	Date	8/18/02
		Height	
		Weight	100 kg
Rx		Tetrahydrazoline hydrochloride solution 0.5 mg/ml	
		Disp: qs SA	
		Sig: 4 gtt qid ou for 4 days	

a. What instructions would you give the patient?

b. What is the route of administration? What is the dosage form?

c. How much solution is administered in a single dose?

d. How much solution should be dispensed?

e. Express the amount of a single dose of the drug in milligrams?

f. Express the amount of a single dose of the drug in grains?

Problem 33

Phone 716-555-1234		DEA# AT -12736280			
Dr. Ampulla Auricle, M.D.					
Name	Concha Tragus	Age	12 yr	Height	
Address	8 Pinna St, Stapes City	Date	8/18/02	Weight	35 kg
<p>Rx Benzocaine 14 mg/ml Antipyrine 54 mg/ml Mft solution. Disp 2 day supply with std dropper v gtt au q2h prn pain</p>					

a. What is the route of administration?

b. What instructions would you give the patient?

c. What is the volume of a single drop?

d. How much **benzocaine** is in a single dose?

e. How much **antipyrine** is in a single dose?

f. How much product would you dispense?

Problem 34

Phone 246-135-7890	DEA# AR -12736280				
<p>Dr. Jasmine Alladin, M.D. 22 W. Sultan Blvd Agrabah, OR</p>					
Name	<u>Ariel Flounder</u>	Age	<u>22 yr</u>	Height	<u>160 cm</u>
Address	<u>1 Triton Ave, Sebastian, OR</u>	Date	<u>8/18/97</u>	Weight	<u>50 kg</u>
<p style="text-align: center;"> R NORDETTE-28® Disp 4 packs Sig: 1 cap as directed </p> <p style="text-align: right; margin-top: 10px;"><u>Jazzie Alladin, MD</u></p>					

Each pack of Nordette-28® contains: 21 active orange tablets **each** containing 0.15 mg levonorgestrel and 0.03 mg ethinyl estradiol **and** 7 pink placebo tablets. (A placebo is a preparation with no active ingredients).

The patient is instructed to take one active tablet/day for 21 days followed by 1 placebo tablet/day for the next 7 days.

- a. The dosing regimen for the pill is based on the menstrual cycle, which is 28 days long. Calculate the number of menstrual cycles in a year.

- b. How many **packs** of Nordette-28® are required for **one** year?

- c. Calculate the total dose of levonorgestrel administered over one menstrual cycle?

- d. What is the annual dose of levonorgestrel?

e. What is the annual dose of ethinyl estradiol?

f. What is the weight normalized daily dose of ethinyl estradiol in $\mu\text{g}/\text{kg}$? Carry out the calculations for a day in which the active pill is administered.

g. Using the nomogram, determine the body surface area normalized daily dose of ethinyl estradiol in $\mu\text{g}/\text{m}^2$. Carry out the calculations for a day in which the active pill is administered.

Problem 35

Dr. Matt Glossy, M.D.					
3 Flash Ave					
Digital, NC					
Name	Sepia Black-White	Age	18 yr	Height	5'8
Address	400 Color St, Zoom, NY	Date	8/18/97	Weight	125 lb
<p>R Tri-Levlen[®]28 triphasic contraceptive regimen Disp 1 year supply Sig: I tab qd ut</p>					

Female oral contraceptive regimens contain different synthetic progestins and estradiol taken in a specific sequence over the 28-days of the menstrual cycle. Each Tri-Levlen[®]28 triphasic contraceptive regimen is a kit that contains a total of 28 tablets:

Number & Description	Active ingredients in each tablet
6 brown tablets	0.05 mg levonorgestrel and 0.03 mg of ethinyl estradiol
5 white tablets	0.075 mg levonorgestrel and 0.04 mg of ethinyl estradiol
10 light yellow tablets	0.125 mg levonorgestrel and 0.03 mg of ethinyl estradiol
7 light green tablets	Inert, no active drugs

a. How many days are there in a non-leap year? How many regimens should be dispensed?

b. What is total dose of levonorgestrel over a 28-day menstrual cycle?

c. What is total dose of ethinyl estradiol over a 28-day menstrual cycle?

d. Calculate the average dose of ethinyl estradiol in micrograms/kg/day?

Problem 36

Phone 716-645-2828		Dr. Donna Prima, M.D.		DEA# AP -12736280	
		3 Tenor Ave			
		Aintover, NC			
Name	<u>Alto Baritone</u>	Age	<u>25 yo</u>	Weight	<u>71 kg</u>
Address	<u>Bass Ave, Aintover, NY</u>	Date	<u>12/23/05</u>	Height	<u>130 cm</u>
<p>R_x Trimethoprim 800 mg Sulfamethoxazole 4 grams div m ft sa x caps Sig: i cap bid pc</p>					

This is a combination antibiotic. It contains a fixed ratio of two drugs and its dosage is usually expressed in terms of trimethoprim.

a. How much trimethoprim is present in a single dose?

b. What is the route of administration?

c. What is patient's body surface area?

d. Oral trimethoprim doses should not exceed 150 mg/m² day. Is this regimen safe? **Show work.**

e. Because of the severity of the patient's pneumonia, the physician wishes to treat the patient with the highest allowable trimethoprim dose of 150 mg/m² day. How much **sulfamethoxazole** accompanies a **single** dose of trimethoprim at this level.

Problem 37

Phone 555-3784			
Royal Cancer Infirmary 101 Downing St. Buckingham			
Name	<u>Betty Windsor</u>	Age	<u>39</u>
Weight	<u>50 kg</u>	Date	<u>9/6/96</u>
Address	<u>101 Palace St, London</u>	Height	<u>5 ft 3"</u>
R_x Cyclophosphamide IV at 6000 mg/day for 4 days.			
<u>Rupert Bootstocking M.D.</u>			

a. Determine the body surface area of the patient.

b. Determine the daily dose of cyclophosphamide per m² of body surface.

c. Cyclophosphamide causes heart failure (and possible death) within 15 days if the **total dosage** exceeds 5.2 g/m² of body surface. Is the regimen in the prescription safe? Why?

Problem 38

Phone 716-555-1234	DEA# AT -12736280
<p>Dr. Robert Tussin Theo Phyllin Memorial Cancer Hospital Etoposide, NY 14002</p>	
Name Donna Rubicin	Age _____ Height 160 cm
Address 124 5th Ave, New York, NY	Date 8/18/97 Weight 110 lbs
<p>Rx Carboplatin 360 mg/m² iv in NS q4w m ft 1 mg/ml sol in NS. Infuse over 30 min. <u>RTussin M.D.</u></p> <p>THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> <p>Dispense as written</p>	

a. What is the patient's body surface area?

b. What is the drug dose?

c. Carboplatin is toxic when the cumulative or total dose exceeds 2000 mg/m². After how many doses should carboplatin treatment be stopped?

Problem 39

Phone 716-555-1234		DEA# AT -12736280			
Dr. William Alfayyad, M.D.					
Name	Harry Windsor	Age	13 yr	Height	5 ft 3 in
Address	8 Buckingham, London, ON	Date	8/18/02	Weight	50 kg
<p>Rx Sulfamethoxazole. Initial dose of 1 g/m² followed by 0.5 g/m² bid Dispense 250 mg/5ml suspension. Take for 10 days</p> <p style="text-align: right;"><u>W. Alfayyad, MD</u></p>					

- a. What is the patient's body surface area?

- b. What is the initial dose of sulfamethoxazole? What is the route of administration?

- c. What is the dose of sulfamethoxazole on each of the **subsequent** doses?

- d. How much suspension will the patient take for the **initial** dose? What instructions would you give the patient?

- e. How much suspension would you dispense?

- f. The maximum recommended daily dose of sulfamethoxazole is 75 mg/kg. Is this regimen safe? Show **correct** work to get credit.

Problem 40

Phone 716-555-1234		DEA# BP -12736280			
Dr. Diana Parker, M.D.					
Name	Camilla Charles	Age	7yr	Height	60 cm
Address	8 Buckingham Pl, London, ON	Date	8/18/02	Weight	20 kg
<p>Rx Dactinomycin 500 mcg/m²/day Inj iv qd 5d</p> <p style="text-align: right;"><u>Diana Parker, MD</u></p>					

a. What is the patient's body surface area?

b. What is the dose of dactinomycin?

c. Dactinomycin is reconstituted as a 0.5 mg/ml solution. How much of this reconstituted solution should be injected?

d. The dose of dactinomycin should not exceed 15 mcg/kg/day. Is this regimen safe? Show work for credit.

e. Express the single dose of dactinomycin in grains.

Problem 41

Phone 716-555-1234		DEA# BU -12736280			
Dr. Minna Unchi, M.D.					
Name	Margarita Martini	Age	7 yr	Height	1.07 m
Address	8 Tequila Pl, Mojito, TX	Date	8/18/02	Weight	50 lb
<p>Rx Phenytoin daily dose of 250 mg/m² in 2 equally divided doses. M sa 20 mg/ml oral suspension. Dispense 30 day supply Sig: take ud bid</p> <p style="text-align: right;"><u>M Unchi, MD</u></p>					

a. What is the patient's body surface area? Use the nomogram method.

b. How much drug is present in a single dose?

c. What instructions would you give the patient?

d. How much phenytoin suspension should be dispensed in milliliters?

e. Express the **daily dose** in **milligrams/kilograms**.

Problem 42

Phone 246-135-7890	DEA# BO -12736280	
<p>Dr. Blondie d'Aquitaine, M.D. 3 South Devon Ave Hereford, WI</p>		
Name <u>Anatole Black</u>	Age <u>55 yr</u>	Height <u>160 cm</u>
Address <u>87 Randall Lane, Pembroke</u>	Date <u>8/18/97</u>	Weight <u>110 lbs</u>
<p>R <u>Chemotherapy Regimen BACON</u></p> <p>Bleomycin 30 units IV day 1, weekly x6</p> <p>Adriamycin 40 mg/m² IV day 1 q4w</p> <p>CCNU (lomustine) 65 mg/m² po day 1 q8w</p> <p>Vincristine 1 mg iv day 1 q weekly x6</p> <p>Mecholorethamine 8 mg/m² IV day 1 q4w</p> <p style="text-align: center;"><u>B d'Aquitaine, MD</u></p>		

The patient is being treated for non-small cell lung cancer caused by smoking several packs a day of nonfiltered cigarettes. Her oncologist is using the chemotherapy regimen "BACON".

a. Calculate the single dose of adriamycin. What is the route of adriamycin administration?

b. Adriamycin causes serious irreversible myocardial toxicity and congestive heart failure when the cumulative dosage exceeds 550 mg/m². After how many doses should adriamycin treatment be discontinued?

c. Calculate the single dose of CCNU required. What is the route of CCNU administration?

Problem 43

Phone 716-645-2828	Patty Sirloin		DEA# BS -12736280
Flank Cancer Center			
Brisket, NY 14002			
Name	Chuck Bacon	Age	30
Weight		Weight	80 kg
Address	Shank Street, Brisket, NY	Date	9/23/97
Height		Height	5' 11"
<p>Rx Anti-CD20 antibody 750 mg</p> <p>Inject by slow IV infusion in NS qw for 6 weeks</p>			

The following table summarizes the manufacturer’s recommendations on the use of this anti-cancer agent.

Daily dose	Route	Cycle length	Total Dose Cycle
125 - 375 mg/m ²	IV	weekly 4	500 – 1400 mg/m ²

a. Determine the patient’s body surface area?

b. What is the **maximum** allowable **daily** dose for this patient? Is the prescribed daily dose safe?

c. What is the total dose received by the patient in this cycle?

d. What is the **maximum** allowable total dose per cycle? Is the prescribed total dose in the cycle safe?

Problem 44

Phone 716-555-1234		DEA# BT -12736280			
Dr. Brie Takahashi-Samuels, M.D. Seaview Bay, MT					
Name	Mikayla Jackson	Age	16 yr	Height	6 ft 3 in
Address	8 Dollie Road, MT	Date	8/18/02	Weight	100 kg
<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;"> <p>Rx Carbamazepine susp: 100 mg/5 ml Dispense 30 day supply Sig: 100 mg qid</p> </div> <div style="text-align: right; font-weight: bold; font-size: 1.2em;"> <u>B Takahashi, MD</u> </div> </div>					

a. What instructions would you give the patient?

b. What is the dosage form? What is the route of administration?

c. What is the patients weight in pound avoirdupois?

d. Express the single dose of carbamazepine in **mg/lb**? (note units!!)

e. Determine the patient's body surface area using the nomogram method.

Problem 46

Phone 716-555-1234		DEA# BF -12736280	
Dr. Venus Flytrap, M.D.			
Name	Goldie Butterwort	Age	24 yr
Address	Sundew Street, Cobralily, TX	Date	8/18/02
		Height	
		Weight	100 kg
<p>Rx Phenytoin sodium 1.5 grains Phenobarbital 0.5 grains DTD 40 caps Sig: 1 tid</p> <p style="text-align: right;"><u>V. Flytrap, MD</u></p>			

- a. How much phenytoin sodium is present in a single dose. Express your answer in **milligrams**.

- b. How much phenobarbital is present in a single dose? Express your answer in **milligrams**.

- c. What is the route of administration? What is the dosage form?

- d. The optimum **daily** dose of phenytoin sodium varies considerably but is usually in the range 6-7 mg/kg. Calculate the daily dose in mg/kg.

- e. Express the **total amount of phenytoin sodium** required for compounding the all capsules in scruples?

Problem 47

Phone 716-555-1234		DEA# AT -12736280			
Dr. Sharpey Bolton, M.D. Salt Lake City, MS					
Name	Gabiella Evans	Age	24 yrs	Height	5' 10"
Address	8 East High St, SLC	Date	8/18/02	Weight	200 lb
<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <p>Rx Acetaminophen elixir: 325 mg/5 ml Dispense 100 ml Sig: 2 3 q4-6 h prn fever.</p> </div> <div style="width: 35%; text-align: right;"> <p><u>S Bolton, MD</u></p> </div> </div>					

a. What instructions would you give the patient?

b. What is the dosage form? What is the route of administration?

c. What is the patients weight in kilograms?

d. Calculate the single dose of acetaminophen

Problem 48

Phone 555-3784			
Achilles Tendon, MD			
Name	<u>Adam Apple</u>	Age	<u>5</u>
Wt	<u>36 kg</u>	Date	<u>1/10/95</u>
Address	<u>12 Broca's Area, Isle of Langerhans, AZ</u>	Height	<u>100 cm</u>
Rx Cyclosporine		5 mg/kg	
Disp 200 ml solution containing 18 mg/ml cyclosporine			
Sig: take qd po ud			
Refill	<u>A. Tendon M.D.</u>		

a. Write the Mosteller formula for body surface area. Be sure to indicate units of all variables. No calculations, just provide formula.

b. Calculate this patient's body surface area using the Mosteller body surface area **formula**.

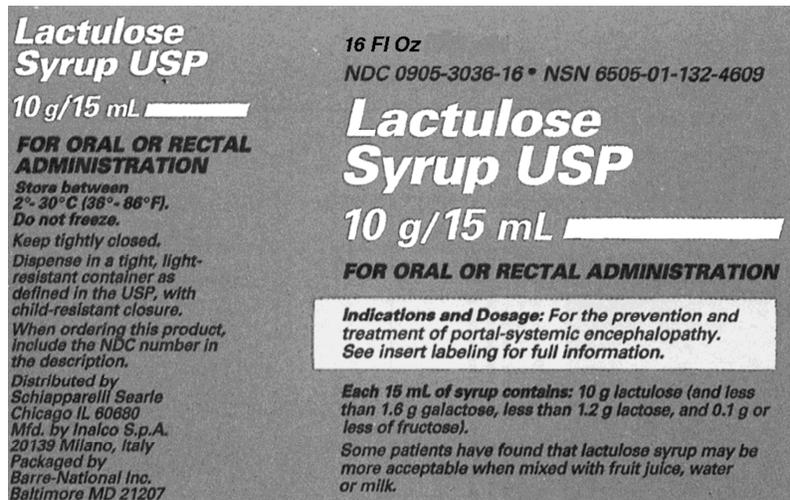
c. What is the body surface area of an **average** human?

d. What is the body weight of an **average** human?

e. What is the cyclosporine dose for this patient?

f. What instructions would you give this patient?

Problem 49



Use the information in the label above to answer the following questions

a. Express the total volume of drug preparation in the container in **milliliters**.

b. What routes of administration can be used for this drug? Are these parenteral routes? You must get both answers correct to get any credit.

c. What is the lactulose dose in grams if the patient is administered 1 tablespoonful of drug preparation.

d. What is the lactulose dose in **grams** if the patient is administered 1 teaspoonful of drug.

e. The patient typically mixes the required volume of lactulose syrup with a glassful of orange juice. What is the volume associated with a glassful in **milliliters**.

Problem 50

Phone 716-555-1234		DEA# AT -12736280			
Dr. Ballena Calamar, M.D.					
Salt Lake City, UT					
Name	Medusa Cangrejo	Age	24 yrs	Height	5' 10"
Address	8 Estrella del Mar, Tiburon	Date	8/18/02	Weight	200 lb
<p>Rx Tobramycin ophthalmic solution: 3 mg/ml Dispense 100 ml Sig: 2 gtt ou q4 h conjunctivitis.</p> <p style="text-align: right;"><u>B Calamar, MD</u></p>					

a. What instructions would you give the patient?

b. What is the dosage form? What is the route of administration?

c. What is the volume of a single drop from a standard dropper? Express your answer in ml.

d. How much solution is needed for a single dose?

e. Calculate the single dose of tobramycin?

Problem 51

Phone 555-3784		Nadia Blonsky, MD	
Name	Elizabeth (Betty) Ross	Age	25
		Wt	78 kg
Address	Marlo Street, Chandler, AZ	Date	1/10/95
		Height	6 feet
Rx		Theophylline 3 mg/kg per day	
		Disp 30 day supply of 26 mg/5 ml solution	
		Sig: Take sol ut po tid	
Refill	<u>Nadia Blonsky M.D.</u>		

a. How much theophylline is present in a single dose.

b. Calculate this patient's height in centimeters.

c. What is the body surface area of the patient?

d. Express the single dose of theophylline in **grains/kg**.

e. Express the single dose of theophylline in **mg/m²**.

f. What instructions would you give this patient?

CHAPTER 5
CONCENTRATION

NOTES

Outline

- Rationale
- Definitions of percent w/w, percent w/v, percent v/v.
- Ratio strength
- Interconverting from percentage to ratio strength
- Calculating amounts of ingredients required
- Calculating dosage for prescriptions with percent and ratio strength
- Problems

Definition

- In general terms, concentration is defined as follows:

$$\text{Concentration} = \frac{\text{Amount of Drug or Ingredient}}{\text{Quantity of Preparation}}$$

- Note that the denominator refers to the **preparation**, not the solvent or diluent.
- In this Workbook, “amount” will be used for the drug or ingredient and the “quantity” will be used for the preparation.
- In the United States Pharmacopoeia, the formulae for drug preparations are written for 1000 g for solid and semi-solid preparations and 1000 ml for liquid preparation. The units for solid and semi-solid ingredients are in grams and those for liquid ingredients are in ml.

Percentage Strength

- In everyday usage, percentage refers to concentration in parts per 100 parts. So a "true percentage" solution would represent, for example, the grams of solute in 100 grams of solution. Such an expression of concentration is **nondimensional**.
- In pharmacy however, several different conventions are used.
- Percent volume in volume (% v/v). The number of ml of ingredient in 100 ml of solution or liquid preparation.
- Percent weight in weight (% w/w). The number of grams of ingredient in 100 g of solution or mixture.
- Percent weight in weight (% w/w) and percent volume in volume (% v/v) are nondimensional.
- Percent weight in volume (% w/v). The number of grams of ingredient in 100 ml of solution or liquid preparation. This is equivalent to the number of grams of product that would be present in **100 grams of the standard, water**.

- Clearly, the need for the standard, water, arises because the percent weight in volume (% w/v) representation has units of weight per 100 units of volume.
- Equivalently, the definition of percent weight in volume (% w/v) can be extended to the apothecary system as the number of grains of ingredient in a volume of preparation that would be occupied by 100 grains of the standard, water.

$$\% \text{ w/v} = \frac{\text{Grains of drug}}{\text{Volume occupied by 100 grains water}}$$

- Recall that the density of water in apothecary units is 456.3 grains per fluid ounce. So, in theory, you can convert the concentration in % w/v to grains per fluid ounce.

$$\text{Concentration in grains/fluid ounce} = \frac{456.3 (\% \text{ w/v})}{100}$$

- The term percent when written without a modifying suffix, should be taken to mean % w/w for mixtures of solids and semi-solids; % w/v for solutions or suspensions of solids in liquids; % v/v for solutions of liquids in liquids.

Milligram Percent

- The number of milligrams of substance per 100 ml of liquid. It is used to report laboratory test results.

Parts Per Million

- Often used for expressing the concentration of contaminants in drugs and of environmental toxins.
- Parts per million (abbreviated ppm) and parts per billion (abbreviated ppb) are generalization of the percentage strength. Recall, percentage strength represents the number of parts of ingredient per 100 parts of preparation. Similarly, ppm represents the number of parts of ingredient in a million (10^6) parts of preparation. Analogously, ppb represents the number of parts of ingredient in a billion (10^9) parts of preparation.

Ratio Strength

- It is another way of expressing concentration. It is also called parts strength.
- The drug concentration is expressed as a ratio. By convention, the ratio strength is the number of parts of preparation that contains one part of the ingredient. e.g., A 1:25 solution of peppermint oil contains 1 ml of peppermint oil in 25 ml of solution.
- In the ratio 1:X, the **X refers to the number of parts of the preparation**. Do not confuse X with the parts diluent or solvent.

Proof Strength

- It is a unit of concentration used **commercially** with ethanol only. While ethanol concentrations in pharmacy are usually expressed as % v/v, you may occasionally see this.
- The official density of alcohol is 0.794 at the official temperature of 15.56°C (60°C).

- Proof strength alcohol is 50% v/v alcohol and is considered 100 proof. All concentrations greater than are above proof and concentrations below 50% v/v are below proof. Absolute alcohol is 100% or twice proof.
- To convert from % v/v strength to proof strength, multiply % strength by 2.
- To convert from proof strength to % v/v strength, divide % proof strength by 2.

BIOLOGICAL POTENCY CALCULATIONS

- Potency or specific activity of antibiotics and "biologicals" such as vitamins, insulin, growth factors, heparin, vaccines and enzymes is expressed in terms of units.
- This is because it is more important to provide information on biological activity, rather than quantity.
- Units of activity are determined by comparing the activity of the preparation to the activity of a reference standard in a standardized biological assay. The standards are maintained/established by the USP, the Food and Drug Administration, and the National Institutes of Health.
- For antibiotics, the activity is frequently defined in terms of " μg ". The reference standard is assigned an activity of 1000 " μg " per milligram. Thus if a derivative or a preparation is more active on a mass basis than the standard, it will have a potency of greater than 1000 " μg " per milligram and if it is less active than the standard, it will have a potency of less than 1000 " μg " per milligram.
- The concentration of insulin preparations is often designated as U-40, U-100 and U-500. These refer to concentrations of 40 units/ml, 100 units/ml and 500 units/ml.
- Most calculations with units and " μg " can be solved by treating these potency expressions as having dimensions of mass.

PROBLEMS

Problem 1

- a. Define percent weight in weight. Make sure you indicate whether the quantities refer to the solute, the solvent or the total preparation?

- b. What kind of pharmaceutical preparations (e.g. solids, liquids, gases) is **the percent weight in volume** concentration system most frequently used?

- c. Define mg%. Be sure to distinguish between the ingredient or solute and the preparation. What is it usually used for?

- d. Define the abbreviation ppb. Be sure to distinguish between the ingredient or solute and the preparation. Be sure to express any large number involved in the definition using scientific notation.

Problem 2

a. What is the proof strength of “absolute” or pure ethanol?

b. What does the abbreviation U-40 mean in a prescription for insulin?

c. A chemical modified penicillin has twice the activity of the standard. Express the potency of the drug in μg per mg.

d. What is the density of water in units of grains/fluidounce? Show how the value is derived from a specific gravity of 1.000. Give your answer to **FOUR significant figures**.

Problem 3

State which unit of percentage or ratio strength unit would most likely be used in the following situations.

a. The concentration of bismuth subsalicylate in Pepto-Bismol®.

b. The concentration of psyllium in Metamucil® powder.

c. The concentration of dextrose in D5W.

d. The concentration of alcohol in Robitussin®.

e. The concentration of alcohol in a shot of Johnnie Walker®.

f. The strength of a dilute potassium permanganate solution.

g. The concentration of mercury in Lake Erie.

h. The serum cholesterol concentration of a 60 year-old male.

i. The concentration of erythropoietin, a red cell growth factor.

j. The concentration of insulin.

Problem 4

Phone 555-1212					
Cupid Heart Research Unit 100 Michigan St Coronary , NY. 14226					
Name	<u>Tomas Szczesny</u>	Age	<u>15</u>	Weight	<u>88.2 lbs</u>
Address	<u>11 Hart, Chktga, NY</u>	Date	<u>11/23/97</u>	Height	<u>135 cm</u>
R_x				Verapamil 0.15 mg/kg as 2.5 mg/ml solution IV stat.	
				_____ M.D.	

a. How much solution should be drawn into the syringe?

b. What is the verapamil concentration in percent strength? Verapamil is a solid.

c. What is the verapamil concentration in mg/deciliter?

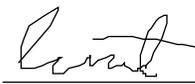
Problem 5

Phone 555-1212		DEA #AR9124366
Ray Robinson 101 Candy St Buffalo , NY. 14226		
Name <u>Diana Bettick</u>	Age <u>35</u>	Weight <u>140 lbs</u>
Address <u>Sweet Home Dr, Amherst</u>	Date <u>10/31/95</u>	Height <u>160 cm</u>
Rx Extended Insulin Human Zinc Suspension U-40 Sig: 16 units sc 60 min before breakfast. _____ M.D.		

a. What is the concentration of insulin in the Insulin Human Zinc suspension?

b. What volume of Insulin Human Zinc suspension should be injected for a single dose?

Problem 6

Phone 555-1212			
Health Sciences Pharmacy Dispensing Research Institute Buffalo, NY. 14226			
Name	<u>Archie Raspberry</u>	Date	<u>10/1/95</u>
Address	<u>15 Neptune, Eden, NY</u>		
Age	<u>23</u>	Height	<u>160 cm</u>
		Weight	<u>60 kg</u>
Rx Menthol 0.8% Alcohol qs ad 120 ml			
<u></u> M.D.			

a. Menthol is a solid. What suffix is implied for the % strength?

b. How much menthol is required?

c. What is the menthol concentration in g/liter?

d. What is the menthol concentration in ppm?

Problem 7

Phone 555-1212	DEA# AS4218334
<p>L. Acidophilus, M.D. Roswell Park Memorial Cancer Institute Buffalo, NY. 14226</p>	
Name <u>Helia Pylori</u>	Date <u>10/1/95</u>
Address <u>1015 Ulser St, W. Seneca, NY</u>	
Age <u>53</u>	Height <u>160 cm</u> Weight <u>120 kg</u>
<p>Rx Atropine sulfate 1.25% Ft isotonic and buffered f 3 ss Sig: ii gtt as directed os</p> <p style="text-align: right;"><i>L. Acidophilus</i> M.D.</p>	

a. Calculate the concentration in grains per fluid ounce?

b. How much atropine sulfate in grains is required?

c. Calculate the atropine sulfate concentration in parts or ratio strength?

Problem 8

Phone 555-1212	
Thuan Nguyen, M.D. 101 Niagara Falls Bld Amherst, NY. 14226	
Name	<u>Selena Raintree</u>
Age	<u>32</u>
Address	<u>15 Oak Rd, Colden, NY</u>
Date	<u>10/1/95</u>
R_x 250 ml Calamine lotion	
Sig: Apply to affected areas locally tid.	
Refill: 1	
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW	
<div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div>	
Dispense as written	

USP FORMULA

Calamine	80 g
Zinc oxide	80 g
Glycerin	20 ml
Bentonite magma	250 ml
Calcium hydroxide	1000 ml
solution to make	

a. How much calamine and zinc oxide are required?

b. How much bentonite magma is required?

Problem 9

Phone 555-1212	
Maria Jimenez, M.D. 101 Niagara Falls Bld Amherst, NY. 14226	
Name <u>Chuck Windsor</u>	Age <u>32</u>
Address <u>15 Buckingham Rd, London, ON</u>	Date <u>10/1/95</u>
Rx Psyllium 82% Senna 18% ft. 250 g powder Sig: Two tsp a.m. a.c. and h.s. c. 8 \cup cool water for BM	

a. How much psyllium and senna are required?

b. What instructions would you give the patient?

c. Express the concentration of the psyllium and senna in the powder in mg/gram

Problem 10

Phone 555-1212	DEA# AS4218334	
Jake Sleepwell, M.D. 102 Tranquil St Amherst, NY. 14226		
Name	<u>Vito Insomniak</u>	Age <u>22</u>
Address	<u>15 Sleepy Hollow Rd, Warsaw, NY</u>	Date <u>10/1/95</u>
Rx Promethazine HCl 1/2 gr/tsp Morphine sulfate 1/4 gr/tsp Caffeine 1 gr/tsp Aromatic elixir q.s. a.d. 120 ml Sig: 1 tsp q 4 hours prn pain		
Refill:	_____ <u>M.D.</u>	
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW		
<div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div>		
Dispense as written		

a. What is the dose of morphine sulfate in mg?

b. What is the maximum daily dose of morphine sulfate in mg?

c. Calculate the amount of caffeine required?

Problem 11

Phone 555-1212	Peter Soriasis, M.D.	DEA# AS2355712
	203 Rash St	
	Buffalo, NY. 14226	
Name <u>Evian Perrier</u>		Age <u>22</u>
Address <u>15 Spring Rd, Artesian, NY</u>		Date <u>10/1/95</u>
R_x		
	Camphor	℥ iiss
	Starch	℥ i
	Zinc oxide q.s. a.d.	℥ ii
	Sig: Sprinkle sos epidermis.	
Refill: 1x		

a. Rewrite the formula in terms of parts?

b. Rewrite the formula the way it would be written if it were in the USP? The USP expresses formulas for solid products to 1000 g of product and liquid products for 1000 ml of product.

c. How much zinc oxide is required?

Problem 12

Phone 555-1212	DEA# AM5962217
Hakim Mfume, M.D.	
100 Niagara Falls Bld	
Amherst, NY. 14226	
Name <u>Eva Adams</u>	Age <u>32</u>
Address <u>15 Apple Rd, Eden, NY</u> Date <u>10/1/95</u>	
<p>Rx Ferrous sulfate syrup</p> <p>Disp: 2 week supply</p> <p>Sig: 400 mg Ferrous sulfate b.i.d.</p>	
Refill:	

USP FORMULA

Ferrous Sulfate	40
Citric acid	2
Peppermint spirit	2
Sucrose	825
Water q.s. a.d.	1000

Using the formula for ferrous sulfate syrup determine the following.

- a. What are the units of ferrous sulfate, citric acid, peppermint spirit, sucrose and water in the formula? All syrup ingredients are solids except for peppermint spirit, which is liquid.

- b. What instructions would you give the patient?

- c. How much syrup would you dispense?

- d. How much ferrous sulfate is needed?

- e. How much peppermint spirit is needed?

Problem 13

Phone 555-1212	Jasmine Aladdin, M.D.		DEA# AS4218334
100 W. Sultan St			
Agrabah , NY. 14226			
Name <u>Ian Genie</u>	Age <u>22</u>	Weight <u>220.5 lbs</u>	
Address <u>15 Battlecreek Rd, Warsaw, NY</u>	Date <u>10/1/95</u>	Height <u>158 cm</u>	
Rx	Doxorubicin hydrochloride 40 mg/m ² IV day 1 and q 4 weeks		
Refill:			

a. Doxorubicin for intravenous injection is available as a red lyophilized powder in 10 mg, 20 mg, 50 mg and 150 mg vials that should be reconstituted in 5 ml, 10 ml, 25 ml and 75 ml respectively, of sodium chloride injection, USP (0.9%). Determine the doxorubicin concentration in these vials after reconstitution.

b. What volume of doxorubicin is required for single dose?

c. What is the concentration of doxorubicin in percent w/v?

Problem 14

Phone 555-1212	DEA# AS4218334
<p>Jeanpaul Jabar, M.D. Roswell Park Memorial Cancer Institute Buffalo, NY. 14226</p>	
Name <u>G. Gotfried</u>	Date <u>10/1/95</u>
Address <u>15 Pluto, Agrabah, NY</u>	
Age <u>3</u>	Height <u>60 cm</u> Weight <u>20 kg</u>
<p>Rx Methotrexate 12 mg for i.t. injection</p> <p style="text-align: right;"><i>Jeanpaul Jabar</i> M.D.</p>	

Methotrexate for injection is available in vials that contain 50 mg drug in 2 ml of preservative free solution.

- a. Calculate the concentration of methotrexate in mg/ml.

- b. Calculate the concentration of methotrexate in percent strength.

- c. Express the methotrexate concentration in ratio strength.

- d. Calculate the methotrexate concentration in mg% strength.

- e. Derive the relationship that converts % strength to mg/ml.

f. Derive the relationship that converts mg/ml to % strength.

g. Derive the relationship that converts ratio strength to mg/ml.

h. Derive the relationship that converts mg/ml to ratio strength.

i. What volume of the drug solution should be injected.

Problem 15

Phone 555-1212	DEA# AS4218334
<p>Robert Roentgen, M.D. 100 W. Femur St Bone View , NY. 14226</p>	
Name <u>Rexx Ray</u>	Date <u>10/1/95</u>
Address <u>15 Battlecreek Rd, Warsaw, NY</u>	
Age <u>22</u>	Height <u>160 cm</u> Weight <u>50 kg</u>
<div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;"> <p>R_x</p> <p>Refill:</p> </div> <div> <p>Barium sulfate 360g Water qs ad. 360 ml</p> </div> </div> <div style="text-align: right; margin-top: 10px;"> <p><u>Robert Roentgen, M.D.</u></p> </div> <p style="text-align: center; font-size: small;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; margin: 10px 0;"> <div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> <p>Dispense as written</p> </div>	

Barium sulfate is an **insoluble** powder that is used by radiologists to image the gastrointestinal tract because it is opaque to x-rays.

a. If 1 ml of barium sulfate weighs 2.40 g, calculate the volume occupied by the barium sulfate.

b. What is the **volume** of water is required?

c. What is the total volume of the suspension?

d. How many **grams** of water are required?

e. What is the total weight of the suspension?

f. What is the barium sulfate % w/w?

g. What is the barium sulfate % v/v?

h. What is the barium sulfate % v/w?

i. What is the barium sulfate % w/v?

j. What is the barium sulfate concentration in mg/ml?

k. Which of the percent expressions is most likely to be used in practice for this situation?

l. Justify your answer to (j) above? Why is this so?

Problem 16

Phone 555-1212	Jorge Jungle, M.D.		DEA# AJ5905154
100 N. Forest St, Eden , NY. 14226			
Name <u>George Curious</u>	Age <u>55</u>	Weight <u>220.5 lbs</u>	
Address <u>15 Yellow Hat Rd, Paris, TX</u>	Date <u>17/8/95</u>	Height <u>160 cms</u>	
<p>R_x</p> <p>Sulfur 3% w/v</p> <p>Resorcinol 1% w/v</p> <p>Talc 8% w/v</p> <p>Zinc oxide 8% w/v</p> <p>Glycerin 10% v/v</p> <p>Purified water qs ad 90 ml</p> <p>Sig: Apply to affected areas bid</p> <p>Refill: _____</p> <p style="text-align: right;"><u>Jorge Jungle, M.D.</u></p>			

a. How much sulfur is required for this prescription?

b. How much glycerin is required?

c. In the United States Pharmacopoeia (USP), formulas for liquids are written in terms of 1000 ml of product. Rewrite the formula the way it would be written in the USP. All the ingredients are solids, **except** for glycerin and water. **Indicate units.**

Problem 17

Phone 555-1212	D. Glass, M.D.	AS5905154
100 N. Pyrex St		
Buffalo, NY. 14226		
Name <u>C. Corning</u>	Age <u>55</u>	Weight <u>220.5 lbs</u>
Address <u>15 Palace Rd, Lense, NY</u>	Date <u>17/8/95</u>	Height <u>160 cms</u>
<p>Rx Benzalkonium chloride solution 120 ml</p> <p>Make solution such that 2 teaspoonsful added to 1 L yields a 1:10,000 solution.</p> <p>Sig: Add 2 teaspoonful to 1 liter with warm water and use as a soak.</p> <p>Refill: _____</p>		

a. What is the benzalkonium chloride concentration applied?

b. What is the benzalkonium chloride concentration dispensed?

c. How much benzalkonium chloride is required?

Problem 18

Phone 555-1212		
Roswell Park Cancer Institute Pharmacy 100 Michigan St Buffalo , NY. 14226		
Name _____	Age _____	Weight _____
Address _____	Date _____	Height _____
<p>R_x Benzalkonium chloride solution Benzalkonium chloride solution 17% qs Purified water qs ad 100 ml M ft 1: 5000 solution. Label: Stock solution of Benzalkonium chloride.</p>		

a. What is the benzalkonium chloride concentration in mg/ml?

b. How much benzalkonium chloride is required in mg?

c. How much 17% benzalkonium chloride solution is required?

Problem 19

Phone 555-1212	DEA# AS4218334	
Cardiac Emergency Center Cupid Heart Research Institute, Coronary, NY. 14226		
Name <u>Archie Rasperry</u>	Date <u>10/1/95</u>	
Age <u>23</u>	Height <u>160 cm</u>	Weight <u>60 kg</u>
Rx Epinephrine hydrochloride 0.01 mg/kg IV stat Repeat q5 min if needed.		
 M.D.		

Epinephrine hydrochloride is frequently used in cardiac arrest emergencies.

a. Interpret this prescription.

b. What is the initial dose of epinephrine hydrochloride in **mg**?

c. Epinephrine hydrochloride for injection is available as a **1 : 10000** solution. What is the concentration of epinephrine hydrochloride in this solution in **% w/v**?

d. What is the concentration of epinephrine hydrochloride in **mg/ml**?

e. How many **ml** of epinephrine hydrochloride are needed for each dose?

Problem 20

Phone 555-3784	DEA# AH039240
Alco Hall, M.D. 100 Spirits Blvd. Inebria, CA 14003	
Name <u>Etha Noll</u>	Age <u>24</u>
Address <u>15 Topsy Rd, Inebria, CA 13002</u>	Date <u>1/10/95</u>
R_x Lactulose solution 3.333 g/5 ml Disp: 1 weeks supply Sig: 20 g Lactulose p.o. qid Refill	

a. What is the **volume in ml** of **each dose** of the lactulose preparation?

b. What instructions would you give the patient?

c. Express the concentration of lactulose in **mg/ml**.

d. Express the concentration of lactulose in **% w/v**.

Problem 21

Phone 555-1212	Belladonna Foxglove, M.D.	DEA# AS4218334
101 Niagara Falls Blvd		
Buffalo, NY. 14226		
Name	<u>Sophie Schwartz</u>	Date <u>10/1/95</u>
Address	<u>1015 Spring St. W. Seneca, NY</u>	
Age	<u>33</u>	Height <u>160 cm</u> Weight <u>120 kg</u>
R_x Atropine sulfate 2% Ft isotonic and buffered qs ad fl. dr. iv Sig: ii gtt as directed os		
_____ M.D.		

a. Convert the atropine sulfate concentration to **grains/fluid ounce** is required?

b. How much atropine sulfate in **grains** is required?

c. Convert the atropine sulfate concentration to mg/ml?

d. Convert the atropine sulfate concentration to g/Liter?

Problem 24

Phone 555-6765	DEA# BP0365420
<p>Evian Perrier 101 Mystic St. Snapple, PA 94143</p>	
Name <u>Arizona Soda</u>	Age <u>7</u>
Address <u>Mountaindew Rd, Sprite, NY</u>	Date <u>1/10/95</u>
<p>Rx Dextromethorphan HBr 1 mg/ml Chlorpheniramine maleate 0.134 mg/ml Pseudoephedrine HCl 2 mg/ml Syrup qs ad 1 ml</p> <p>M ft SA. Disp 5 day supply Sig: 1 qid</p> <p>Refill: None</p> <p style="text-align: right;"><u>E Perrier M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>	

- a. What instructions would you give this patient?

- b. How much pseudoephedrine HCl is required for the prescription?

- c. Could you dispense Vicks Nyquil[®] Childrens which contains 5 mg/teaspoon dextromethorphan HBr, 0.67 mg/teaspoon chlorpheniramine maleate and 10 mg/teaspoon pseudoephedrine HCl? Why?

Problem 25

Phone 555-6765	DEA# AL0365420
<p>Mercedes LeBaron 101 Chrysler St. Plymouth, MA 94143</p>	
Name <u>Ford Tercel</u>	Age <u>52</u>
Address <u>Avalon St, Dodge, MA</u>	Date <u>6/26/96</u>
<p>Rx Diphenhydramine 1 % Hydrocortisone 2 % Cream qs ad 50 g</p> <p>Sig: Apply tid prn itching</p> <p>Refill: None <u>MLeBaron M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; margin: 10px 0;"> <div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> </div> <p style="text-align: center;">Dispense as written</p>	

a. How much hydrocortisone is required for this prescription?

b. If all the ingredients are solids at room temperature, express the formula in the manner the U.S. Pharmacopoeia would write it. Indicate the units.

c. If the units are not indicated on a prescription, what units are you expected to assume for liquids?

Problem 26

Phone 555-6765	DEA# AP0365420
<p>Rajeev Singh 101 Sutter St. San Francisco, CA 94143</p>	
Name <u>Peter Goldstein</u>	Age <u>27</u>
Address <u>11 Clay St, San Francisco</u>	Date <u>1/10/48</u>
<p>R_x Acetaminophen gr. iv Aspirin gr. iv Caffeine gr. i</p> <p>M ft caps DTD #60 Sig: 2 caps qid pc and hs</p> <p>Refill: None <u>Rajeev Singh M.D.</u></p> <p style="text-align: center; font-size: small;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; margin: 10px 0;"> <div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> </div> <p style="text-align: center; font-size: small;">Dispense as written</p>	

a. This is an old fashioned prescription for something like extra-strength Excedrin. How many milligrams of caffeine are present **per capsule**. _____

b. How many milligrams of acetaminophen are present **per dose**? _____

c. **Without converting** the prescription itself to metric units, express the formula in the manner it would expressed in the U.S. Pharmacopoeia. Be sure to indicate the right units for these solids. _____

Problem 27

Phone 555-6765	DEA# BP0365420
<p>Wallaby Deere 101 N. Forest St. Foxtrot, PA 24242</p>	
Name <u>Tiger Doe</u>	Age <u>39</u>
Address <u>Raccoon Rd, El Charro, TX</u>	Date <u>1/10/95</u>
<p>Rx Aspirin 0.325 Chlorpheniramine maleate 0.005 Pseudoephedrine HCl 0.025 Lactose qs</p> <p>M ft caps SA DTD#10. Sig: 1 cap qid for sinus headache</p>	

You are preparing to fill the above prescription when you realize that your colleague has already compounded a large excess of capsules to fill the following prescription.

Phone 555-6765	DEA# BT0365420
<p>David Thoreau 101 Martin Luther King St. Walden, MA 94143</p>	
Name <u>Jean Sartre</u>	Age <u>65</u>
Address <u>Kant Rd, Russell, TX</u>	Date <u>1/10/95</u>
<p>Rx Aspirin 16.25 g Chlorpheniramine maleate 250 mg Pseudoephedrine HCl 1.25 g Lactose qs ad 0.5 g/capsule</p> <p>M ft caps. Div#50. Sig: 1 cap tid</p>	

- a. All other things being satisfactory, could you dispense the material that your colleague has prepared? Justify your answer.

Problem 28

Phone 555-3784			
Royal Cancer Infirmary 101 Downing St. Buckingham			
Name	<u>Chuck Windsor</u>	Age	<u>39</u> Weight <u>220.5 lb</u>
Address	<u>Palace St, London</u>	Date	<u>9/6/96</u> Height <u>5 ft 3"</u>
<p>R_x Doxopram HCl. Dissolve 250 mg in 250 ml NS. Infuse 0.05 mg/(kg min) for first 10 min, then 0.03 mg/(kg min) for 20 min and 0.01 mg/(kg min) for 30 min.</p>			
<u>Rupert Bootstocking M.D.</u>			

a. Expand the abbreviation NS.

b. Calculate the infusion rate (in **ml/min**) for the 0.03 mg/(kg min) dosing rate.

c. Calculate the total dose of doxopram HCl administered?

Problem 29

Phone 555-6765	DEA# AP0365420
<p>Roxane Pfizer 101 Searle St. Winthrop, CA 94143</p>	
Name <u>Geneva Hoffmann-LaRoche</u>	Age <u>67</u>
Address <u>11 Burroughs St, Wellcome</u>	Date <u>1/10/48</u>
<p>R Codeine phosphate gr. 1/4 Acetophenitidin gr. iiss ASA gr. iiiss Caffeine gr. ss</p> <p>M ft caps DTD #xlvii Sig: 1 caps tid</p> <p>Refill: None <u>RPfizer M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>	

a. Determine the total weight of each **capsule** in **grains**.

b. How many **pounds (avoirdupois)** of acetophenitidin are present in 13.5 pounds (avoirdupois) of this product?

Problem 30

Phone 555-3784			
H. Blofish 121 Garcia Ave Catharsis, CA			
Name	<u>S. N. Peppa</u>	Age	<u>39</u>
Weight	<u>220.5 lb</u>		
Address	<u>Sugar St, Cinnamon, CA</u>	Date	<u>9/6/96</u>
Height	<u>5 ft 3"</u>		
R_x 30 ml of 60% w/v castor oil suspension in water for total colonic evacuation.			
<u>HBlofish M.D.</u>			

a. What instructions would you give the patient?

b. Convert the castor oil concentration to **grams/100 ml**.

c. Convert the castor oil concentration to **mg/ml**.

d. Convert the castor oil concentration to **grams/liter**.

Problem 31

Phone 555-3784			
Gina Lotrimin 101 Sedate St. Lake Placid, NY			
Name	<u>Donna Rubicin</u>	Age	<u>12</u>
Weight	<u>50 kg</u>		
Address	<u>Payne Ave, Hartburne, NY</u>	Date	<u>9/6/96</u>
Height	<u>4 ft 6"</u>		
R_x Dilute 15 mg thiotepa in 1.5 ml sterile water. Administer IV bolus q 4 weeks.			
<u>G.Lotrimin</u> <u>M.D.</u>			

Thiotepa is a crystalline solid freely soluble in water. Assume the volume change on dissolution is negligible.

a. Determine the concentration in **mg/ml**.

b. Determine the concentration in % w/v?

c. Determine the concentration grams/liter?

d. Determine the concentration in mg%.

Problem 32

Phone 555-3784	DEA# AM0365420
<p>Diana Ferguson 121 London Ave Windsor, MI</p>	
Name <u>Stephanie Rainier</u>	Age <u>39</u> Weight <u>220.5 lb</u>
Address <u>Royal Road, Monaco, CA</u>	Date <u>9/6/96</u> Height <u>5 ft 3"</u>
<p>Rx Cocaine hydrochloride solution 4% Apply topically for local anesthesia</p>	
<p><u>Diana Ferguson</u> <u>M.D.</u></p>	

a. Convert the concentration of cocaine hydrochloride to grains per fluid ounce.

b. Convert the concentration to **mg/ml**.

c. Convert the concentration to **mg%**.

d. Convert the concentration to **parts strength**.

Problem 34

Phone 555-3784	DEA# AM0365420
<p>Peoria Baltimore 101 City St. Waco, TX 14003</p>	
Name <u>Austin Houston</u>	Age <u>26</u>
Address <u>City St., Waco, TX 14004</u>	Date <u>1/10/95</u>
<p>Rx Epinephrine metered dose aerosol inhaler for asthma. Inhaler to contain 1:100 solution of epinephrine and deliver 160 mcg drug per metered spray.</p> <p>2 inhalations q4h ud prn asthma.</p> <p>Refill <u>PBaltimore M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>	

Epinephrine is a powder and this is a spray inhaler similar to Primatene[®] mist.

a. Calculate the concentration of epinephrine in inhaler solution in mg/ml?

b. Calculate the concentration in percent strength.

c. Each metered spray contains 0.16 mg of epinephrine. How much is a single dose?

d. What volume (in ml) of the solution contains 0.32 mg of epinephrine?

Problem 35

Phone 555-3784	DEA# AL -12736280
<p>Kitty Litter Diaper Avenue Buffalo, NY 14226</p>	
Name <u>Kim Wipes</u>	Age <u>40</u>
Address <u>Napkin St., Waco, TX 14004</u>	Date <u>1/10/97</u>
<p>R_x Aspirin iii gr Salicylamide ii gr Acetaminophen iss gr Caffeine i gr m ft caps #100 i cap prn headache</p>	
Refill	<u>KLitter M.D.</u>

This is a recipe for an analgesic similar to Excedrin. All the ingredients and the product are solids.

a. How many grains are there to a mg? **Answer to four significant figures please.**

b. Express the concentration of aspirin as a percentage strength. Be sure to include the appropriate suffix.

c. Express the concentration of aspirin as in grams/gram product.

d. Express the formula in the manner it would be written in the U.S. Pharmacopeia (USP).

Problem 36

Phone 716-555-1234	DEA# AR -12736280										
<p>Dr. Ivy Pollen 33 Mite Street Allergen, NY 14002</p>											
Name <u>Cilia Larynx</u>	Age <u>8</u>										
Address <u>123 Windpipe Rd, Nasal, NY</u>	Date <u>9/28/97</u>										
<p>Rx</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 60%;">Benzocaine</td> <td style="width: 40%; text-align: right;">3%</td> </tr> <tr> <td>Chloroxylenol</td> <td style="text-align: right;">0.5%</td> </tr> <tr> <td>Benzalkonium chloride</td> <td style="text-align: right;">1:750</td> </tr> <tr> <td>Alcohol</td> <td style="text-align: right;">10%</td> </tr> <tr> <td>Water qs ad</td> <td style="text-align: right;">100 ml</td> </tr> </table> <p>Disp 100 ml Sig: Apply to affected area bid</p> <p style="text-align: right;"><u>I. Pollen M.D.</u></p>		Benzocaine	3%	Chloroxylenol	0.5%	Benzalkonium chloride	1:750	Alcohol	10%	Water qs ad	100 ml
Benzocaine	3%										
Chloroxylenol	0.5%										
Benzalkonium chloride	1:750										
Alcohol	10%										
Water qs ad	100 ml										

This is a recipe for poison ivy lotion. Benzocaine, chloroxylenol and benzalkonium chloride are solids at room temperature. All other ingredients are liquids.

a. What suffix is implied for the ingredients? List the suffixes for the all the ingredients except water.

b. Calculate the concentration of benzocaine in mg/ml?

c. Calculate the concentration of benzalkonium chloride in mg/ml

d. How much alcohol is needed?

Problem 37

Phone 716-555-1234	DEA# AT -12736280	
<p>Dr. Hailey Storm Level III, Harry Cane Hospital Typhoon, NY 14002</p>		
Name <u>Gale Elniño</u>	Age _____	Height <u>125 cm</u>
Address <u>1 Pacific Hts, Cyclone, NY</u>	Date <u>8/18/97</u>	Weight <u>45 kg</u>
<p>R_x Calamine 65 mg/ml Zinc oxide 65 mg/ml Water qs ad 250 ml</p> <p style="text-align: right;"><u>GayleStorm M.D.</u></p> <p style="text-align: center;">THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW</p> <div style="text-align: center; border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div> <p style="text-align: center;">Dispense as written</p>		

a. Express the concentration of calamine in **grams/liter**.

b. Express the concentration of calamine (a solid) as a **percentage**.

c. Express the concentration of calamine as ratio or parts strength.

Problem 38

Phone 555-3784	DEA# AS -12736280
Wesson Smith Cannon, AK 14226	
Name <u>Art Illery</u>	Age <u>40</u>
Address <u>Uzi St., Cannon, AK 47001</u>	Date <u>11/10/97</u>
Weight <u>100 kg</u>	Height <u>5 ft 8 in</u>
Rx 2 vials U-100 Insulin Zinc Inj 20U sc 1 hour before ac am.	
Refill	<u>W.Smith M.D.</u>
THIS PRESCRIPTION WILL BE FILLED GENERICALLY UNLESS THE PRESCRIBER WRITES "d a w" IN THE BOX BELOW	
<div style="border: 1px solid black; width: 80px; height: 40px; margin: 0 auto;"></div>	
Dispense as written	

a. What is the concentration of insulin dispensed?

b. What is the volume of insulin required per dose?

c. What is the route of administration?

Problem 39

Phone 716-555-1234		DEA# AS -12736280													
C. Cobol Perl Street, Algol, NY 14226															
Name	Pascal Fortran	Age	30												
Address	Python St., Java, NY 47001	Date	9/23/97												
Weight	80 kg	Height	5 ft 6 in												
<table style="width: 100%; border: none;"> <tr> <td style="width: 15px; vertical-align: top;">R_x</td> <td style="padding: 5px;">Nystatin</td> <td style="padding: 5px;">100,000 units/g</td> </tr> <tr> <td></td> <td style="padding: 5px;">Triamcinalone acetonide</td> <td style="padding: 5px;">0.1%</td> </tr> <tr> <td></td> <td style="padding: 5px;">Ointment base qs ad</td> <td style="padding: 5px;">75 g</td> </tr> <tr> <td></td> <td colspan="2" style="padding: 5px;">Apply ung to affected area qid</td> </tr> </table>				R_x	Nystatin	100,000 units/g		Triamcinalone acetonide	0.1%		Ointment base qs ad	75 g		Apply ung to affected area qid	
R_x	Nystatin	100,000 units/g													
	Triamcinalone acetonide	0.1%													
	Ointment base qs ad	75 g													
	Apply ung to affected area qid														
Refill	<u>C. Cobol M.D.</u>														

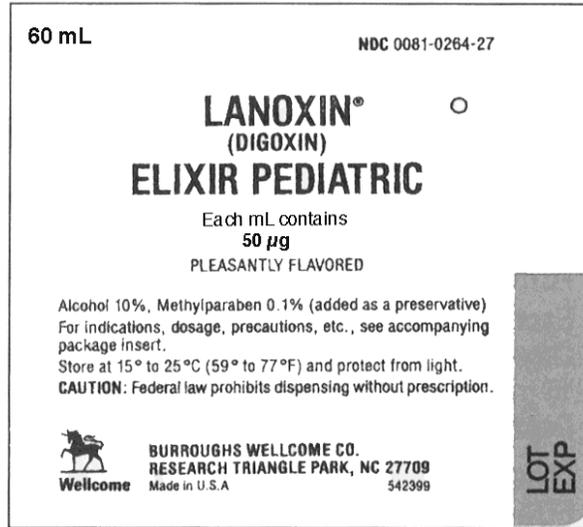
This is a recipe for an antifungal cream and all the ingredients are solids or semi-solids. The specific activity of nystatin is 5000 units/mg.

a. Determine the concentration of nystatin in mg/gram product.

b. How many units of nystatin are needed for the preparation.

c. How many mg of nystatin are needed?

Problem 40



Use the label above to answer the following questions. Digoxin occurs as white to clear crystals.

a. Why is this product an elixir?

b. What is drug concentration in mg/ml?

c. How much drug does the package contain, in **grams**?

d. What suffix is implied for the alcohol percentage?

e. Express the concentration of digoxin in ppm.

Problem 41

Phone 716-555-1234	Dr. Cherry San Marzano	DEA# AP -12736280
Orchard Park, NY 14002		
Name Juliet Roma	Age 5	Height 100 cm
Address Ida Gold Ave, Heirloom, NY	Date 8/8/08	Weight 25 kg
<p>R_x Administer 600,000 units of penicillin G benzathine IM</p> <p style="text-align: center;"><u>C. San Marzano M.D.</u></p>		

You have a stock solution of penicillin G benzathine containing 300,000 units per ml. Penicillin G benzathine, a solid, has a potency of 1200 units/mg.

a. What volume of this stock solution should be injected?

b. What dose of penicillin G benzathine, in **milligrams**, has the patient received

c. What is the concentration of Penicillin G benzathine in the stock vial in mg/ml.

d. Penicillin G benzathine is less active on a weight basis than its reference compound, Penicillin G. Do you expect the potency in $\mu\text{g}/\text{mg}$ to be less than or greater than 1000 $\mu\text{g}/\text{mg}$?

Problem 42

Phone 716-555-1234		DEA# AA -12736280	
Dr. Eddie Adams Amberwaves, IA 14002			
Name	Dirk Diggler	Age	30
Height	5ft 11 in		
Address	Roller Street, Amberwaves, IA	Date	9/18/01
Weight	80 kg		
<div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 10px;">℞</div> <div> Dispense 100 ml of tincture of benzalkonium chloride 1:750 for preoperative cleaning <div style="text-align: right; margin-top: 5px;"> <u>E. Adams</u> <u>M.D.</u> </div> </div> </div>			

Benzalkonium chloride is a solid.

a. What is the concentration of benzalkonium chloride in mg/ml?

b. What is the concentration in % w/v?

c. What is the concentration of benzalkonium chloride in mg %.

d. How much benzalkonium chloride is needed for compounding this preparation?

e. The tincture contains 50% v/v ethanol. Express the ethanol concentration in proof strength.

Problem 43

Lactulose Syrup USP
10 g/15 mL

FOR ORAL OR RECTAL ADMINISTRATION

Store between 2°-30°C (36°-86°F).
Do not freeze.
Keep tightly closed.
Dispense in a tight, light-resistant container as defined in the USP, with child-resistant closure.
When ordering this product, include the NDC number in the description.
Distributed by Schiapparelli Searle Chicago IL 60680
Mfd. by Inalco S.p.A. 20139 Milano, Italy
Packaged by Barre-National Inc. Baltimore MD 21207

16 Fl Oz
NDC 0905-3036-16 • NSN 6505-01-132-4609

Lactulose Syrup USP
10 g/15 mL

FOR ORAL OR RECTAL ADMINISTRATION

Indications and Dosage: For the prevention and treatment of portal-systemic encephalopathy. See insert labeling for full information.

Each 15 mL of syrup contains: 10 g lactulose (and less than 1.6 g galactose, less than 1.2 g lactose, and 0.1 g or less of fructose).
Some patients have found that lactulose syrup may be more acceptable when mixed with fruit juice, water or milk.

a. What is the concentration of lactulose in mg/ml?

b. What is concentration of lactulose in % w/v?

c. What is the concentration of lactulose in grams/ml?

d. What is the concentration of lactulose in grams/liter?

e. What is concentration of lactulose in grains/fluid ounce?

Problem 44

<p>6505-00-299-8760 AMPOULES Adrenalin® Chloride Solution (Epinephrine Injection, USP)</p> <hr/> <p>1:1000</p> <p>25 AMPOULES (1 mL each)</p> <p>PARKE-DAVIS Div of Warner-Lambert Co © 1991 Morris Plains, NJ 07950 USA</p>	<p>Each mL contains Adrenalin (epinephrine) as the hydrochloride dissolved in water for injection with sodium chloride added for isotonicity.</p> <p>Do not use the solution if it is pinkish or darker than slightly yellow or if it contains a precipitate.</p> <p>Dose—Intramuscularly or subcutaneously, 0.2 to 1 mL. Start with small dose and increase if required. Intravenously, intracardially, or intraspinally, see package insert.</p> <p>Caution—Administer with caution to elderly people, to those with hypertension, cardiovascular disease, diabetes or hyperthyroidism. Contains not more than 0.1% sodium bisulfite as an antioxidant. Air in ampoules is displaced by nitrogen.</p> <p>Store between 15° and 25°C (59° and 77°F). Protect from light and freezing. Keep this and all drugs out of the reach of children.</p>
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Epinephrine hydrochloride is a powerful vasoconstricting drug. It is produced endogenously by the adrenal medulla and is a white crystalline powder.

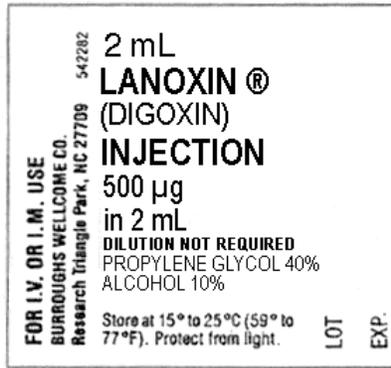
a. What suffix is implied for the concentration of epinephrine hydrochloride?

b. Express the concentration of epinephrine hydrochloride in mg/ml?

c. How much epinephrine hydrochloride is present in each ampoule?

d. Express the concentration of epinephrine hydrochloride as a percentage.

Problem 45



a. What is the concentration of digoxin in mcg/ml?

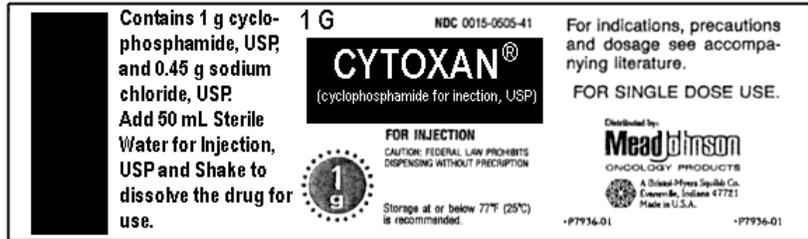
b. What is the concentration of digoxin in mg/ml?

c. What is the concentration of digoxin in parts strength?

d. What is the concentration of digoxin in ppm?

e. What is the concentration of alcohol in the preparation in proof strength?

Problem 46



a. What is the concentration of cyclophosphamide in mg/ml when the product is diluted as directed. Assume that the dissolved solids do not add volume.

b. What the concentration of sodium chloride in mg/ml after dilution?

c. What is the concentration of sodium chloride as percentage?

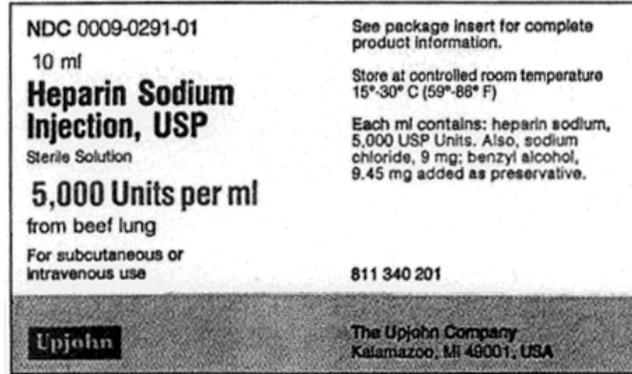
d. How much is a billion? Express your answer to 3 significant figures.

Problem 47



a. What is the specific activity of the penicillin in the preparation?

Problem 48



Heparin is an (solid) anticoagulant derived from either beef lung or pig intestinal mucosa.

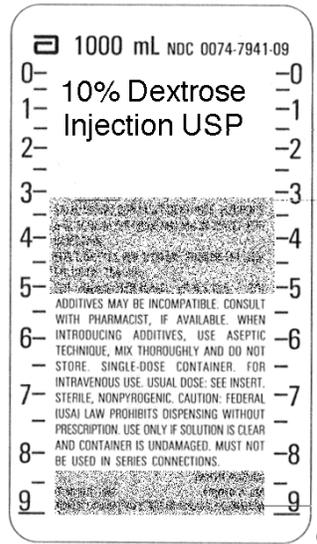
a. How many units of heparin are present in the preparation?

b. The specific activity of the heparin is 150 units/mg. What is concentration of the heparin in mg/ml?

c. What is the concentration of heparin in percent strength?

d. What is the concentration of heparin in parts strength strength?

Problem 49



a. Dextrose is a solid. What suffix is implied for the concentration of dextrose in this preparation?

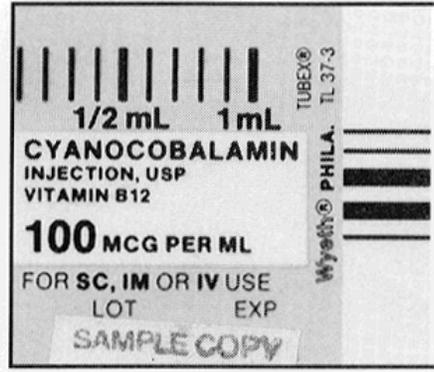
b. What is the concentration of dextrose in mg/ml?

c. What is the concentration of dextrose in g/L?

d. What is the concentration of dextrose in parts strength?

e. Determine the amount of dextrose present in the preparation.

Problem 50



Cyanocobalamin is a solid

a. What is the concentration of cyanocobalamin in mg/ml?

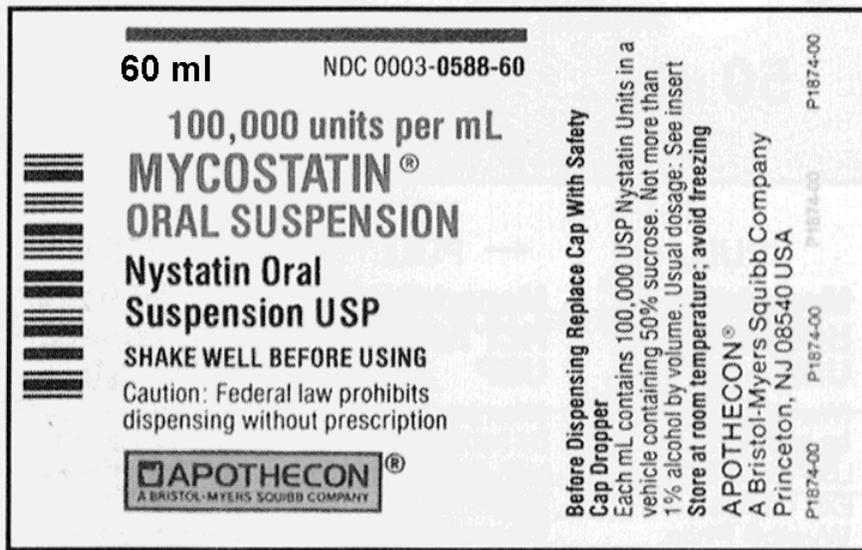
b. What routes of administration can this preparation be used for? All must be correct for credit.

c. What is the cyanocobalamin concentration in percent?

d. What is the cyanocobalamin concentration in parts strength?

e. What is the cyanocobalamin concentration in parts per million?

Problem 51



Nystatin, a solid, is an antifungal antibiotic. The specific activity of the nystatin is 5000 units per milligram.

a. How many units are present in the preparation?

b. What is the maximum alcohol concentration in proof strength?

c. What is concentration of nystatin in mg/ml?

d. What is the concentration of nystatin in % strength?

Problem 52

Phone 716-555-1234	DEA# AT -12736280	
<p>Dr. Peter Out, M.D. 3 Sue Court Ilium, WA</p>		
Name <u>Mark Myword</u>	Age <u>45 yr</u>	Height <u>5 ft 8 in</u>
Address <u>87 Lois Lane, Ilium,</u>	Date <u>8/18/97</u>	Weight <u>90 kg</u>
<p>R 0.5% etidocaine hydrochloride containing 1:200,000 epinephrine Sig: Inject 9 mg of etidocaine hydrochloride in mandibular area <u>Peter Out, MD</u></p>		

Epinephrine (a solid) is included in local anesthetics preparation and prolongs their effects by causing vasoconstriction.

a. What volume of drug preparation should be injected?

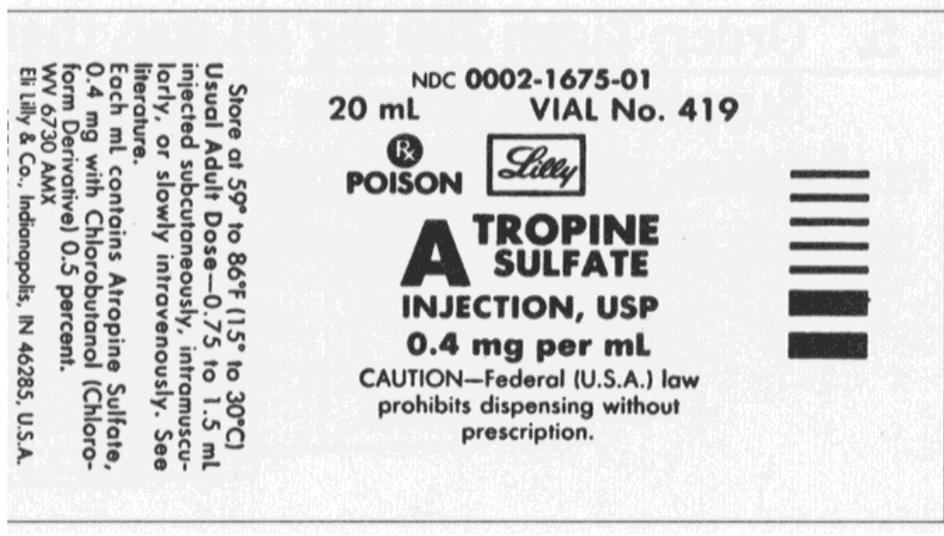
b. Express the concentration of **epinephrine** as percentage.

c. Express the concentration of **epinephrine** as **parts per billion**.

d. Express the concentration of epinephrine in mg/ml.

e. Determine the dose of epinephrine.

Problem 53



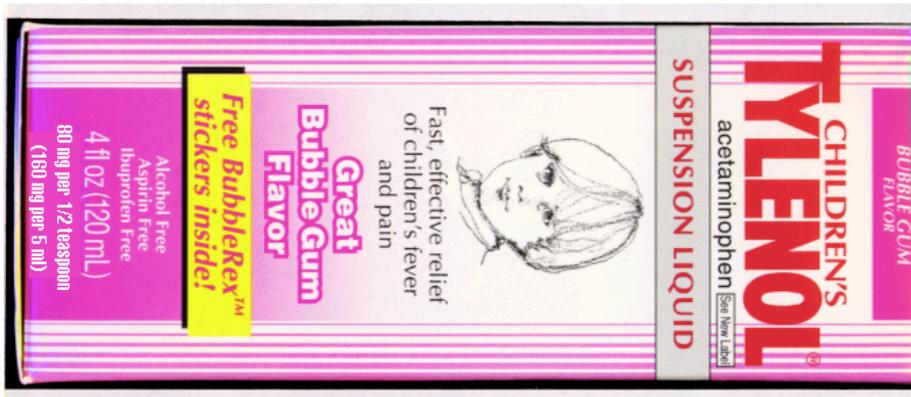
a. Convert the concentration of atropine sulfate to percent strength

b. Convert concentration of atropine sulfate to grains/fluid ounce.

c. Express the concentration of atropine sulfate in parts strength.

d. Express the concentration of atropine sulfate in parts per million.

Problem 54



- a. Express the concentration of acetaminophen in Childrens' Tylenol in mg/ml.

- b. Express the concentration of acetaminophen in Childrens' Tylenolin g/Liter

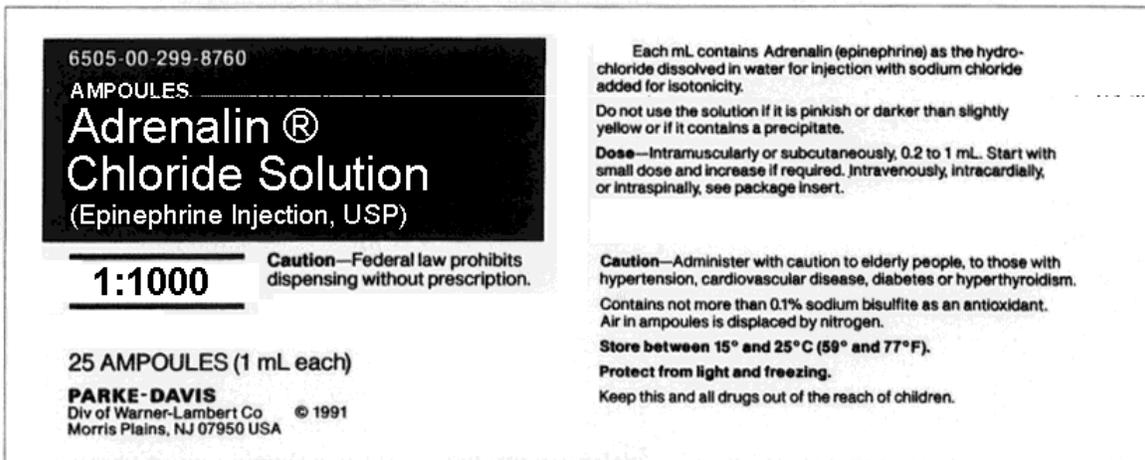
- c. Express the concentration of acetaminophen in Childrens' Tylenol in % w/v

- d. Express the concentration of acetaminophen in Childrens' Tylenol in mg%.

- e. Express the concentration of acetaminophen in Childrens' Tylenol in ratio strength.

- f. Express the concentration of acetaminophen in Childrens' Tylenol in grains per fluid ounce.

Problem 55



Use the label for Adrenalin[®] to answer the following questions.

a. Express the concentration of epinephrine in mg/ml.

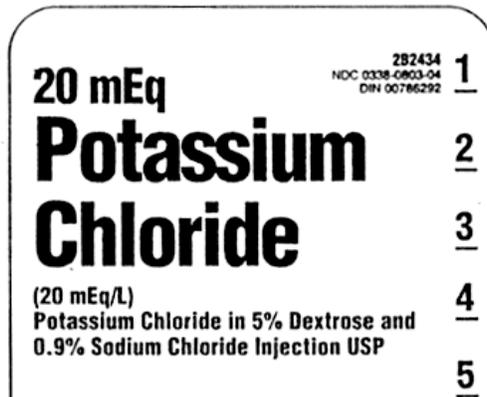
b. Express the concentration of epinephrine in ppm.

c. Express the concentration of epinephrine in mg%.

d. Express the concentration of epinephrine in mcg/ml.

e. Express the concentration of epinephrine in grains/fluid ounce.

Problem 56



a. What is the concentration of **Sodium chloride** in the preparation in percent strength? Indicate appropriate suffix.

b. What is the concentration of **sodium chloride** in **grams/liter**.

c. What is the concentration of **sodium chloride** in **mg/ml**.

d. What is the concentration of **sodium chloride** in **milligrams percent**?

e. What is the concentration of **sodium chloride** in **parts strength**?

f. What is the concentration of **sodium chloride** in **grains per fluid ounce**?

Problem 57

Phone 716-555-1234		DEA# AT -12736280			
Dr. William Alfayyad, M.D.					
Name	Harry Parker	Age	13 yr	Height	5 ft 3 in
Address	8 Buckingham, London, ON	Date	8/18/02	Weight	50 kg
Rx 1% w/v lidocaine hydrochloride containing 1:200,000 epinephrine Inject 25 ml epidurally					
<u>W. Alfayyad, MD</u>					

a. Express the concentration of **epinephrine** in mg/ml.

b. Express the concentration of **epinephrine** in micrograms/ml.

c. Express the concentration of **epinephrine** in percent strength. Epinephrine is a solid.

d. Calculate the concentration of **epinephrine** in parts per million.

e. Calculate the dose of **epinephrine**.

f. Calculate the dose of **lidocaine hydrochloride**.

Problem 58

Phone 716-555-1234		DEA# AT -12736280			
Dr. Anna Phylaxis, M.D.					
Name	Al Lergen	Age	8 yr	Height	3 ft
Address	8 Clam Street, Springville	Date	8/18/02	Weight	50 lb
Rx 0.625 mg/m ² of epinephrine solution (1:200) sc for anaphylaxis q6h <u>A. Phylaxis, MD</u>					

Epinephrine is a solid.

a. Convert the concentration of epinephrine into **mg/ml**.

b. Convert the concentration of epinephrine into **percent strength**. Indicate the suffix.

c. Convert the concentration of epinephrine into **milligram percent**.

d. Convert the concentration to **mg/deciliter**.

e. Convert the concentration to parts per million. Indicate the suffix.

f. Convert the concentration to grains per fluid ounce.

Problem 59

Phone 716-555-1234		DEA# AT -12736280			
Dr. Tahini Tabouli, M.D.					
Name	B. Ganoush	Age	28 yr	Height	5 ft 3 in
Address	8 Hummus Street	Date	8/18/02	Weight	120 lb
<p>Rx Administer 15 ml of 2% mepivacaine hydrochloride solution epidurally</p> <p style="text-align: right;"><u>Tahini Tabouli, MD</u></p>					

Mepivacaine hydrochloride is a solid.

a. Convert the concentration of mepivacaine hydrochloride into **mg/ml**.

b. What the dose of mepivacaine hydrochloride.

c. Convert the concentration of mepivacaine hydrochloride into **milligram percent**.

d. Convert the mepivacaine hydrochloride concentration to **mg/deciliter**.

e. Convert the mepivacaine hydrochloride concentration to parts strength. Indicate the suffix.

f. Convert the mepivacaine hydrochloride concentration to grains per fluid ounce.

Problem 60

Phone 716-555-1234		DEA# AT -12736280			
Dr. Petunia Bloom, M.D.					
Name	Rose Thorne	Age	52 yr	Height	6ft 2 in
Address	8 Impatiens Pl, Lillyvale	Date	8/18/02	Weight	100 kg
<p>Rx Inject 2% mepivacaine hydrochloride containing 1: 20,000 levonordefrin by dental infiltration for local anesthesia of oral cavity. Dose of mepivacaine hydrochloride should be 2 mg/kg</p> <p style="text-align: right;"><u>Petunia Bloom, MD</u></p>					

Both mepivacaine hydrochloride and levonordefrin are solids

a. Calculate the concentration of **levonordefrin** in **mg/ml**.

b. Calculate the concentration of **levonordefrin** in **grams/liter**.

c. Calculate the concentration of **levonordefrin** in **parts per million**.

d. Calculate the concentration of **levonordefrin** in **mg%**.

e. Calculate the volume of solution injected.

f. Calculate the dose of **levonordefrin**.

Problem 61

Phone 555-3784		DEA# BS0365420																		
Pepo Curcubita																				
407 Mulch Street, Terracotta, TX 90210																				
Name	Clay Basalt	Age	23	Wt	70 kg															
Address	Chalk St, Terracotta, TX 90210	Date	1/10/95	Height	5 ft 8 in															
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 5%; text-align: center;">R_x</td> <td style="width: 55%;">Oxycodone hydrochloride</td> <td style="width: 40%;">5 mg</td> </tr> <tr> <td></td> <td>Ibuprofen</td> <td>400 mg</td> </tr> <tr> <td></td> <td>Lactose qs ad</td> <td>500 mg</td> </tr> <tr> <td></td> <td colspan="2">DTD: Mft 28 caps</td> </tr> <tr> <td></td> <td colspan="2">Sig: 1 cap q6h postoperative pain</td> </tr> </table>						R_x	Oxycodone hydrochloride	5 mg		Ibuprofen	400 mg		Lactose qs ad	500 mg		DTD: Mft 28 caps			Sig: 1 cap q6h postoperative pain	
R_x	Oxycodone hydrochloride	5 mg																		
	Ibuprofen	400 mg																		
	Lactose qs ad	500 mg																		
	DTD: Mft 28 caps																			
	Sig: 1 cap q6h postoperative pain																			

a. Express the concentration of oxycodone hydrochloride in grams/gram.

b. Express the concentration of oxycodone hydrochloride in percent strength. All ingredients are solids. Include the appropriate suffix.

c. Express the concentration of oxycodone hydrochloride in parts strength. Include the suffix.

d. Express the concentration of oxycodone hydrochloride in parts per million. Include the suffix.

e. Express the concentration of oxycodone hydrochloride in grains per grain.

Problem 62

Phone 716-555-1234		DEA# AT -12736280			
Dr. Melman Mancziwicz, M.D.					
Name	Gloria Alex	Age	28 yr	Height	5 ft 3 in
Address	8 Bronx Street	Date	8/18/02	Weight	120 lb
<p>Rx Administer 10 mg of 24 mg/ml dexamethasone phosphate solution intravenously for edema.</p> <p style="text-align: right;"><u>M Mancziwicz, MD</u></p>					

Dexamethasone phosphate is a solid.

- a. Convert the concentration of dexamethasone phosphate to **percent** strength. Indicate suffix.

- b. Convert the concentration dexamethasone phosphate to parts strength. Indicate suffix

- c. Convert the concentration dexamethasone phosphate to milligram percent.

- d. Convert the concentration dexamethasone phosphate to **grams/liter**.

- e. Convert the concentration dexamethasone phosphate to **grains/fluid ounce**.

Problem 63

Phone 716-555-1234		DEA# AT -12736280			
Dr. Petunia Bloom, M.D.					
Name	Rose Thorne	Age	52 yr	Height	6ft 2 in
Address	8 Impatiens Pl, Lillyvale	Date	8/18/02	Weight	100 kg
Rx Benzalkonium chloride tincture 1:750 spray Dispense 250 ml spray bottle for pre-operative disinfection					

Benzalkonium hydrochloride is a solid.

- a. Calculate the concentration of benzalkonium hydrochloride in **mg/ml**.

- b. Calculate the concentration of benzalkonium hydrochloride in **percent strength**.

- c. Calculate the concentration of benzalkonium hydrochloride in **milligrams/deciliter**.

- d. Calculate the concentration of benzalkonium hydrochloride in **parts per million**.

- e. Calculate the amount of benzalkonium hydrochloride required for make the preparation.

- f. The tincture is prepared with commercial ethanol that has 190 proof strength. Express this concentration of ethanol in **ml/ml**.

Problem 64

Phone 716-555-1234		DEA# AT -12736280			
Dr. Enema Pañales, M.D.					
Name	Camilla Suppositori	Age	7yr	Height	60 cm
Address	8 Buckingham Pl, London	Date	8/18/02	Weight	20 kg
Rx		Phenylephrine hydrochloride		0.12 g/100 ml	
		m ft isotonic solution			
		ii gtt ou q4h prn			
				N. Pañales, MD	

Phenylephrine hydrochloride is a solid.

a. What is the concentration of phenylephrine hydrochloride in **percentage strength**? Be sure to indicate the suffix.

b. What is the concentration of phenylephrine hydrochloride in **parts per million**? Be sure to indicate the suffix.

c. What is the concentration of phenylephrine hydrochloride in **parts or ratio strength**?

d. What is the concentration of phenylephrine hydrochloride in **grains per fluid ounce**?

e. What is the dose of phenylephrine hydrochloride in **micrograms**?

f. What instructions would you give the patient?

Problem 65

Phone 555-3784		DEA# BS0365420	
Jack Hammer 407 Nailer St., Chainsaw, TX 90210			
Name	Chuck Sander	Age	23
		Wt	70 kg
Address	Router St, Chainsaw, TX 90210	Date	1/10/95
		Height	5 ft 8 in
Rx Lidocaine hydrochloride solution 1.5% w/v at 4 mg/kg for epidural anesthesia.			
Jack Hammer			M.D.

- a. Express the concentration of lidocaine hydrochloride in **grams/ml**.

- b. Express the concentration of lidocaine hydrochloride in **mg/ml**.

- c. Express the concentration of lidocaine hydrochloride in **parts strength**. Lidocaine hydrochloride is a solid. Include the suffix.

- d. Express the concentration of lidocaine hydrochloride in parts per million.

- e. Express the concentration of lidocaine hydrochloride in grains per fluid ounce.

- f. Calculate the volume of solution injected.

Problem 66

Phone 716-555-1234		DEA# AT -12736280			
Dr. Maxime Abraxame, M.D.					
Name	Billy Wig-Boggart	Age	28 yr	Height	5 ft 3 in
Address	8 Azkaban Street	Date	8/18/02	Weight	120 lb
Rx Infuse 0.5 g/(kg hour) dextrose as D5W for 2 hours <u>Maxime Abraxame, MD</u>					

a. Convert the concentration of dextrose to mg/ml.

b. Convert the concentration of dextrose in D5W to **milligrams per deciliter**.

c. Convert the concentration of dextrose in D5W to **grams per liter**.

Problem 67

Phone 716-555-1234		DEA# AT -12736280			
Dr. Misty Pikachu, M.D.					
Name	Megami Gyakutenno	Age	52 yr	Height	6ft 2 in
Address	8 Dian Keto Street	Date	8/18/02	Weight	100 kg
<p>Rx Add 1 ml of Epinephrine hydrochloride 1:1000 parenteral concentrate to 500 ml of NS. Infuse IV at 2 mcg/min for 1 hour</p> <p style="text-align: right;"><u>Misty Pikachu, MD</u></p>					

Epinephrine hydrochloride is a solid.

- a. Calculate the concentration of epinephrine hydrochloride in the **parenteral concentrate** in **mg/ml**.

- b. Calculate the concentration of epinephrine hydrochloride in the **parenteral concentrate** in **percent strength**.

- c. Calculate the concentration of epinephrine hydrochloride in the **parenteral concentrate** in **parts per million**.

- d. Calculate the concentration of epinephrine hydrochloride in the **parenteral concentrate** in **micrograms/ml**.

- e. Calculate the concentration of epinephrine hydrochloride in the **parenteral concentrate** in **milligrams percent**.

Problem 68

Phone 716-555-1234		DEA# AT -12736280			
Dr. Hera Zeus, M.D.					
Name	Athena Artemis	Age	7yr	Height	60 cm
Address	8 Apollo Pl, Athens, GA	Date	8/18/02	Weight	20 kg
<p>Rx Digoxin for injection 100 micrograms/ml containing alcohol 10% v/v and propylene glycol 40% w/v Inject 10 mcg/kg digoxin IV slowly over 5 minutes <u>H. Zeus, MD</u></p>					

- a. What is the concentration of digoxin in **percentage strength**? Indicate the suffix.

- b. What is the concentration of digoxin in **parts per million**? Be sure to indicate the suffix.

- c. What is the concentration of digoxin in **parts or ratio strength**?

- d. What is the concentration of digoxin in **grains per fluid ounce**?

- e. What is the concentration of **ALCOHOL** in **proof strength**?

- f. What volume of the preparation should be injected?

Problem 69

Phone 716-555-1234		DEA# AT -12736280			
Dr. Brittany Bassett, M.D.					
Name	Collie Boxer	Age	7yr	Height	60 cm
Address	8 Beagle Street, Mastiff	Date	8/18/02	Weight	20 kg
<p>Rx Sodium fluoride 200 ppm Sig: Rinse mouth with 10 ml of solution bid after brushing Disp: 0.5 liter bottle</p> <p style="text-align: right;"><u>B. Bassett, MD</u></p>					

Sodium fluoride is a solid.

a. What is the concentration of sodium fluoride in **percentage strength**?

b. What is the concentration of sodium fluoride in mg/ml?

c. What is the concentration of sodium fluoride in **parts or ratio strength**?

d. What is the concentration of sodium fluoride in **milligram percent**?

e. What is the concentration sodium fluoride in **grams/liter**?

f. What is the concentration sodium fluoride in **micrograms/ml**.

Problem 70

Phone 555-3784		DEA# BS0365420	
Firenza Tuscany 407 Venice St., Rome, NY 90213			
Name	Milano Naples	Age	8
		Wt	40 kg
Address	Appian Way, Rome, NY 90210	Date	1/10/95
		Height	3 ft 8 in
R Albuterol sulfate solution 0.083% w/v MDI. 2 p ut dict q6h bronchospasm. 1 min between puffs <div style="text-align: right;">F Tuscany, M.D.</div>			

- a. Express the concentration of albuterol sulfate albuterol sulfate in the solution in **mg/ml**.

- b. Express the concentration of albuterol sulfate albuterol sulfate in the solution in **g/liter**.

- c. Express the concentration of albuterol sulfate in the solution in **parts strength**. Albuterol sulfate is a solid. Include the suffix.

- d. Express the concentration of albuterol sulfate in the solution in parts per million.

- e. Express the concentration of albuterol sulfate in the solution in grains per fluid ounce.

- f. The **dose** of albuterol sulfate is 180 micrograms. Calculate the volume of solution used up from the metered dose inhaler per dose.

Problem 71

Phone 716-555-1234		DEA# AT -12736280			
Dr. Patty Mayo, M.D.					
Name	Chuck Ground-Burger	Age	52 yr	Height	6ft 2 in
Address	8 Grill Street	Date	8/18/02	Weight	100 kg
<p>Rx Benzalkonium chloride tincture 1:750 w/v with acetone 10% v/v and ethanol 50% v/v M ft 100 ml for pre-operative disinfection</p> <p style="text-align: right;"><u>Patty Mayo, MD</u></p>					

Benzalkonium chloride is a solid and acetone is a liquid at room temperature.

a. Calculate the concentration of benzalkonium chloride in **mg/ml**.

b. Calculate the concentration of benzalkonium chloride in **percent strength**.

c. Calculate the concentration of benzalkonium chloride in **parts per million**.

d. Calculate the concentration of benzalkonium chloride in **milligram percent**.

e. Calculate the concentration of **acetone** in the tincture in **ml/ml**.

f. Calculate the concentration of **ethanol** in the tincture in **proof strength**.

Problem 72

Phone 716-555-1234		DEA# AT -12736280			
Dr. Tibia Coccyx, M.D.					
Name	Ulna Carpal	Age	28 yr	Height	5 ft 3 in
Address	8 Femur Street	Date	8/18/02	Weight	120 lb
<p>Rx Infuse 100 mcg/ml NTG in 5% w/v dextrose at 5 mcg/min. Check BP q5 min. If target blood pressure is not reached in 5 minutes increase by 5 mcg/min every 5 minutes to a maximum of 20 mcg/min. Once target BP is reached maintain dosing rate. Total infusion time for the entire infusion is 30 minutes.</p> <p style="text-align: right;"><u>T Coccyx, MD</u></p>					

- a. Convert the concentration of nitroglycerin to mg/ml. _____

- b. Convert the concentration of nitroglycerin in D5W to **milligrams per deciliter**. _____

- c. Convert the concentration of nitroglycerin in ppm w/v. _____

- d. Calculate the concentration of nitroglycerin in percent strength. _____

- e. Calculate the concentration of nitroglycerin in parts strength. _____

- f. Calculate the concentration of nitroglycerin in grains per fluid ounce. _____

CHAPTER 6
CHEMICAL CALCULATIONS

NOTES

Outline

- Molecular weight, equivalents weights, composition and dosage
- Gases

Equivalent weight

- The equivalent weight of a chemical species is the number of grams required to chemically combine with 1 equivalent (1.008 g) of hydrogen or 1 equivalent of some other chemical species.
- The equivalent weight of an electrolyte is obtained by dividing the molecular weight by the **total** valence of **either** the anion or the cation. The water of hydration does not interfere with the calculations.

$$\text{Equivalent Weight} = \frac{\text{Molecular Weight}}{\text{Valence}}$$

- Equivalent weights are useful because all chemical compounds involve EQUAL numbers of equivalents of each chemical constituent. For example, x equivalents of calcium chloride contain x equivalents of chloride ion, and x equivalents of calcium ion. However, x moles of calcium will NOT yield x moles of calcium chloride, when reacted with x moles of chlorine, you get only $x/2$ moles of calcium chloride because of the stoichiometry.
- Equivalent weights are useful because all chemical reactions involve EQUAL numbers of equivalents of each chemical species. All chemical compounds contain equal numbers of equivalents of the constituent species. For example, if x equivalents of calcium are reacted with x equivalents of chlorine, you will obtain x equivalents of calcium chloride. However, x moles of calcium will NOT yield x moles of calcium chloride, when reacted with x moles of chlorine.
- The concentration of electrolytes for parenteral solutions is frequently expressed in mEq/ml or milliequivalents per liter.

Calculating Molar Composition

- You may have to calculate molar (or equivalent) % composition given % w/w or %w/v. To do this, divide the %w/w of each ingredient by its molecular weight (or equivalent weight) to obtain the number of moles (or equivalents) of each species. Add these up to give you the total number of moles and obtain the % molar composition.
- To calculate % w/w or %w/v given molar (or equivalent) % composition, multiply the molar (or equivalent) % composition each ingredient by its molecular weight (or equivalent weight) to obtain the number of grams of each species. Add these up to give you the total number of grams and obtain the % molar composition.

Gases

- The ideal gas law is used for a wide variety of calculations with gases.

$$PV = nRT$$

- Here, P , V and T are the pressure, volume and absolute temperature respectively. n is the number of moles and R is the gas constant.
- The units of pressure and volume must be consistent with the units of the gas constant. For example, if $R = 8.314 \times 10^7$ ergs. $^{\circ}\text{K}^{-1} \cdot \text{mol}^{-1}$ is used, the value of P must be in dynes/cm², V must be in cm³ and T in $^{\circ}\text{K}$.
- If P is in atmospheres, volume is in liters, and T in $^{\circ}\text{K}$, the gas constant $R = 0.08205$ liter. atmosphere $^{\circ}\text{K}^{-1} \text{mol}^{-1}$ must be used.
- Similarly, in SI units, where pressure is in newtons/m², volume is in m³ and T in $^{\circ}\text{K}$, the value of $R = 8.314$ Joules. $^{\circ}\text{K}^{-1} \cdot \text{mol}^{-1}$.
- As consequence of Avogadro's principle, 1 mole of any (ideal) gas occupies 22.41 liters (or 22410 ml) at 273.15 $^{\circ}\text{K}$ (0 $^{\circ}\text{C}$) and 1 atmosphere. This information is used to calculate the density and volumes of gases under any condition, via the ideal gas law.
- For a mixture of gases, the **effective molecular weight** can be taken to be the **mole % weighted average** of the molecular weight of the individual gases in the mixture. For example, if a gaseous mixture contains 95 mole % oxygen and 5 mole % carbon dioxide, the effective molecular weight is $(0.95 \times 32 + 0.05 \times 44) = 32.6$.
- At constant temperature, the **partial pressure** of a gas in gaseous mixture is a **measure of gas concentration**. This follows from Dalton's law of partial pressure which states that the total pressure of an ideal gas mixture is equal to the sum of the partial pressures.

$$P = \text{Total pressure} = p_1 + p_2 + p_3 + p_4 + \dots = (n/V) RT$$

$p_1, p_2, p_3, p_4, \dots$ are the partial pressures of the constituent gases.

If $n_1, n_2, n_3, n_4, \dots$ represent the number of moles of these constituent gases, then from the ideal gas law:

$$p_1V = n_1RT$$

Similar equations can be written for the other constituents. Alternatively,

$$p_1/(RT) = (n_1/V)$$

The (n_1/V) term represents the number of moles per unit volume or concentration.

Therefore, at constant temperature, the **partial pressure of a constituent is proportional to its concentration in a gas mixture**.

- Similarly, for an ideal gas mixture, **the mole percent of any constituent is identical to its % volume in volume**.

Let $v_1, v_2, v_3, v_4, \dots$ represent the volumes occupied by the constituent gases. Remember, $(100 v_1/V)$, $(100 v_2/V)$, $(100 v_3/V)$, $(100 v_4/V) \dots$ are the % volume in volume. Because of the ideal gas law, we can also write

$$Pv_1 = n_1RT \text{ and } Pv_2 = n_2RT \text{ and } Pv_3 = n_3RT \text{ and } Pv_4 = n_4RT \dots$$

Since, $PV = nRT$, we can divide the left and right hand sides of each of the equations in the box by PV and nRT , respectively.

Remember, $V = \text{Total volume} = v_1 + v_2 + v_3 + v_4 + \dots$ and $n = \text{Total number of moles} = n_1 + n_2 + n_3 + n_4 + \dots$. The division yields:

$$(v_1/V) = (n_1/n) \text{ and } (v_2/V) = (n_2/n) \text{ and } (v_3/V) = (n_3/n) \text{ and } (v_4/V) = (n_4/n) \dots$$

Thus volume percent and mole percent for an ideal gas are the same.

TABLE OF ATOMIC WEIGHTS

Name (A-G)	Symbol	Atomic Weight	Atomic Number	Name (H-P)	Symbol	Atomic Weight	Atomic Number
Actinium	<i>Ac</i>	[227]	89	Hafnium	<i>Hf</i>	178	72
Aluminium	<i>Al</i>	27	13	Hassium	<i>Hs</i>	[270]	108
Americium	<i>Am</i>	[243]	95	Helium	<i>He</i>	4	2
Antimony	<i>Sb</i>	122	51	Holmium	<i>Ho</i>	165	67
Argon	<i>Ar</i>	40	18	Hydrogen	<i>H</i>	1	1
Arsenic	<i>As</i>	75	33	Indium	<i>In</i>	115	49
Astatine	<i>At</i>	[210]	85	Iodine	<i>I</i>	127	53
Barium	<i>Ba</i>	137	56	Iridium	<i>Ir</i>	192	77
Berkelium	<i>Bk</i>	[247]	97	Iron	<i>Fe</i>	56	26
Beryllium	<i>Be</i>	9	4	Krypton	<i>Kr</i>	84	36
Bismuth	<i>Bi</i>	209	83	Lanthanum	<i>La</i>	139	57
Bohrium	<i>Bh</i>	[272]	107	Lawrencium	<i>Lr</i>	[262]	103
Boron	<i>B</i>	11	5	Lead	<i>Pb</i>	207	82
Bromine	<i>Br</i>	80	35	Lithium	<i>Li</i>	7	3
Cadmium	<i>Cd</i>	112	48	Lutetium	<i>Lu</i>	175	71
Caesium	<i>Cs</i>	133	55	Magnesium	<i>Mg</i>	24	12
Calcium	<i>Ca</i>	40	20	Manganese	<i>Mn</i>	55	25
Californium	<i>Cf</i>	[251]	98	Meitnerium	<i>Mt</i>	[276]	109
Carbon	<i>C</i>	12	6	Mendelevium	<i>Md</i>	[258]	101
Cerium	<i>Ce</i>	140	58	Mercury	<i>Hg</i>	201	80
Chlorine	<i>Cl</i>	35.5	17	Molybdenum	<i>Mo</i>	96	42
Chromium	<i>Cr</i>	52	24	Neodymium	<i>Nd</i>	144	60
Cobalt	<i>Co</i>	59	27	Neon	<i>Ne</i>	20	10
Copper	<i>Cu</i>	63.5	29	Neptunium	<i>Np</i>	[237]	93
Curium	<i>Cm</i>	[247]	96	Nickel	<i>Ni</i>	59	28
Darmstadtium	<i>Ds</i>	[281]	110	Niobium	<i>Nb</i>	93	41
Dubnium	<i>Db</i>	[268]	105	Nitrogen	<i>N</i>	14	7
Dysprosium	<i>Dy</i>	163	66	Nobelium	<i>No</i>	[259]	102
Einsteinium	<i>Es</i>	[252]	99	Osmium	<i>Os</i>	190	76
Erbium	<i>Er</i>	167	68	Oxygen	<i>O</i>	16	8
Europium	<i>Eu</i>	152	63	Palladium	<i>Pd</i>	106	46
Fermium	<i>Fm</i>	[257]	100	Phosphorus	<i>P</i>	31	15
Fluorine	<i>F</i>	19	9	Platinum	<i>Pt</i>	195	78
Francium	<i>Fr</i>	[223]	87	Plutonium	<i>Pu</i>	[244]	94
Gadolinium	<i>Gd</i>	157	64	Polonium	<i>Po</i>	[209]	84
Gallium	<i>Ga</i>	70	31	Potassium	<i>K</i>	39	19
Germanium	<i>Ge</i>	73	32	Praseodymium	<i>Pr</i>	141	59
Gold	<i>Au</i>	197	79	Promethium	<i>Pm</i>	[145]	61
				Protactinium	<i>Pa</i>	231	91

TABLE OF ATOMIC WEIGHTS

Name (R-T)	Symbol	Atomic Weight	Atomic Number	Name (U-Z)	Symbol	Atomic Weight	Atomic Number
Radium	<i>Ra</i>	[226]	88	Ununbium	<i>Uub</i>	[285]	112
Radon	<i>Rn</i>	[222]	86	Ununhexium	<i>Uuh</i>	[293]	116
Rhenium	<i>Re</i>	186	75	Ununoctium	<i>Uuo</i>	[294]	118
Rhodium	<i>Rh</i>	103	45	Ununpentium	<i>Uup</i>	[288]	115
Roentgenium	<i>Rg</i>	[280]	111	Ununquadium	<i>Uuq</i>	[289]	114
Rubidium	<i>Rb</i>	85	37	Ununtrium	<i>Uut</i>	[284]	113
Ruthenium	<i>Ru</i>	101	44	Uranium	<i>U</i>	238	92
Rutherfordium	<i>Rf</i>	[267]	104	Vanadium	<i>V</i>	51	23
Samarium	<i>Sm</i>	150	62	Xenon	<i>Xe</i>	131	54
Scandium	<i>Sc</i>	45	21	Ytterbium	<i>Yb</i>	173	70
Seaborgium	<i>Sg</i>	[271]	106	Yttrium	<i>Y</i>	89	39
Selenium	<i>Se</i>	79	34	Zinc	<i>Zn</i>	65	30
Silicon	<i>Si</i>	28	14	Zirconium	<i>Zr</i>	91	40
Silver	<i>Ag</i>	108	47				
Sodium	<i>Na</i>	23	11				
Strontium	<i>Sr</i>	88	38				
Sulfur	<i>S</i>	32	16				
Tantalum	<i>Ta</i>	181	73				
Technetium	<i>Tc</i>	[98]	43				
Tellurium	<i>Te</i>	128	52				
Terbium	<i>Tb</i>	159	65				
Thallium	<i>Tl</i>	204	81				
Thorium	<i>Th</i>	232	90				
Thulium	<i>Tm</i>	169	69				
Tin	<i>Sn</i>	119	50				
Titanium	<i>Ti</i>	48	22				
Tungsten	<i>W</i>	184	74				

Notes

The Table is arranged in alphabetical order by name of element. The dashed lines indicate the start of a new alphabet.

The atomic weights have been rounded off.

The atomic weights of elements with no stable nuclides are in brackets, e.g., [244]. The values indicate the mass number of the longest-lived isotope of the element.

PROBLEMS

Problem 1

a. Provide a formula that defines Equivalent Weight.

b. Define molarity. Make sure you indicate whether the quantities refer to the solute, the solvent or the total preparation

c. What is the volume (**in liters**) occupied by 1 mole of an ideal gas at 0°C, 1 atmosphere pressure.

d. State the ideal gas law. Indicate what the terms represent.

e. Write the formula that describes the relationship between temperature in Kelvin and temperature in Celsius.

f. What factor or constant can be used to determine the number of molecules, given the number of moles?

Problem 2

a. What are units of molecular weight?

b. Define equivalent weight. **Do NOT** give the practical formula $EW = MW/Valence$.

c. Lithium (Li^+) salts are used to treat manic depression. What is the valence of lithium citrate, $Li_3^+(C_6H_5O_7)^{3-}$?

d. What is the equivalent weight of ferrous iron, Fe^{2+} ?

e. What is the valence of ferric pyrophosphate, $Fe_4^{3+}(P_2O_7)_3^{4-}$?

f. Convert a concentration of 1.45 M to millimoles/ml.

Problem 3

Oral calcium supplements are widely recommended for the prevention of osteoporosis in post-menopausal women and as a dietary supplement in nursing and pregnant women. A variety of calcium salts, such as those listed in the table below, can be used.

Salt	Formula	F.W.	Calcium Content
Calcium carbonate	CaCO_3	100.1	
Calcium chloride	CaCl_2	111.0	
Calcium citrate	$\text{Ca}_3\text{C}_{12}\text{H}_{10}\text{O}_{14}$	498.4	
Calcium lactate	$\text{CaC}_6\text{H}_{10}\text{O}_6$	218.2	
Dibasic calcium phosphate	CaHPO_4	136.1	
Monobasic calcium phosphate	$\text{Ca}(\text{H}_2\text{PO}_4)_2$	234.1	
Tribasic calcium phosphate	$\text{Ca}_3(\text{PO}_4)_2$	310.2	

a. Calculate the calcium content of each salt in g/g?

b. Calculate the calcium content of each salt in % w/w?

c. Calculate the calcium content of each salt in mEq calcium per gram?

Problem 4

Choose a compound, preferably a salt, for which you know the chemical formula and atomic weights. Show that the elements in the compound are combined in equal number of equivalents.

Problem 5

Fill in the blanks in the following table.

Ion	Formula	Valence	Formula Weight	Equivalent Weight
Ammonium	NH_4^+	1		18
Calcium	Ca^{++}	2	40	
Iron (III)	Fe^{+++}		56	18.67
Iron (II)		2		
Lithium	Li^+	1	7	
Magnesium	Mg^{++}	2		12
Potassium	K^+		39	39
Sodium	Na^+	1		23
Acetate	CH_3COO^-	1	59	
Bicarbonate	HCO_3^-	1		61
Carbonate	CO_3^{2-}	2	60	
Chloride	Cl^-	1	35.5	
Citrate	$\text{C}_6\text{H}_5\text{O}_7^{3-}$	3		63
Gluconate	$\text{C}_6\text{H}_{11}\text{O}_7^-$	1	195	
Lactate	$\text{C}_3\text{H}_5\text{O}_3^-$	1	89	
Phosphate	H_2PO_4^-	1		97
	HPO_4^{2-}	2		
Sulfate	SO_4^{2-}	2	96	

Problem 6

Phone 853-2020	Hans N. Franz		DEA# AK0365420
	101 Nealon St.		
	New York, NY 14003		
Name	Pat Chris	Age	26
Address	Sweeney St., New York, NY 14004	Date	1/10/05
Rx	Dried Ferrous sulfate tablets		150 mg
	Disp: 4 wk supply.		
	Sig: 50 mg elemental iron tid		

Dried ferrous sulfate has the formula $\text{FeSO}_4 \cdot \text{H}_2\text{O}$ and has a molecular weight of 170 grams/mole.

a. What is the valence of dried ferrous sulfate.

b. What is the equivalent weight of dried ferrous sulfate?

c. Calculate the iron content of dried ferrous sulfate in **grams of iron per gram of dried ferrous sulfate**.

d. Calculate the iron content in mg per tablet.

e. What instruction would you give the patient?

Problem 7

Phone 716-555-1234		DEA# AT -12736280			
Dr. Nina Pañales, M.D.					
Name	Camilla Charles	Age	7yr	Height	60 cm
Address	8 Buckingham Pl, London	Date	8/18/02	Weight	20 kg
Rx		Aluminium hydroxide 500 mg			
		i tid prn heartburn		<u>N. Pañales, MD</u>	

Aluminium hydroxide is $Al^{3+}(OH)_3^-$. It has a molecular weight of 78.

a. What is valence of aluminum hydroxide?

b. What is the equivalent weight of aluminum hydroxide?

c. How many **millimoles** of aluminum hydroxide are present in each dose?

d. How many **milliequivalent** of aluminum hydroxide are present in each dose?

e. Aluminum hydroxide reacts with stomach acid. How many **milliequivalents** of stomach acid will each dose neutralize?

Problem 8

Phone 555-3784	DEA# BS0365420			
<p>Dr. Celeste Babar 12 Flamingo St. Celesteville, TX 90210</p>				
Name	Flora Zephir	Age	23	
Weight	80 kg	Date	1/10/95	
Address	144 Pool St, Celesteville, TX 90210		Height	5 ft 10 in
<p>Rx Take 100 mEq of ammonium chloride from 26.75% w/v ammonium chloride parenteral concentrate solution. Dilute the parenteral concentrate by mixing with 500 ml NS. Infuse 4 g at 5 ml/min q6h for metabolic alkalosis</p>				
Refill	<u>Flora Zephir, M.D.</u>			

Ammonium chloride ($NH_4^+Cl^-$) has a molecular weight of 53.5 and is an acidifying agent.

a. Express the concentration of ammonium chloride in the **parenteral concentrate** in mg/ml.

b. Express the concentration of ammonium chloride in the **parenteral concentrate** in grams/liter.

c. Express the concentration of ammonium chloride in the **parenteral concentrate** in molarity.

d. Express the concentration of ammonium chloride in the **parenteral concentrate** in milliequivalents/ml.

Problem 9

Phone 716-555-1234		DEA# AM -12736280	
Atria Venacava, M.D. Cupid Ave, Pericardia, AK			
Name	Venus Bypass	Age	65
Address	Artery Blvd, Pericardia	Date	8/18/97
		Height	160 cm
		Weight	85 kg
Rx	Protamine sulfate 50 mg Water qs ad 5 ml Administer by very slow IV injection over 3 min. Repeat if necessary to reduce bleeding. No more than 50 mg over 10 min.		

Usually patients undergoing open-heart surgery are administered heparin to prevent clotting in the heart-lung machine. During recovery however, protamine sulfate, a heparin antagonist, is administered to prevent excessive bleeding. Protamine sulfate is a **polycationic** protein, and because heparin is a **polyanion**, protamine sulfate binds heparin via ionic interactions and neutralizes it. Excess protamine sulfate however, is undesirable because of associated toxicities.

a. What is the concentration of protamine sulfate in **mg/ml** in the injection?

b. Generally 1 mg of protamine sulfate will neutralize 100 units of heparin. What dose of heparin **in units** will a single 50 mg dose of protamine sulfate neutralize?

c. Heparin has a specific activity of 150 units per mg. How many **milligrams** of heparin are neutralized by a single 50 mg dose of protamine sulfate?

d. Heparin has a molecular weight of 12000. How many moles of heparin are neutralized by 50 mg of protamine sulfate?

e. Protamine sulfate has a molecular weight of 15000. Determine the number of moles of protamine sulfate in 50 mg.

Problem 10

Phone 853-2020		Candy Kane		DEA #AC9124366	
		Marshmallow, KS			
Name	Caramel Praline	Age	37	Weight	140 lb
Address	Taffy Lane, Marshmallow, KS	Date	5/3/99	Height	160 cm
Rx NH ₄ Cl 5 mEq/5ml Syrup qs DTD #50; Sig: 1 tsp prn cough					

- a. Calculate the equivalent weight of ammonium chloride.

- b. Calculate the **milliequivalents** of ammonium ions **per dose**?

- c. Calculate the **total** number of **milliequivalents** of **ammonium chloride** dispensed?

- d. Calculate the **total** number of **milliequivalents** of **chloride ion** dispensed?

- e. How much ammonium chloride, **in milligrams**, is required for compounding this prescription?

Problem 11

Phone 716-555-1234		DEA# BD -12736280			
Dr. Nueve Diaz, M.D.					
Name	Flores Mercado	Age	27yr	Height	160 cm
Address	8 Sierte Pl, London	Date	7/5/06	Weight	80 kg
<p>Rx Potassium chloride solution 2 M Mft SA 250 ml sol 10 mmoles bid</p>					

Potassium chloride has the formula (K^+Cl^-) and the molecular weight 74.5.

a. What instructions would you give the patient?

b. Express the potassium chloride concentration in Normality?

c. Express the potassium chloride concentration in grams/liter?

d. Express the potassium chloride concentration in percent w/v?

e. Express the **potassium ion** concentration in percent w/v?

f. Express the **potassium ion** concentration in mg/ml

Problem 12

Phone 555-1212	Blanca Clavela		DEA #AR9124366		
	101 New Road				
	Newleaf, MT				
Name	Nicola Rooster	Age	8	Weight	88.2 lb
Address	Fianna Ave, Newleaf, ID	Date	1/31/06	Height	135 cm
	Rx Potassium chloride		10 mEq/15 ml		
	Cherry syrup		qs ad 105 ml		
	Sig: 15 ml tid				

a. What is the equivalent weight of potassium chloride ($K^+ Cl^-$)?

b. Determine the concentration of potassium chloride in mEq/ml.

c. What is the concentration of potassium chloride in mmoles/ml?

d. What is the concentration of **potassium ion** in mEq/ml?

e. What is the concentration of **chloride ion** in mEq/ml?

f. How much potassium chloride should be weighed out?

Problem 13

Phone 555-1212	Desiree Kipfler		DEA #AR9124366		
	101 Spud St.				
	King Edward, ID				
Name	Russet Burbank	Age	35	Weight	140 lb
Address	Tate Ave, King Edward, ID	Date	1/31/06	Height	160 cm
	R NH ₄ Cl 5 mEq/5ml Syrup qs DTD #30 I Sig: 1 tsp prn cough				

- a. Determine the concentration of ammonium chloride in mmoles/ml?

- b. Determine the concentration of ammonium chloride in mg/ml?

- c. How much ammonium chloride (in mg) is administered in a single dose?

- d. How much ammonium chloride is required for compounding this prescription?

Problem 14

Phone 853-2020		Phoebe Gaia Jackson, MS		DEA #AC9124366	
Name	Eve Adams	Age	32	Weight	150 lb
Address	Red Apple Ave, Eden, NY	Date	5/3/99	Height	5 ft 8"
Rx Ferrous sulfate syrup Disp: 2 week supply Sig: 400 mg Ferrous sulfate (anhydrous) b.i.d.					

The USP formula for Ferrous sulfate syrup is:

Ferrous Sulfate. 7H ₂ O	40
Citric acid. H ₂ O	2
Sucrose	825
Water q.s. a.d.	1000

The molecular weights of ferrous sulfate heptahydrate (FeSO₄ · 7H₂O), citric acid monohydrate and sucrose are 278, 210 and 342, respectively.

a. Rewrite the formula in terms of molarity.

b. Determine the number of milliequivalents of iron, sulfate and citrate per ml?

c. Determine the iron content in mg/ml of syrup?

d. What is the daily dose of iron received by Eva Adams?

Problem 15

Phone 853-2020		Beldar Konehed		DEA# AK0365420	
		101 State St., Remulac			
Name	Connie Bluntskul	Age	26		
Address	Prymaat St., Remulac, NM 14004		Date	1/10/95	
	Rx	Magnesium hydroxide	13 mEq/5 ml		
		Cherry flavor	qs		
		Water qs	100 ml		
Disp 250 ml. Sig 5 ml prn acidity					

Magnesium hydroxide has the formula $Mg(OH)_2$.

a. Calculate the concentration of magnesium hydroxide in mEq/ml.

b. Calculate the equivalent weight of magnesium hydroxide.

c. Calculate the concentration in mg/ml.

d. How much magnesium hydroxide is required?

e. If the acid in the stomach is assumed to be primarily hydrochloric acid, how many equivalents of hydrochloric acid are neutralized by a single dose?

f. How many grams of hydrochloric acid are neutralized?

Problem 16

Phone 716-555-1234		DEA# AM -12736280	
Dr. Gale Monsoon, M.D. Blizzard Ave, Cyclone City, FL			
Name	Tempest Windstorm	Age	65
		Height	160 cm
Address	Windy City Ave, Chicago	Date	8/18/97
		Weight	85 kg
Rx Sodium bicarbonate		420 mg	
DTD: 24 tabs. Sig: ii tab qid			

This is a recipe for an antacid. Sodium bicarbonate ($Na^+(HCO_3)^-$) has a molecular weight of 84.

- a. The Food and Drug Administration requires that each dose of an approved antacid contain at least 5 mEq of acid neutralizing power per dose. Does **each** tablet of this antacid meet this requirement? Show your reasoning.

- b. The daily dose of sodium bicarbonate should not exceed 200 mEq/day in patients younger than 60 years and 100 mEq in patients over 60 years of age. Is this dose safe?

After a couple of days, your patient calls and complains of gastric distension and flatulence. After consulting the physician, you substitute the sodium bicarbonate with milk of magnesia, which is a suspension containing **290 mg** of magnesium hydroxide ($Mg^{2+}(OH^-)_2$, molecular weight 58) **per 5 ml**. Answer the following questions regarding the milk of magnesia regimen

- c. What is the equivalent weight of magnesium hydroxide?

- d. How many milliequivalents of magnesium hydroxide should be provided by the milk of magnesia in each dose?

Problem continues...

Problem continued

- e. What dosing instructions would you give the patient regarding the milk of magnesia?

After a couple of days, your patient calls and now complains of laxative effects and diarrhea. After consulting the physician, you substitute the milk of magnesia with aluminum hydroxide tablets ($Al^{3+}(OH^-)_3$, molecular weight 78). Answer the following questions regarding the aluminum hydroxide tablets.

- f. What is the valence of aluminum hydroxide?

- g. You have capsules containing 475 mg or 500 mg, and tablets containing 300 mg or 600 mg aluminum hydroxide. Which dosage form provides the nearest dosage substitution?

Problem 17

YOKO MFUME HOSPITAL 110 CAPITOL STREET, CAPITOLA, NY		
Hospital policy requires a 24-hour expiration date on compounded IV admixtures.	Bush, B No. 90210 Age: 9 63 Wright St., Houston, TX	Weight: 25 kg Room: 101A H. Clinton, M.D.
Rx 1/16/92, 10 am: 40 mEq of K ⁺ per L in 5% dextrose and 0.9% NaCl. Infuse 1L of solution over 4 hrs.		

The potassium ion is derived from potassium chloride (KCl).

a. Determine the concentration of **Potassium chloride** in **mg/ml**.

b. Determine the concentration of **Sodium** chloride in **mg/ml**?

c. Determine the equivalent weight of **Sodium** chloride.

d. Determine the concentration of **Sodium chloride** in **milliequivalents per liter**.

e. Determine the concentration of the **Chloride ion** in **milliequivalents per liter**.

Problem 18

Phone 555-3784		Robin Crow	
		101 Hummingbird St.	
		Finch, VT	
Name	Avian Crane	Age	32
		Weight	50 kg
Address	Sandpiper Ave, Canary, VT	Date	9/6/96
		Height	5 ft 6"
R Digoxin immune Fab qs. Infuse 1:100 dilution of Fab in NS IV stat			

Digoxin immune Fab is an antibody-derived protein drug that is administered for digoxin poisoning, a condition that is life threatening if not treated. 1 mg of Digoxin immune Fab binds 15 µg of Digoxin.

a. Convert the concentration of diluted Digoxin Fab into **mg/ml**.

b. The dose of digoxin immune Fab is determined by the extent of the poisoning. This patient has consumed thirty five 0.2 mg capsules of digoxin. What is the minimum dose of digoxin immune Fab required for this patient?

c. Determine total volume of the 1:100 solution that must be infused.

d. One mole of the Fab binds exactly one mole of digoxin. If the molecular weight of digoxin is 781 grams/mole, determine the molecular weight of Digoxin immune Fab.

Problem 19

Phone 555-3784			
John Johnson			
66 Sing Sing Ave, Walla Walla, WA			
Name	Bill Williams	Age	39
		Weight	111 kg
Address	11 Bora Bora St, Walla Walla, WA	Date	9/6/96
		Height	5 ft 3"
Rx Infuse 500 ml of solution containing 100 mEq of ammonium chloride in NS. Infuse at 2.5 ml/min.			

- a. What is the equivalent weight of ammonium chloride (NH₄Cl)?

- b. Calculate the concentration of ammonium chloride in mEq/ml.

- c. Calculate the molar concentration of ammonium chloride.

- d. Calculate the concentration of ammonium chloride in mg/ml.

- e. Calculate the milliequivalents of **sodium chloride** (NaCl) per **liter** of NS.

- f. Calculate the **total** concentration of **chloride** ions in the **mixture** in mEq/ml.

Problem 20

Wendy McDonald Fries Hospital, Mayo, MN 14226 716-789-0123			
Name	<u>Arby Burger-King</u>	Age	<u>70</u>
		Weight	<u>50 kg</u>
Address	<u>Patty Street, Mayo</u>	Date	<u>10/1/97</u>
		Height	<u>5' 3"</u>
R_x 1200 ml D5W IV infusion over 10 hour .			

a. What is the concentration of dextrose in D5W in %w/v

b. Express the concentration of dextrose in grams/liter.

c. Dextrose has a molecular weight of 180 grams/mole. Calculate the concentration in molarity.

d. Calculate the D5W flow rate in ml/min.

e. The maximum allowable dextrose dosing rate is 0.8 g/(kg hour). Is this infusion safe?

Problem 21

Dr. Jordan Tibbet			
Colombia, SC 12002			
Name	Kenya Israel	Age	_____ Weight 45 kg
Address	1 Cameroon St, Colombia, SC	Date	8/18/08 Height 125 cm
Rx		Sodium polystyrene sulfonate suspension 1.25 g/5 ml	
Sig 15 g bid			

Sodium polystyrene sulfonate is an ion exchange resin used to reduce potassium levels in patients with hyperkalemia.

a. Express the concentration of sodium polystyrene sulfonate in **grams/ml**.

b. What is the volume of a single dose?

c. What instructions will you give the patient.

d. 1 gram of sodium polystyrene sulfonate combines with 3 mEq of potassium. Calculate the equivalent weight of sodium polystyrene sulfonate ions.

Problem 22

Dr. Westin Hilton			
Mariotta, GA 47002			
Name	Howie Johnson	Age	40
		Weight	100 kg
Address	8 Raddisson St, Hyatt, GA	Date	18/8/07
		Height	5ft 8"
	Rx Calcium chloride parenteral solution Administer IV 10 mEq of Ca^{2+}		10% w/v

a. How many mEq of calcium chloride are required?

b. What is the equivalent weight of calcium chloride (CaCl_2 , Molecular weight = 111)?

c. What is the valence of calcium chloride?

d. What is the concentration of calcium chloride in mmoles/ml?

e. What is the concentration of calcium chloride in mEq/ml?

f. What volume of the parenteral solution should be administered?

Problem 23

Phone 888-1212-2020	Dr. Virginia Montana		DEA# AM0365420
	Delaware Street		
	Nevada, IA 14002		
Name	Carolina Washington	Age	30
Address	California Street, Nevada, IA	Date	9/23/07
Rx Milk of magnesia 100 ml Sig: 2 \mathfrak{z} bid for 3 days			

Milk of magnesia is an 8.7% w/v aqueous suspension of magnesium hydroxide, $\text{Mg}(\text{OH})_2$ (molecular weight = 58).

a. What is the valence of magnesium hydroxide.

b. What is the concentration of magnesium hydroxide in mg/ml?

c. What is the equivalent weight of magnesium hydroxide? Indicate units.

d. What is the concentration of magnesium hydroxide in mEq/ml?

e. How many mEq of hydrochloric acid will a single dose of this antacid neutralize?

Problem 24

Phone 818-1212-2121	Dr. Ricky Springer,		DEA# AS0365420
	99-A Montel Ave		
	Talkville, NC		
Name	Leeza Povich	Age	30
Address	Lake Street, Talkville, IA	Date	9/23/07
Rx	Calcium carbonate qs m ft 36 caps so that patient receives 1000 mg/day calcium Sig: i cap tid pc		

Calcium carbonate is a white, water insoluble solid with the chemical formula CaCO_3 .

a. What is the molecular weight of calcium carbonate?

b. What is valence of calcium carbonate?

c. Determine the equivalent weight of calcium carbonate.

d. What is the calcium content of calcium carbonate in g/g

e. What is the daily dose of **calcium carbonate**?

f. How much **calcium carbonate** is present in a single capsule?

Problem 25

Phone 818-1212-2121	Dr. Pete Moss, 88 Jetsam Lane Driftwood, AK		DEA# BM0365420
Name	Leaf Sphagnum	Age	25
Address	Compost Street, Driftwood, AK	Date	9/23/07
Rx	Magnesium carbonate	840 mg	
	Calcium carbonate	500 mg	
	Disp 24 tabs		
	Sig: i cap tid pc		

This is a recipe for an antacid tablet. Magnesium carbonate has the formula $MgCO_3$ and calcium carbonate has the formula $CaCO_3$.

a. What is the molecular weight of magnesium carbonate?

b. What is the concentration of **magnesium carbonate** in %w/w?

c. How many moles of **magnesium** carbonate are present in each tablet?

d. How many moles of **calcium** carbonate are present in each tablet?

e. What is the **mole %** of **calcium** carbonate in the tablet?

Problem 26

Phone 716-555-1234		DEA# BB -12736280			
Dr. Frank Blunt, M.D. 3 Laconic Ave Candid, NC					
Name	Curt Gruff	Age	25	Height	130 cm
Address	Direct Ave, Candid	Date	8/18/97	Weight	71 kg
<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <p>Rx Ferrous fumarate tablets 100 mg Disp 100 tabs Sig: i cap qd</p> </div> <div style="width: 35%; text-align: center;"> <p><u>F. Blunt, MD</u></p> </div> </div>					

Ferrous fumarate or Iron (II) fumarate ($Fe^{2+}(C_4H_2O_4)^{2-}$), molecular weight 170) is a commonly used iron supplement used for treating iron deficiency anemia and for pregnant women.

a. What is the valence of iron in ferrous fumarate?

b. What is equivalent weight of ferrous fumarate?

c. What is the iron content of ferrous fumarate in **mg/g**?

d. What is the dose of iron in a single tablet of ferrous fumarate in mg?

e. What is dose of iron in a tablet of ferrous fumarate in mEq?

Problem 27

Phone 716-555-1234		DEA# AT -12736280			
Dr. Loqua Cious, M.D. 3 Prolix Ave Prattle, NC					
Name	Gabby Verbose	Age	25	Height	130 cm
Address	Prolix Ave, Prattle	Date	8/18/97	Weight	71 kg
Rx		Infuse 30 ml/kg of 1/6 M sodium lactate solution over 15 min.			
					<u>L. Cious, MD</u>

Sodium lactate ($Na + (CH_3CH(OH)COO)^-$), molecular weight 112) is an alkalanizing agent that is used for treating mild and moderate acidosis. It is a racemic salt consisting of equal amounts of *d*-isomer and *l*-isomer.

a. What is the valence of sodium lactate?

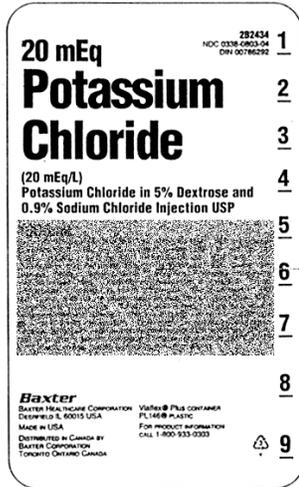
b. Express the concentration of sodium lactate in mEq/ml.

c. Express the concentration of sodium lactate in mg/ml.

d. Express the concentration of sodium lactate as a percentage.

e. Express the **dose** of sodium lactate in **mg/kg**.

Problem 28



Phone 716-555-1234		DEA# AT-12736280	
Dr. Iris Sclera, M.D. Pupil Street Macula, MO			
Name	<u>Cornea Conjunctiva</u>	Age	<u>25</u>
Address	<u>Choroid St, Macula, MO</u>	Date	<u>8/18/97</u>
		Height	<u>130 cm</u>
		Weight	<u>71 kg</u>
Rx Infuse 1000 ml of NS over 1 hour. Then infuse 20 mEq/L KCl in NS containing 5% dextrose at a rate of 10 mEq/hr of K ⁺ for 2 hrs.			
<u>L. Sclera, MD</u>			

Answer the following questions using the label and prescription above

a. What is the concentration of potassium chloride (K⁺ Cl⁻) in Normality?

b. How much solution is available in the package?

c. What is the infusion flow rate?

d. What is potassium chloride flow rate in **mEq/min**?

e. What is total dose of potassium chloride?

Problem 29

Phone 716-555-1234		DEA# AT -12736280			
Dr. Otis Media, M.D. 3 Cochlear Ave Tympanum, NC					
Name	Incus Stapes	Age	25	Height	130 cm
Address	Malleus Ave, Tympanum	Date	8/18/97	Weight	70 kg
<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="font-size: 2em; font-weight: bold; margin-right: 10px;">R_x</div> <div> Lithium citrate syrup 8 mEq Lithium ion per 5 ml. Sig: 13 tid </div> </div>					
<u>Otis Media, MD</u>					

Lithium citrate ($Li_3^+(C_6H_5O_7)^{3-}$, molecular weight 210) is used to treat manic depression.

a. What is the valence of lithium citrate?

b. What instructions would you give the patient?

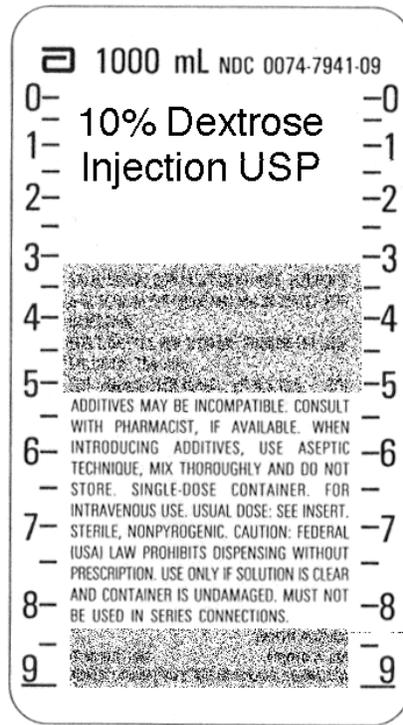
c. What is the concentration of lithium citrate in **mEq/ml**?

d. What is the concentration of lithium citrate in **mg/ml**?

e. What is the concentration of lithium ion in **mg/ml**?

f. What is the daily dose of lithium ion in **mEq/kg**?

Problem 30



Dextrose is a solid with molecular weight of 180.

a. Express the concentration of dextrose in mg/ml

b. What is the concentration of dextrose in g/L?

c. What is the concentration of dextrose in molarity?

d. What is the concentration of dextrose in parts strength?

e. Determine the **millimoles** of dextrose present in the preparation.

Problem 31

Phone 716-555-1234		DEA# AT -12736280			
<p>Dr. Penny Shilling, M.D. 3 Euro Court Lira, GA</p>					
Name	Mark Guilder	Age	45 yr	Height	5 ft 8 in
Address	87 Pound Lane, Lira	Date	8/18/97	Weight	100 kg
<p>R Potassium bicarbonate qs m ft SA 36 tab each containing 25 mmoles of potassium ion Sig: 25 mmoles potassium ion bid dissolve with 8 oz OJ</p>					

Potassium bicarbonate has the formula KHCO_3 .

a. What instructions would you give the patient?

b. What is the molecular weight of potassium bicarbonate?

c. How many millimoles of **potassium bicarbonate** are required for each dose?

d. How many grams of **potassium bicarbonate** are present in each tablet?

e. What is the concentration of potassium ion in potassium bicarbonate in mg/g?

Problem 32

Phone 716-555-1234	DEA# AT -12736280	
<p>Dr. May Showers, M.D. 3 April Court Augusta, GA</p>		
Name <u>June Flowers</u>	Age <u>45 yr</u>	Height <u>5 ft 8 in</u>
Address <u>87 April Lane, Augusta</u>	Date <u>8/18/97</u>	Weight <u>100 kg</u>
<p>R Infuse 42 mg/ml sodium bicarbonate solution at 1 mmole/kg intravenously over 1 hour</p> <p style="text-align: right;"><u>M Showers, MD</u></p>		

Sodium bicarbonate, a solid, has the formula NaHCO_3 .

a. Calculate the molecular weight of sodium bicarbonate?

b. What is the dosage form and route of administration? Both must be correct.

c. What is the sodium bicarbonate concentration in % w/v?

d. What is concentration of sodium bicarbonate in molarity?

e. What is the dose of sodium bicarbonate in **grams**?

Problem 33

Phone 716-555-1234	DEA# AT -12736280	
<p>Dr. Phil Anderer, M.D. 3 Casa Nova Don Juan, PR</p>		
Name <u>Ruth Lessness</u>	Age <u>45 yr</u>	Height <u>5 ft 8 in</u>
Address <u>87 Harsh Lane, Severe</u>	Date <u>8/18/97</u>	Weight <u>90 kg</u>
<p>R m ft. 1L of 0.3M tromethamine in sterile water Sig: Infuse 700 ml over 1 hour</p> <p style="text-align: right;"><u>P Anderer, MD</u></p>		

Tromethamine, a solid with molecular weight 120, is used for treating acidosis in cardiac bypass surgery.

a. How many moles of drug are dosed?

b. What is the infusion flow rate?

c. Express the concentration of tromethamine in mmoles/ml.

d. Express the concentration of tromethamine in grams/Liter.

e. Express the concentration in % w/v.

Problem 34

Dr. Serratia Marcesan, M.D.					
Name	Varicella Zoster	Age	25 yr	Height	5'9"
Address	87 Papilloma St, Coxsackie	Date	8/18/97	Weight	50 kg
	\mathcal{R} Potassium bicarbonate		312 mg		
	Sodium bicarbonate		958 mg		
	Citric acid monohydrate		832 mg		
	DTD#12. Sig: Dissolve 1 tab in 8 oz water bid prn heartburn				

This is an effervescent antacid tablet. Molecular weights: sodium bicarbonate ($Na^+HCO_3^-$) = 84, potassium bicarbonate ($K^+HCO_3^-$) = 100, and citric acid = 210.

a. What is the concentration of sodium ion in **pure** sodium bicarbonate in grams/gram?

b. What is the concentration of bicarbonate ion in **pure** sodium bicarbonate in grams/gram?

c. What is the concentration of sodium ion in the tablet?

d. Antacids must be labeled for sodium content if they contain more than 0.2 mEq of sodium per dose. What is the sodium content per dose in milliequivalents?

e. Assuming a glassful (8 ounces) is 240 ml, and that the effervescent reaction causes no change in volume, what is the concentration of sodium ion in the glass.

f. What is the concentration of bicarbonate ion in the tablet in grams/gram

Problem 35

Phone 716-555-1234		DEA# AT -12736280			
<p>Dr. Yersinia Pestis, M.D. 3 Sinbid Ave Coxsackie, NC</p>					
Name	Varicella Zoster	Age	25 yr	Height	5'9"
Address	87 Papilloma St, Coxsackie	Date	8/18/97	Weight	50 kg
<p style="text-align: center;"> ℞ Urea 300 mg/ml in D5W. Infuse 1 g/kg at 2 ml/min <u>Yersinia Pestis, MD</u> </p>					

Urea $\text{CO}(\text{NH}_2)_2$ is a solid (Molecular weight 56). It is used as a diuretic and to reduce intracranial or intraocular pressure preoperatively.

- a. Convert the urea concentration to percent strength. Be sure to indicate the suffix.

- b. Convert the urea concentration to parts strength.

- c. Convert the urea concentration to g/liter

- d. Convert the urea concentration to molarity.

- e. What is the drug dose in grams?

- f. What is the drug dose in **millimoles**?

Problem 36

Phone 716-555-1234		DEA# AT -12736280			
Dr. Angel Hair-Capellini, M.D. 3 Orzo Ave Rigatoni, NC					
Name	Penne Ditalini	Age	25 yr	Height	5'9"
Address	87 Ziti St, Rigatoni, NC	Date	8/18/97	Weight	50 kg
 Deferoxamine mesylate 500 mg IM		Angel Capellini, MD			

Deferoxamine mesylate is a chelating agent used as an antidote for lethal iron poisoning and chronic iron overloads in thalassemia and chronic anemia. Theoretically 1 g of deferoxamine mesylate reacts with 85 mg of ferric (Fe^{3+}) iron ions.

- a. What is the valence of the Fe^{3+} iron ion?

- b. What are units of equivalent weight?

- c. What is the equivalent weight of Fe^{3+} iron ion?

- d. How many milligrams of Fe^{3+} iron ion can the dose of deferoxamine mesylate theoretically neutralize?

- e. How many milliequivalents of Fe^{3+} iron ions are present in 85 mg of Fe^{3+} iron ions?

- f. Calculate the equivalent weight of desferoxamine mesylate.

Problem 37

Rusty Steele 101 Verdigris St. Barnacle Island, NY			
Name	Patina Copper	Age	26
Address	Tarnish St., Barnacle Island	Date	1/10/95
Rx	Magnesium hydroxide		13 mEq/5 ml
	Cherry flavor		qs
	Water qs		100 ml
Disp 250 ml. Sig 5 ml prn acidity			

Magnesium hydroxide has the formula $Mg^{2+}(OH)^{-}_2$ (molecular weight 58).

a. What is the valence of magnesium hydroxide?

b. Calculate the equivalent weight of magnesium hydroxide?

c. What is the valence of magnesium ion?

d. Calculate the equivalent weight of magnesium ion?

e. How many milliequivalents of magnesium ion are present per teaspoonful?

f. How many equivalents of stomach acid will a single dose neutralize?

Problem 38

Phone 555-3784					
Monterrey Clipper Galleon, CT 14210					
Name	Marina Dredger	Age	53	Wt	80 kg
Address	Harbor Road, Ferry Island 12205	Date	2/14/96	Height	170 cm
R_x Calcium carbonate suspension 1 g/5ml 5 ml bid prn heartburn					

Calcium carbonate ($Ca^{2+}CO_3^{2-}$) has a molecular weight of 100.

a. What instructions would you give the patient?

b. What is the calcium content of **pure** calcium carbonate in grams/gram.

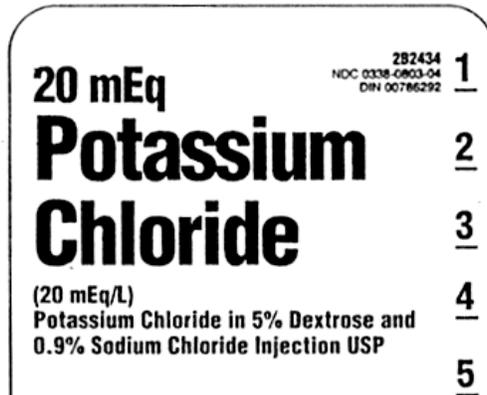
c. What is the valence of calcium carbonate?

d. How much calcium ion is present in a single dose?

e. Express the concentration of **calcium carbonate** in the **suspension** in mEq/ml.

f. Express the concentration of **calcium ion** in the **suspension** in mEq/ml.

Problem 39



Use the label fragment to answer the questions as needed. Potassium chloride is a crystalline solid and has the formula $K^+ Cl^-$.

a. What is the concentration of **POTASSIUM chloride** in mg/ml?

b. What is the concentration of **SODIUM chloride** in mg/ml?

c. What is the concentration of **SODIUM chloride** in mEq/ml?

d. What is the concentration of **chloride ion** in mEq/ml?

e. What is the concentration of **chloride ion** in mg/ml?

Problem 40

Phone 716-555-1234		DEA# AT -12736280			
Dr. Anna Phylaxis, M.D.					
Name	Al Lergen	Age	18 yr	Height	5'4" ft
Address	8 Wheezing Street, Springville	Date	8/18/02	Weight	125 lb
<p>Rx Potassium chloride 8 mEq of K⁺ DTD 30 extended release cap 2 cap tid</p> <p style="text-align: right;"><u>A. Phylaxis, MD</u></p>					

Potassium chloride has the formula (K⁺Cl⁻) is a solid. Its molecular weight is 74.5 grams/mole.

- a. What is the valence of potassium chloride?

- b. What is the equivalent weight of potassium chloride?

- c. How many **milliequivalents** of potassium chloride are present in each capsule?

- d. How many **milligrams** of **potassium chloride** are present in each capsule?

- e. How many **milligrams** of **potassium ion** are present in each capsule?

- f. How many **milligrams** of **chloride ion** are present in each capsule?

Problem 41

Phone 716-555-1234		DEA# AT -12736280			
Dr. Yasmin Cade, M.D.					
Name	Sharidon Cameron	Age	52 yr	Height	6ft 2 in
Address	8 Vinessa Ave, Dylanville	Date	8/18/02	Weight	100 kg
Rx	Diatrizoate meglumine 60% w/v Administer 10 ml in left knee joint. Obtain images within 15 min				

This is a drug that is used as an x-ray contrast agent. Diatrizoate meglumine is an effective contrast agent because it contains iodine. **Pure** diatrizoate meglumine contains 47.06% w/v iodine.

a. What is the **iodine** concentration in the solution dispensed in the prescription?

b. What is the **iodine** dose?

c. Each molecule of diatrizoate meglumine three atoms of iodine. What is the molecular weight of diatrizoate meglumine?

d. What is the concentration of the diatrizoate meglumine solution injected in molarity?

Problem 42

Dr. Millicent Pede 12 Locust St., Pappillon, TX 90210					
Name	Cicada Weevil	Age	23	Wt	80 kg
Address	144 Beetle St, Pappillon, TX 90210	Date	1/10/95	Height	5 ft 10 in
R_x Lithium citrate oral solution 5 ml qid			8 mEq per 5 ml		
Refill				<u>Millie Pede, M.D.</u>	

Lithium citrate ($Li_3^+(C_6H_5O_7)^{3-}$) has a molecular weight of 210 and is used to treat manic depressive illness. It is a solid.

a. Calculate the equivalent weight of lithium citrate.

b. Calculate the concentration of lithium citrate in **mg/ml**.

c. Express the concentration lithium citrate in **molarity**.

d. Express the concentration of lithium citrate in **percent strength**. Be sure to indicate the suffix.

e. Calculate the dose of **lithium ion** provided in a single dose of the solution. Express the dose in **milliequivalents** of lithium ion.

f. Calculate the dose of **lithium ion** provided in a single dose of the solution in **milligrams** of lithium ion.

Problem 43

Phone 716-555-1234		DEA# BV -12736280			
Dr. Licuadora Velocidades, M.D.					
Name	A. Blender	Age	18 yr	Height	5'4" ft
Address	8 Clam Street, Springville	Date	8/18/04	Weight	70 kg
Rx Edetate disodium parenteral concentrate 150 mg/ml Dilute the required quantity of parenteral concentrate with 500 ml D5W. Infuse 50 mg/kg (maximum of 3 grams) over 3 hrs.					

Edetate disodium (molecular weight = 336) is a chelating agent with valence 2 that binds calcium ions (Ca^{2+}) with high affinity. It has 2 atoms of sodium per molecule and is used for treating hypercalcemia.

a. What is the equivalent weight of edetate disodium?

b. What is the concentration of edetate disodium in the parenteral concentrate in **molarity**?

c. What is the concentration of edetate disodium in the parenteral concentrate in **normality**?

d. What is the concentration of edetate disodium in the parenteral concentrate in **milliequivalents/ml**?

e. How many **milliequivalents/ml** of **sodium ion** are present in the parenteral concentrate solution?

Problem continues...

Problem continued

f. How many **milligrams/ml** of **sodium ion** are present in the parenteral concentrate solution?

g. How many **milliequivalents** of **calcium ion** will each **milliliter** of the parenteral concentrate solution bind?

h. What is the equivalent weight of calcium ion?

i. How many **milligrams** of **calcium ion** will each **milliliter** of the parenteral concentrate solution bind?

Problem 44

Phone 716-555-1234		DEA# AT -12736280			
Dr. Alfresco Congelado, M.D.					
Name	Cocina Tiernas	Age	17yr	Height	60 cm
Address	8 Buckingham Pl, London	Date	8/18/04	Weight	20 kg
<p>Rx Magnesium sulfate solution 50 mEq Mg²⁺/5 ml 15 ml hs constipation. Dispense 150 ml <u>Al Congelado, MD</u></p>					

Anhydrous magnesium sulfate has the formula ($Mg^{2+}(SO_4)^{2-}$) is a solid and its molecular weight is 120 grams/mole.

a. What is the **magnesium ion** concentration in the solution in milligrams/ml?

b. What is the anhydrous **magnesium sulfate** concentration in the solution in milliequivalents/ml?

c. What is the anhydrous **magnesium sulfate** concentration in the solution in millimoles/ml?

d. What is the anhydrous **magnesium sulfate** concentration in the solution in milligrams/ml?

e. Magnesium sulfate is usually available as the more stable hydrated salt $Mg^{2+}(SO_4)^{2-} \cdot 7H_2O$ (molecular weight = 246), which also called Epsom salt. How much Epsom salt should be weighed (in **grams**) for this prescription?

Problem 45

Phone 716-555-1234		DEA# AT -12736280			
Dr. Nueve Diaz, M.D.					
Name	Flores Mercado	Age	7yr	Height	60 cm
Address	8 Sierte Pl, London	Date	8/18/02	Weight	20 kg
Rx	Aluminium hydroxide qs M ft SA caps that each neutralize 5 mEq of stomach acid i tid prn heartburn				

Aluminium hydroxide is $Al^{3+}(OH)_3^-$. It is used as an antacid and has a molecular weight of 78.

a. What is the equivalent weight of aluminum hydroxide?

b. How many **milliequivalents** of aluminum hydroxide must be present in each dose?

c. How many **milligrams** of aluminum hydroxide must be present in each dose?

d. Assume that the stomach acid is entirely hydrochloric acid (HCl). How many **grams** of hydrochloric acid will be neutralized by a single dose of aluminum hydroxide?

e. The concentration of hydrochloric acid in the gastric juice of the stomach is 0.15M. How many **milliliters** of gastric juice will be neutralized by a single dose?

Problem 46

Dr. Wendy Pan					
12 Tinkerbell St., Neverland, CA 90210					
Name	Peter Darling	Age	23	Weight	80 kg
Address	144 Hook St, Neverland, CA 90210	Date	1/10/95	Height	5 ft 10 in
<p>Rx Take 100 mEq of ammonium chloride from 26.75% w/v ammonium chloride parenteral concentrate solution. Dilute the parenteral concentrate by mixing with 500 ml NS. Infuse 4 g at 5 ml/min q6h for metabolic alkalosis</p>					

Ammonium chloride ($NH_4^+Cl^-$) has a molecular weight of 53.5 and is an acidifying agent. It reacts with bicarbonate ions (HCO_3^-) in blood to produce urea, carbon dioxide, water and chloride ions according to the reaction: $2NH_4Cl + 2HCO_3^- \rightarrow CO(NH_2)_2 + CO_2 + 3H_2O + Cl^-$

a. How much ammonium chloride in **grams** is removed from the **parenteral concentrate** container?

b. Calculate the **volume of parenteral concentrate solution** removed.

c. Express the amount of ammonium chloride in a **single dose** in **milliequivalents**.

d. How many grams of bicarbonate ion will be neutralized by a single dose?

e. How many grams of urea will be formed from a single dose?

f. How much infusion fluid is used up for a single dose.

Problem 47

Phone 716-555-1234		DEA# AT -12736280			
Dr. Alfresco Congelado, M.D.					
Name	Cocina Tiernas	Age	17yr	Height	60 cm
Address	8 Buckingham Pl, London	Date	8/18/04	Weight	20 kg
Rx	Aluminium hydroxide	200 mg			
	Magnesium hydroxide	200 mg			
	DTD 30 tablets. Sig: 1 tid.				

Magnesium hydroxide ($Mg^{2+}(OH)_2^-$) and aluminium hydroxide ($Al^{3+}(OH)_3^-$) have molecular weights of 58 grams/mole and 78 grams/mole, respectively.

a. What is the equivalent weight of magnesium hydroxide?

b. What is the equivalent weight of aluminum hydroxide?

c. How many milliequivalents of **magnesium ion** are present in each tablet?

d. How many milliequivalents of **aluminium ion** are present in each tablet?

e. How many milliequivalents of hydroxide ion are present in each tablet?

f. Both magnesium hydroxide and aluminum hydroxide react with stomach acid. Assuming stomach acid is hydrochloric acid (HCl), determine the mass of hydrochloric acid neutralized by a single tablet.

Problem 48

Phone 555-3784		DEA# BR0365420	
Dr. Barbara M. Roberts-Ken 12 Flamingo St., Celesteville, TX 20210			
Name	Chloe Bryce	Age	23
Weight	80 kg	Address	144 Yasmin St, Kobyville
Date	1/10/95	Height	5 ft 10 in
R Ammoniated mercury topical lotion AAA psoriasis bid		5% w/v	
Refill		Barbie Ken, M.D.	

Pure ammoniated mercury ($Hg(NH_2)Cl$) or mercury amide chloride is a powder and has a molecular weight of 252 and has bacteriostatic activity.

a. What is the **mercury** content of **PURE** ammoniated mercury powder in **grams/gram**?

b. What is the **mercury** content of **PURE** ammoniated mercury powder in **percent w/w**?

c. Express the concentration of **ammoniated mercury** in the **lotion** in grams/liter.

d. Express the concentration of **ammoniated mercury** in the **lotion** in molarity.

e. Express the concentration of **mercury** in the **lotion** in molarity.

f. Express the concentration of **mercury** in the **lotion** in mg/ml.

Problem 49

Dr. Neon Mercury 12 Cuprum St. Krypton, TX 90210					
Name	Argon Lanthanum	Age	23	Height	5 ft 10 in
Address	8 Plutonium Pl, Krypton	Date	1/18/04	Weight	120 kg
Rx	Lithium carbonate capsules DTD #30. One cap tid pc		16.24 mEq		

Lithium carbonate ($Li_2^+(CO_3)^{2-}$) has a molecular weight of 74 and is used to treat manic disorders

- What is the valence of **lithium carbonate**?

- What is the equivalent weight of lithium carbonate.

- What is the equivalent weight of lithium ion.

- Calculate the mass of lithium carbonate in each capsule in milligrams.

- Calculate the dose of **lithium** ion in each capsule in milligrams.

- Lithium carbonate happens also to react with stomach acid to form carbon dioxide and lithium chloride. Consider stomach acid to be hydrochloric acid (HCl), calculate the number of milligrams of hydrochloric acid neutralized by a single capsule.

Problem 50

Phone 716-555-1234		DEA# AP -12736280			
Dr. India Paleale, M.D.					
Name	Flanders Stout	Age	17yr	Height	60 cm
Address	8 Lager Ave, Pilsener	Date	8/18/04	Weight	20 kg
Rx Potassium iodide oral solution 325 mg/5 ml 325 mg potassium iodide tid.					

Potassium iodide has the formula (K^+I^-).

a. What is the molecular weight of potassium iodide?

b. What is the equivalent weight of potassium iodide?

c. What is the potassium iodide concentration in **molarity**.

d. What is the potassium iodide concentration in **milliequivalents/ml**?

e. How many **milligrams** of potassium ion are present in **each dose**?

f. How many **milligrams** of **iodide ion** are present in **each dose**?

Problem 51

Phone 555-3784		DEA# BS0365420	
Dr. Daphne Blake-Rogers 12 Scoobyville St., Norville, TX 10210			
Name	Velma Dinkley-Jones	Age	23
Wt	80 kg		
Address	144 Freddy St, Norville	Date	1/10/95
Height	5 ft 10 in		
Rx	Omalizumab 150 mg dissolved in 1.2 ml of reconstitution solution 150 mg sc q2 weeks		
Refill	<u>Daphne Blake, M.D.</u>		

Omalizumab is a monoclonal antibody used to treat asthma. It reduces the allergic responses that can trigger asthma attacks.

Omalizumab has two binding sites for immunoglobulin E, an immunoglobulin that mediates allergies. One molecule of reacts with 2 molecules of immunoglobulin E, i.e. the valence of omalizumab is 2.

The molecular weight of omalizumab is 150,000 grams/mole and the molecular weight of immunoglobulin E is 190,000 grams/mole.

a. Calculate the concentration of omalizumab in mg/ml.

b. Calculate the concentration of omalizumab in millimoles/ml?

c. Express the concentration of omalizumab in **nanomoles/ml**.

d. Express the concentration of omalizumab in mEq/ml.

e. How many milligrams of immunoglobulin E will a single dose of omalizumab neutralize.

Problem 52

Phone 515-555-1515		Dr. Brie Romano		DEA# BR -12736280	
12 Ricotta St., Cheddar, WI 80210					
Name	Mozzarella Roquefort	Age	24	Height	5 ft 10 in
Address	144 Gouda St, Cheddar, WI	Date	1/21/06	Weight	120 kg
Rx	Potassium citrate tablets 10 mEq DTD #30. Two tablet tid pc				

Potassium citrate ($K_3^+(C_6H_5O_7)^{3-}$) has a molecular weight of 306 and is used to as a urinary alkalinizer in patients with kidney stones.

a. What is the valence of **potassium citrate**?

b. What is the equivalent weight of potassium citrate.

c. What is the potassium ion content of each tablet in millequivalents.

d. Calculate the potassium content in each tablet in milligrams.

e. Calculate the mass of potassium citrate in each tablet in milligrams.

f. Potassium citrate is converted via the biochemical processes to potassium bicarbonate ($K^+(HCO_3)^-$), which is responsible for urine alkalization. Calculate the milligrams of potassium bicarbonate formed from each tablet.

Problem 53

Phone 716-555-1234		Dr. Nori Sashimi, M.D.		DEA# AT -12736280	
Name	Seiyo Wasabi	Age	52 yr	Height	6ft 2 in
Address	Daikon St, Namida, AL	Date	8/18/04	Weight	100 kg
Rx	Sodium fluoride solution containing 0.09% w/v fluoride ion Dispense 100 ml Rinse 10ml solution over sensitized teeth for 1 minute, spit out qhs after brushing				

The formula for sodium fluoride is Na^+F^- .

a. Calculate the concentration of **fluoride ion** in the solution in mg/ml?

b. Calculate the concentration of **sodium fluoride** in the solution in mg/ml?

c. Calculate the concentration of sodium ion in the solution in mg/ml?

d. Calculate the sodium fluoride concentration in ppm?

e. Calculate the sodium fluoride concentration in mmoles/ml?

f. Calculate the sodium fluoride concentration in mEq/ml?

Problem 54

Phone 716-555-1234		Dr. Ginger Nutmeg, M.D.		DEA# BN 12736280	
Name	Star Anise	Age	17yr	Height	60 cm
Address	8 Pepper Pl, Fennel	Date	8/18/04	Weight	20 kg
Rx Potassium iodide 100 mg/ml Iodine 50 mg/ml Mft this "strong iodide" solution 100 ml Sig: 1ml tid pc for thyrotoxic crisis					

Strong iodide solution is a solution of potassium iodide containing iodine. Potassium iodide has the formula (K^+I^-).

a. What is the valence of potassium iodide?

b. What is the concentration of potassium iodide in normality?

c. What is the potassium ion concentration in **molarity**.

d. Both potassium iodide and iodine contribute iodine. What is the total iodide concentration in **molarity**?

e. How many **milligrams** of potassium ion are present in **each dose**?

f. How many **milligrams** of total **iodine** are present in **each dose**?

GASES

Problem 55

- a. State the ideal gas law. Define the terms.
- b. Rewrite the gas law in terms of gas density?
- c. Calculate the molecular weight of air. Assume air contains 80% v/v nitrogen and 20% v/v oxygen.
- d. What are the units of R, the gas constant? Give a specific example.
-
- e. State the molar volume of an ideal gas at 1 atmosphere and 0°C.
-

Problem 56

- a. You have 500 moles of air. Assume air contains 80% v/v nitrogen and 20% v/v oxygen. Calculate the number of moles of oxygen present.

- b. Lois Lane and Superman marry and decide to move to the planet Krypton. The atmosphere is in Krypton consists of pure krypton gas (molecular weight 83.8). What is the volume of 83.8 grams of krypton at STP?

- c. Oxygen (O_2) has a molecular weight of 32 grams/mole. What volume would 320 grams of oxygen occupy at standard temperature and pressure?

Problem 57

a. Assuming dry air to be 79% v/v percent nitrogen and 21% v/v oxygen, calculate the composition of air on % mole/mole basis.

b. Calculate the mean molecular weight of air.

c. Calculate the mean density of air at 0°C and 1 atmosphere.

d. Calculate the mean density of air at 37°C and 1 atmosphere. Does the density increase or decrease compared to the density at 0°C?

Problem 58

Phone 716-555-1234		DEA# AT -12736280			
Dr. Lemur Gibbon, M.D.					
3 Cynomolgus Ave					
Langur, ME					
Name	Rhesus Macaque	Age	25 yr	Height	130 cm
Address	Marmoset Ave, Langur	Date	8/18/02	Weight	71 kg
Rx Helium 75% v/v containing 25% v/v oxygen by inhalation for hypoxia					

Therapeutic oxygen containing helium is used for the treatment of respiratory obstruction and asphyxia. Helium is monoatomic and oxygen is diatomic. Treat the mixture as being ideal.

- a. Express the concentration of helium in mole %.

- b. What is the molecular weight of the mixture?

- c. What volume would be occupied by 2 moles of the mixture at 1 atmosphere pressure and 0°C?

- d. What volume is occupied by 64 grams of oxygen at 1 atmosphere pressure and 0°C?

- e. Is the density of the mixture greater than, equal to or less than the density of pure oxygen. Calculations are not needed but show mathematical reasoning used to arrive at your answer.

Problem 59

Phone 716-555-1234		DEA# AT -12736280			
Dr. Sandy Loam, M.D.					
3 Silt Lane					
Alluvium, PR					
Name	Clay Basalt	Age	45 yr	Height	5 ft 8 in
Address	87 Humus Lane, Alluvium	Date	8/18/97	Weight	90 kg
<div style="display: flex; justify-content: space-between;"> <div style="width: 20%;"> <p>R</p> <p>Halothane 1% v/v</p> <p>Nitrous oxide 60% v/v</p> <p>Oxygen 39% v/v</p> </div> <div style="width: 80%;"> <p>Administer an anesthetic gas mixture containing:</p> </div> </div> <div style="text-align: right; margin-top: 20px;"> <p><u>S Loam, MD</u></p> </div>					

Halothane has a molecular weight of 197. Nitrous oxide (N₂O) has molecular weight of 44 and oxygen (O₂) has a molecular weight of 32.

- a. Express the concentration of halothane in mole %.

- b. Calculate the molecular weight of the gas mixture.

- c. How many moles of halothane would be present in 2241 Liters of the gas mixture at standard temperature and pressure (0°C, 1 atmosphere pressure)?

- d. How many grams of halothane are present in 2241 Liters of the anesthetic gas mixture at standard temperature and pressure?

Problem 60

EVA WALLY HOSPITAL
110 APPLE STREET
EDEN, NY

R Helium 75% v/v, oxygen 25% v/v. Administer mixture by inhalation for asphyxia

Helium is used as a diluent for oxygen in the treatment of airway obstructions and asphyxia because such mixtures penetrate the airway passages more readily than air.

a. What is the mean molecular weight of the mixture? Remember, helium is monoatomic and oxygen is diatomic.

b. What is the volume (in liters) occupied by 1 mole of the mixture at 0°C and 1 atmosphere pressure?

c. What is the density of the mixture at 0°C and 1 atmosphere pressure? (

d. What is mean molecular weight of air, assuming air to 80% nitrogen and 20% oxygen?

e. What is the **ratio** of the density of the air to the density of the mixture at 37°C and 1 atmosphere pressure? **HINT:** You do NOT need the density of either mixture. Also, you do NOT need to calculate the ratio of two absolute temperatures.

Problem 61

Kay Speciale, DDS 101 Cereal St. Flakes, KS			
Name	<u>Raisy N. Brann</u>	Age	<u>26</u>
Address	<u>Cheerio St., Wheatie, KS 14004</u>	Date	<u>1/10/95</u>
<div style="display: flex; justify-content: space-between; align-items: center;"> ℞ Nitrous oxide 60% v/v and 40% v/v oxygen for dental anesthesia </div> <div style="text-align: center; margin-top: 20px;"> <u>Kay Speciale DDS</u> </div>			

Nitrous oxide (N₂O) is a gas that is sometimes used as a general anesthetic in dentistry and as an analgesic in obstetrics. It produces only light anesthesia but is rapid acting. To avoid damage to the central nervous system it must be used with oxygen.

a. Calculate the concentration of nitrous oxide in mole%.

b. Calculate the molecular weight of the mixture.

c. Determine the weight (in grams) of 22.41 liters of the gas mixture at 0°C and 1 atmosphere pressure.

Problem 62

Phone 716-555-1234		DEA# AT -12736280	
Dr. Rita Lin, M.D.			
Name	Pam E. Diaz	Age	7yr
Address	8 Coumadin Place	Date	8/18/02
		Height	60 cm
		Weight	20 kg
Rx Maintain anesthesia with 7.5% v/v desflurane with 92.5% v/v oxygen			
<u>Rita Lin, MD</u>			

Desflurane is a gaseous anesthetic. It has a molecular weight of 168. Treat the mixture as an ideal gas.

a. What is the apparent molecular weight of the mixture?

b. What is the partial pressure of desflurane in the mixture at 1 atmosphere? Express your answer atmospheres.

c. What is the volume occupied by 10 moles of the gas mixture at 1 atmosphere and 0°C?

d. How many moles of desflurane are present in 10 moles of the gas mixture?

e. What is the density of the gas mixture at 1 atmosphere and 0°C?

CHAPTER 7
INFUSIONS

NOTES

INFUSIONS

- Infusions are dosing regimens in which the drug is continuously administered to a patient.
- Infusions are usually administered intravenously, although oral and transdermal infusion routes may be appropriate for certain drugs. Infusions are more common in hospital settings.
- The mathematics of infusions is very similar to that of discrete dosing. The apparent complexity is caused by the introduction of an additional variable, **time**.
- The other factor contributing to the apparent complexity of infusion calculations is that infused drugs are always administered in a solution such as D5W, normal saline.
- You should distinguish between intravenous bolus or intravenous push administration and intravenous infusions.
- You must distinguish between **drug flow rate** and **infusion flow rate**.
- Here are the equations for calculating drug dosage for infusions.

$$\text{Drug dose} = \text{Drug flow rate} \times \text{Time}$$

$$\text{Drug flow rate} = \text{Infusion flow rate} \times \text{Drug concentration}$$

PROBLEMS

Problem 1

Phone 716-555-1234		DEA# AR -12736280	
Leslie Ryan 101 High St. Seaview, MT 14210			
Name	Ruth Stewart	Age	77 yr
Height	150 cm	Date	9/9/1999
Address	7 Amber Addison Rd, Jackson, MS		Weight 70 kg
R_x Infuse 2500 ml of D5W iv in 24 hours.			
<u>Leslie Ryan, M.D.</u>			

a. Interpret the prescription. Be sure to expand the abbreviation and specify the route of administration.

b. What flow rate (in **ml/min**) should be used?

c. What is the dextrose flow rate?

d. What is the dextrose dose in over a 24-hour period?

Problem 2

Phone 555-3784					
Shamu Bambee 101 Orca St., Seaside, CA 94210					
Name	<u>William Free</u>	Age	<u>57</u>	Weight	<u>120 kg</u>
Address	<u>Pacific Coast Hwy, Monterrey, CA</u>	Date	<u>9/6/96</u>	Height	<u>6 ft 3"</u>
R_x	Aminophylline IV. Dissolve 400 mg in 1000 ml D5W. Infuse at 0.01 mg/(kg min) for 2 hours.				
<u>Shamu Bambee, M.D.</u>					

a. Calculate the concentration of drug in the D5W in **mg/ml**.

b. Determine the drug flow rate in **mg drug/min**.

c. Determine the infusion flow rate in **ml/min**.

d. Determine the total aminophylline dose over the two hours in **mg**.

Problem 3

Phone 716-555-1234	Dr. Beverly Hills	DEA# AR -12736280				
33 Palisades Street						
Compton, CA 90210						
Name	Madison Avenida	Age	55 yr	Height	6 ft 0"	
Address	5 Park Avenue, New York, NY		Date	17/9/2001	Weight	220.5 lb
<p>R_x Sodium nitroprusside 0.5 $\mu\text{g}/\text{kg}/\text{min}$ D5W IV stat. Increase dose at 0.5 $\mu\text{g}/\text{kg}/\text{min}$ q 5 minutes until desired BP is achieved. Do not exceed 10 $\mu\text{g}/\text{kg}/\text{min}$.</p> <p style="text-align: right;"><u>Beverly Hills, M.D.</u></p>						

Sodium nitroprusside is an extremely potent antihypertensive agent used for cardiac emergencies. Because of its extreme potency, it must be prepared in exact concentrations and administered at carefully controlled rates. Effective infusion rates range from 0.5 – 8 $\mu\text{g}/\text{kg}/\text{minute}$.

a. Sodium nitroprusside is supplied as a 50 mg lyophilized powder that is reconstituted in 500 ml D5W before use. What is the concentration of drug in the infusion medium?

b. What is the initial drug dosing rate in mg/min?

c. What is the initial infusion rate in ml/min?

d. If the patient does not respond to the treatment at the initial dose, what action would you take?

e. Calculate the new infusion rate in ml/min and the drug dosing rate in mg/min?

Problem 4

Phone 716-555-1234		DEA# AR -12736280			
Dr. Cherry Raspberry 33 Peachtree Street Coconut Grove, FL 14002					
Name	Persimmon Pearson	Age	32 yr	Height	6 ft 0"
Address	5 Apricot Rd, Coconut Grove	Date	9/9/1999	Weight	120 kg
R_x Heparin sodium. Inject 50 units/kg iv bolus stat. Then, infuse 20,000 units/m ² over 24 hours					
Cherry Raspberry, M.D.					

a. Determine the patient's body surface area.

b. Calculate the drug flow rate in **Units/min** for the infusion.

c. You have heparin sodium for infusion, which contains 50 units/ml. What rate in ml/min should the infusion be set at?

d. What is daily dose of heparin sodium in units?

e. What is daily dose of heparin sodium in units per kilogram?

f. What is daily dose of heparin in units per m²?

Problem 5

Phone 716-555-1234		DEA# AM -12736280			
Wendy McDonald Fries Hospital Panera, NY 14226					
Name	Arby Burger-King	Age	70 yr	Height	5 ft 3 in
Address	Redrobin Rd, Panera, NY	Date	10/1/99	Weight	50 kg
R_x 1200 ml D5W IV over 10 hour		Wendy McDonald, M.D.			

a. What is the concentration of dextrose in D5W in %w/v?

b. Express the concentration of dextrose in grams/liter.

c. Dextrose has a molecular weight of 180 grams/mole. Calculate the concentration in molarity.

d. Calculate the D5W flow rate in ml/min.

e. The maximum allowable dextrose dosing rate is 0.8 g/(kg hour). Is this infusion safe?

Problem 6

Phone 716-555-1234		DEA# BK -12736280			
Gloria Hippo Kingjulian, MA 10002					
Name	Melman Mankiewicz	Age	63 yr	Height	5 ft 7 in
Address	Central Park Ave, NY	Date	9/28/00	Weight	220.5 lbs
<p>Rx Infuse 200 ml of 2 mg/ml ciprofloxacin lactate solution in D5W. Infuse over 60 minutes bid</p> <p style="text-align: right;"><u>Gloria Hippo, MD</u></p>					

a. What is the drug dosage form?

b. How much is a single dose of ciprofloxacin lactate?

c. What is drug flow rate?

d. What is the infusion flow rate?

e. What is the ciprofloxacin lactate dose in mg/kg?

Problem 7

Phone 716-555-1234		DEA# BC -12736280			
Dr. Beverly Crusher Sickbay Street, Enterprise, NY 14002					
Name	Jean-Luc Picard	Age	39 yr	Height	5 ft 7 in
Address	1 Captain's Log, Enterprise, CA	Date	8/18/03	Weight	220.5 lbs
Rx Cimetidine hydrochloride in NS. Inject 150 mg IV bolus loading dose stat. Followed with IV infusion at 40 mg/hour until 160 mg of drug is infused.					
<u>B. Crusher, MD</u>					

a. You have two solutions of cimetidine hydrochloride in NS. One solution contains 150 mg/ml drug and the other contains 6 mg/ml of drug. Which of the two solutions would you prefer for the IV bolus?

b. What is drug flow rate per **minute**?

c. After how long should the drug infusion be stopped?

d. You are using the 6 mg/ml cimetidine product for the infusion. Calculate the infusion flow rate.

e. You are using an infusion device with a drop factor 60 gtt = 1 ml. What drop rate should the device should be set at?

Problem 8

Barney Y. Susamigos			
101 Friends St., Pumpnickel, NY 14210			
Name	Beejay Proceratops	Age	67
		Weight	70 kg
Address	Beebop St, Pumpnickel, NY 12205	Date	9/6/96
		Height	150 cm
<p>Rx Cytarabine continuous IV at 200 mg/(m² day) in two divided doses for 5 days. Dissolve 500 mg Cytarabine powder with 10 ml NS. Transfer entire solution to 500 ml NS and infuse each dose over 3 hours.</p>			

a. Determine the body surface area of the patient.

b. Determine the total daily dose of cytarabine.

c. Determine the concentration of cytarabine in vial after dissolution with 10 ml normal saline.

d. Determine the concentration of cytarabine in vial after dissolution with 10 ml normal saline. Do not neglect the volume of added solution.

e. What is the cytarabine flow rate?

f. What is the infusion flow rate?

Problem 9

Phone 555-3784			
Tweetie Avian			
101 Coyote St., Yosemite, CA 14210			
Name	Sylvester Felis	Age	39
		Weight	50 kg
Address	Gonzales St, Yosemite, CA 14210	Date	9/9/96
		Height	5ft 3in
<p>Rx Cyclophosphamide IV at 2000 mg/day for 5 days. Add 100 ml sterile water to 2 g vial. Transfer the dissolved contents to 500 ml D5W. Infuse over 6 hours</p>			
<u>T. Avian M.D.</u>			

- a. Determine the body surface area of the patient. _____

- b. Determine the daily dose of cyclophosphamide per m² of body surface. _____

- c. Cyclophosphamide causes heart failure (and possible death) within 15 days if the **total dosage** exceeds 5.2 g/m² of body surface. Is the regimen in the prescription safe? Why? _____

- d. What is the cyclophosphamide concentration in the vial after dissolution? _____

- e. What is the cyclophosphamide concentration in the infusion fluid? _____

- f. What is the infusion flow rate? _____

Problem 10

Phone 716-555-1234		DEA# AS -12736280			
Dr. Vincent Vega, M.D.					
Redondo Beach, CA					
Name	Mia Wallace	Age	30 yr	Height	160 cm
Address	5 Foxforce Ave, San Quentin, CA	Date	8/18/07	Weight	80 kg
<p>Rx Administer 20 mg/(kg day) trimethoprim as Co-trimoxazole in 4 divided doses. Dilute each 5 ml Co-trimoxazole parenteral concentrate with 75 ml D5W and administer dose over 90 mins via IV infusion</p>					

Co-trimoxazole is a combination of TWO antibiotic drugs trimethoprim and sulfamethoxazole. The combination is more potent than either drug alone. The **parenteral concentrate** contains 16 mg/ml trimethoprim and 80 mg/ml sulfamethoxazole. Co-trimoxazole dosage is expressed in terms of trimethoprim content.

- a. What dose sulfamethoxazole does the patient receive in **mg/(kg day)**?

- b. What is the concentration of **trimethoprim** in the **infusate**? Don't ignore the added concentrate volume.

- c. What is the flow rate of **trimethoprim**?

- d. What is the infusion flow rate?

- e. How much is a single dose of trimethoprim?

- f. How much **D5W** is required for a single dose?

Problem 11

Phone 716-555-1234		DEA# AS -12736280			
Dr. Eddy Adams, M.D. Amberwaves, IA					
Name	Dirk Diggler	Age	30 yr	Height	5 ft 11 in
Address	Brocklanders Ave, Reseda, CA	Date	8/18/07	Weight	80 kg
<p>Rx Infuse i.v. 5 mcg/min 100 mcg/ml Nitroglycerin in D5W for 5 minutes followed by 10 mcg/min for 10 min, followed by 20 mcg/min for 10 min.</p> <p style="text-align: right;"><u>E. Adams, MD</u></p>					

Nitroglycerin is a cardiac drug used to treat angina.

a. What is the initial flow rate of infusion fluid in ml/min?

b. How would you increase the drug flow rate to 10 mcg/min?

c. What should the infusion fluid flow rate be 20 minutes after the start of the first infusion?

d. What is the total dose received by the patient?

e. What would the drug flow rate be if the infusion flow rate were set at 0.25 ml/min?

Problem 12

Phone 716-555-1234		DEA# AS -12736280			
Dr. Jimmy Sonoma, M.D. 4 Tacoma Street Silverado, NC					
Name	Dakota Ram	Age	25 yr	Height	100 cm
Address	Tacoma Ave, Silverado	Date	8/18/08	Weight	75 kg
Rx Infuse iv 100 ml of 0.5 mg/ml ranitidine in 0.45% sodium chloride solution over 20 min. Repeat q6h					
<u>J. Sonoma, MD</u>					

a. What is the abbreviation for 0.45% sodium chloride?

b. What the concentration of ranitidine in the infusion fluid?

c. What is the infusion flow rate?

d. What is the drug flow rate?

e. What is the daily dose?

Problem 13

Phone 716-555-1234	DEA# AT -12736280	
<p>Dr. Aura Nimbus, M.D. 3 Radiance Ave Aurora, IL</p>		
Name Corona Halo	Age 45 yr	Height 5 ft 6 in
Address 8 Luminous Lane, Aurora	Date 8/18/97	Weight 200 lb
<p>R Doxorubicin hydrochloride 75 mg/m² q3w Infuse dose iv as 2 mg/ml solution in NS over 15 min <u>Aura Nimbus, MD</u></p>		

- a. What is the patient's body surface area?

- b. How much is doxorubicin hydrochloride is administered in a single dose

- c. What volume of doxorubicin hydrochloride solution in NS should be administered?

- d. What is the infusion flow rate per minute?

- e. Doxorubicin hydrochloride causes congestive heart failure when the total dose exceeds 550 mg/m². What is the maximum number of doses the patient can receive?

Problem 14

Phone 716-555-1234	DEA# AT -12736280	
<p>Dr. Luke Warm, M.D. 3 Tepid Ave Scalding, NC</p>		
Name Jack Frost	Age 45 yr	Height 5 ft 8 in
Address 87 Arid Lane, Scalding,	Date 8/18/97	Weight 90 kg
<p>R Thaw 20 mg/ml nafcillin in 3.6% dextrose solution. Infuse dose iv over 60 minutes Sig: 600 mg nafcillin q 4h</p> <p style="text-align: right;"><u>Luke Warm, MD</u></p>		

a. What is the nafcillin concentration?

b. What volume of drug solution should be administered in a single dose?

c. What is the infusion flow rate **per minute**?

d. What is the nafcillin flow rate per minute?

e. Determine the **daily** dose of nafcillin in **mg/kg**.

Problem 15

Phone 716-555-1234		DEA# AT -12736280			
Dr. Curly Fries, M.D. 3 Hashbrown Ave Mayo, NC					
Name	Cole Slaw	Age	25 yr	Height	5'9"
Address	87 Salad St, Mayo, NC	Date	8/18/97	Weight	50 kg
<div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="font-size: 2em; font-family: cursive; margin-right: 10px;">℞</div> <div> Paclitaxel 125 mg/m² over 20 hours by iv infusion q3w Prepare infusion by mixing 50 ml of 6 mg/ml parenteral concentrate \bar{c} 450 ml D5W </div> </div>					
<u>Curly Fries, MD</u>					

- a. What is the patient's body surface area?

- b. How much drug is infused in a single dose?

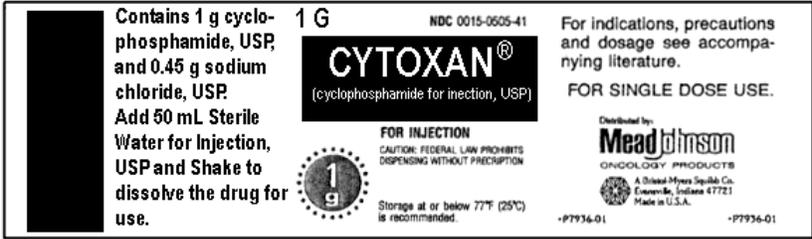
- c. What is the concentration of drug in the infusion fluid?

- d. What is the drug flow rate?

- e. What is the infusion flow rate?

- f. If the drop factor for the infusion set is 60 gtt/ml, what is the infusion flow rate in drops/minute?

Problem 16

Phone 716-555-1234		DEA# AT -12736280	
<p>Dr. Frank Einstein, M.D. 3 Goblin Ave, Booville, NC</p>			
Name	Hal O'Ween	Age	5 yr
Address	87 Imp St, Booville, NC	Date	8/18/97
Height	2'9"	Weight	18 kg
<p>R Cyclophosphamide 50 mg/kg/day for 3 days. Dissolve cyclophosphamide according to label instructions. Mix solution containing 1 g drug with 250 ml NS. Infuse iv qd over 2 hours.</p>			
 <p>The image shows a vial label for CYTOXAN (cyclophosphamide for injection, USP). The label includes the following information: '1 G' (1 gram), 'NDC 0015-0505-41', 'FOR INJECTION', 'CAUTION: FEDERAL LAW PROHIBITS DISPENSING WITHOUT PRESCRIPTION', 'Storage at or below 77°F (25°C) is recommended.', 'Distributed by: Mead Johnson ONCOLOGY PRODUCTS, A Division of Mead Johnson Co., Evansville, Indiana 47721, Made in U.S.A.', and 'FOR SINGLE DOSE USE.' There is also a circular icon with the number '1' and a small 'g' inside.</p>			

- a. What is the daily dose of cyclophosphamide?

- b. What is the concentration of cyclophosphamide in the vial after dilution according to the label instructions? Express your answer in mg/ml.

- c. What is the concentration of cyclophosphamide in the infusion fluid?

- d. What is the drug flow rate?

- e. What is the infusion flow rate?

- f. How much infusion fluid is consumed when the dosing is completed?

Problem 17

Phone 555-3784			
Kitty Litter Diaper, NY 14210			
Name	<u>Kim Wipe</u>	Age	<u>53</u>
Wt	<u>80 kg</u>	Date	<u>2/14/96</u>
Address	<u>Diaper, NY 12205</u>	Height	<u>170 cm</u>
<p>Rx Nitroglycerin 100 mcg/ml in D5W by iv infusion Set initial dosing rate at 5 mcg/min. Increase by 5 mcg/min q5 min until blood pressure responds</p>			
<u>Kitty Litter M.D.</u>			

a. What is the concentration of nitroglycerin in the infusion fluid in mg/ml?

b. What is the initial infusion flow rate?

c. What is the drug dosing rate if the patient's blood pressure does not respond in 5 minutes.

d. How would you go about changing the drug dosing rate to the level in (c)?

e. What is the total dose of nitroglycerin at 10 minutes?

Problem 18

Phone 555-3784		DEA# BS0365420	
Sandy Loam 407 Silt St., Terracotta, TX 90210			
Name	Clay Basalt	Age	23
		Wt	70 kg
Address	Chalk St, Terracotta, TX 90210	Date	1/10/95
		Height	5 ft 8 in
<p>Rx Fludarabine phosphate 25 mg/m² by IV infusion over 30 minutes for chronic lymphocytic leukemia. Repeat each day for consecutive 5 days. Reconstitute fludarabine phosphate to obtain 25 mg/ml parenteral concentrate. Add 2 ml of parenteral concentrate to 125 ml D5W. Infuse.</p>			

a. What is the patient's body surface area?

b. Calculate the concentration of fludarabine phosphate in the infusion fluid in **mg/ml**?

c. What is the single dose of fludarabine phosphate?

d. Calculate the drug flow rate.

e. Calculate the infusion flow rate.

f. Calculate the volume of infusion fluid used up.

Problem 19

Phone 716-555-1234		Dr. Chartreuse Gray, M.D.		DEA# AT -12736280	
Name	Magenta Green	Age	27yr	Height	170 cm
Address	8 Violet St, Greenville, NC	Date	8/18/02	Weight	90 kg
<p>Rx <u>Full dose heparin sodium treatment for deep vein thrombosis.</u> Give 5000 units stat by IV injection of 1000 units/ml heparin sodium solution for parenteral injection. Then infuse iv 30,000 units of 50 units/ml heparin sodium solution for iv infusion over 24 hours</p>					

- a. What volume of heparin sodium solution for **parenteral injection** should be given immediately?

- b. What is the **total dose** of heparin sodium in the full dose treatment in **units**?

- c. The specific activity of heparin sodium is 150 units/mg. What is the **total dose** of heparin sodium in the full dose treatment in **milligrams**?

- d. What is the heparin sodium flow rate in **units/min** during the infusion?

- e. What is the infusion flow rate?

- f. What is the volume of the heparin sodium solution is used up during the infusion?

- g. Express the concentration of 50 units/ml heparin sodium solution used for the infusion in percent strength.

Problem 20

Phone 716-555-1234		Dr. Otis Media, M.D.		DEA# AT -12736280	
Name	Iris Cornea	Age	52 yr	Height	6ft 2 in
Address	8 Pinna Pl, London	Date	8/18/02	Weight	100 kg
<p>Rx 200 mg Lidocaine hydrochloride. Dose at 20 mcg/(kg min) iv infusion for 60 min. Dose at 40 mcg/(kg min) for the remainder of dose</p> <p>M ft sol by mixing 25 ml of 4% w/v parenteral concentrate with 1 liter D5W</p>					

- a. What is the initial drug flow rate?

- b. What is the concentration of drug in the infusion fluid?

- c. What is the infusion flow rate in the first hour?

- d. What is the drug dose administered in the **first 60 minutes**?

- e. What is the infusion flow rate **after** the first 60 minutes?

- f. What is the total duration of the infusion?

- g. How much infusion fluid is used up? **Do not provide volume of D5W.**

Problem 21

Phone 617-555-4321		DEA# AM -12736280			
Dr. Misty Kasumi, M.D.					
Name	Ash Ketchum	Age	27yr	Height	170 cm
Address	8 Professor Oak St, Spearow	Date	8/18/02	Weight	90 kg
<p>Rx Edetate disodium 2 g for hypercalcemia. Administer dose by slow iv infusion of 3% edetate sodium over 4 hours. Repeat q2w</p> <p style="text-align: right;"><u>M. Kasumi, MD</u></p>					

a. Express the dose of edetate sodium in grams/m²?

b. Express the concentration of edetate disodium in **mg/ml**.

c. Express the concentration of edetate disodium in **grams/ml**.

d. Calculate the drug flow rate?

e. What is the infusion flow rate?

f. What is the volume of the edetate sodium solution is used up during the infusion?

Problem 22

Phone 716-555-1234		DEA# AT -12736280			
Dr. Benjamin Reilly, M.D.					
Name	Jessica Carradine	Age	28 yr	Height	5 ft 3 in
Address	8 Winthrop Street	Date	8/18/02	Weight	120 lb
Rx Infuse 0.5 g/(kg hour) dextrose as D5W for 2 hours					
					<u>Ben Reilly, MD</u>

a. Convert the concentration of dextrose to mg/ml.

b. Convert the concentration of dextrose in D5W to **milligrams per deciliter**.

c. Convert the concentration of dextrose in D5W to **grams per liter**.

d. Calculate the dextrose dosing rate.

e. Calculate the infusion flow rate.

f. Calculate the dose of dextrose.

Problem 23

Phone 716-555-1234		DEA# AT -12736280			
Dr. Penny Cillin, M.D.					
Name	Al Buterol	Age	52 yr	Height	6ft 2 in
Address	8 Coumarin Pl, Disulfiram	Date	8/18/02	Weight	100 kg
<p>Rx Add 1 ml of Epinephrine hydrochloride 1:1000 parenteral concentrate to 500 ml of NS. Infuse IV at 2 mcg/min for 1 hour</p> <p style="text-align: right;"><u>Penny Cillin, MD</u></p>					

a. Calculate the **amount** of epinephrine hydrochloride in the entire volume of **infusion fluid** in **micrograms**.

b. Calculate the concentration of epinephrine hydrochloride in the **infusion fluid** in **parts strength**. Do NOT neglect the volume of the parenteral concentrate added.

c. Calculate the concentration of epinephrine hydrochloride in the **infusion fluid** in **micrograms/ml**. Do NOT neglect the volume of the parenteral concentrate added..

d. Calculate the infusion flow rate per minute.

e. Calculate the epinephrine hydrochloride dose.

Problem 24

Phone 987-321-5678		Dr. Tarsal Sternum, M.D.		DEA# AT -12736280	
Name	Carpal Patella	Age	28 yr	Height	5 ft 3 in
Address	8 Clavicle Street, Sacrum, TX	Date	8/18/02	Weight	120 lb
<p>Rx Infuse 100 mcg/ml NTG in 5% w/v dextrose at 5 mcg/min. Check BP q5 min If target blood pressure is not reached in 5 minutes increase by 5 mcg/min every 5 minutes to a maximum of 20 mcg/min. Once target BP is reached maintain dosing rate. Total infusion time for the entire infusion is 30 minutes.</p>					

- a. What is the infusion flow rate during the **first five** minutes of the infusion?

- b. What is the nitroglycerin dose during the **first five** minutes of the infusion in **micrograms**.

- c. What is the **dextrose flow rate** during the **first five** minutes of the infusion in **milligrams**.

- d. Calculate the **dextrose dose** during the **first five** minutes of the infusion in **milligrams**.

- e. Describe what action you would take if the patient does not reach the desired blood pressure after the first five minutes. Be specific.

- f. A patient reaches the desired blood pressure only at the end of 15 minutes. The dosing at the end of the 15 minutes was maintained for the remainder of the prescribed regimen. Calculate the dose of nitroglycerin in micrograms.

Problem 25

Phone 716-555-1234		DEA# AC-12736280	
Dr. Robert Parr, M.D.			
Name	Dashiell Roberts	Age	21 yr
Address	8 Ednamode Street	Date	10/18/02
		Height	160 cm
		Weight	50 kg
Rx		30% Ditrizoate meglumine 300 ml IV over 20 min.	
		R Parr, MD	

Ditrizoate meglumine is an iodine-containing drug that is opaque to X-rays and is used by radiologists for obtaining images of the brain.

- a. The 30% w/v ditrizoate meglumine preparation contains 141 mg/ml iodine. Calculate the iodine (% weight-in-volume) content of the **preparation**.

- b. According to the prescription, what is the infusion flow rate (in **ml/min**) that should be used?

- c. What is the ditrizoate meglumine dosing rate in **mg/min**?

- d. What is the iodine-dosing rate in **mg/min**?

- e. What is the ditrizoate meglumine dose?

- f. What is the dose of iodine?

Problem 26

Phone 716-555-1234		DEA# AT -12736280			
Dr. Felicia Hardy, M.D.					
Name	Norman Osborn	Age	52 yr	Height	6ft 2 in
Address	8 Blackcat Ave., Gotham, NY	Date	8/18/02	Weight	100 kg
<p>Rx Infuse 4 mg/kg of 4 mg/ml ofloxacin in D5W iv over 60 min q12 h. Withdraw sufficient 40 mg/ml ofloxacin parenteral concentrate. Add to 100 ml D5W bag.</p> <p style="text-align: right;"><u>Felicia Hardy, MD</u></p>					

a. Calculate the concentration of ofloxacin in the **infusion fluid** in **percentage strength**. Do NOT neglect the volume of the parenteral concentrate added.

b. Calculate the single dose of ofloxacin.

c. Calculate the volume of ofloxacin parenteral concentrate solution that must be withdrawn.

d. Calculate the drug flow rate per minute.

e. Calculate the infusion flow rate.

f. Calculate the volume of infusion fluid remaining after a dose.

Problem 27

617-865-4321		Salmon Roe	
		Sevruga, NY 14210	
Name	Beluga Caviar	Age	53
		Weight	80 kg
Address	Sevruga, NY 12205	Date	2/14/96
		Height	170 cm
<p>R_x Dopamine HCl 300 mg by IV infusion at 10 mcg/kg/min Make infusion fluid prn using the following method: Dilute 5 ml of 40 mg/ml dopamine HCl parenteral concentrate with 500 ml lactated Ringers.</p>			

a. What is the concentration of dopamine HCl in the infusion fluid?

b. What is the drug flow rate?

c. What is the infusion flow rate?

d. When should the infusion be stopped?

e. What volume of lactated Ringers solution is used up?

f. The drop factor for the infusion set is 60 gtt/ml. What is the flow rate in drops/min?

Problem 28

Phone 555-3784			
Kitty Litter Diaper, NY 14210			
Name	<u>Kim Wipe</u>	Age	<u>53</u>
		Weight	<u>80 kg</u>
Address	<u>Diaper, NY 12205</u>	Date	<u>2/14/96</u>
		Height	<u>170 cm</u>
Rx Nitroglycerin 100 mg dissolved in 250 ml D5W at 12 ml/hr <u>Kitty Litter M.D.</u>			

- a. What is the concentration of nitroglycerin in the infusion fluid?

- b. What is the drug flow rate?

- c. What is the dosing rate in mcg/kg/min?

- d. What is the dosing rate in mcg/m² min?

- e. How long will the infusion last?

- f. The drop factor for the infusion set is 60 gtt/ml. What is the flow rate in drops/min?

Problem 29

Phone 555-3784					
Joyeria Fina					
Mercado, NY 12205					
Name	<u>Compara Precios</u>	Age	<u>53</u>	Wt	<u>80 kg</u>
Address	<u>Mercado, NY 12205</u>	Date	<u>2/1/06</u>	Ht	<u>170 cm</u>
<p>Rx Trastuzumab (Herceptin) loading dose 6 mg/kg IV over 90 min qw for 3 week. Maintenance 4 mg/kg over 30 min q3w for 6 cycles.</p> <p>Add required volume of 21 mg/ml drug solution to 250 ml NS IV bag. Infuse iv ut dict</p> <p style="text-align: right;"><u>Joy Fina M.D.</u></p>					

a. What is the concentration of trastuzumab in the infusion fluid for the loading dose?

b. What is the drug flow rate during a loading dose?

c. What is the infusion flow rate?

d. What is the total dose in the entire chemotherapeutic regimen?

Problem 30

EXAM CITY HOSPITAL EXAM CITY, NEW YORK		
Hospital policy requires a 24 hour expiration date on compounded IV admixtures.	Bosakowski, Robert Hosp. No. 123654 DOB: 7/4/41 133 Norman Drive Exam City, New York	Room 367A Weight: 80 kg R. Rosa, M.D. Medicine
<i>Jan. 8, 1992 8:00 AM</i>		
<i>SMX / TMP 600mg/120mg in 250ml D5W Q12H</i>		
<i>Infuse IV over 1 hour</i>		
<i>R. Rosa, M.D.</i>		

a. Interpret the prescription.

b. What flow rate (**ml/min**) should the infusion be set at?

c. What is the sulfamethoxazole (SMX) dosing rate in **mg/min**?

d. What is the trimethoprim (TMP) dosing rate in **mg/min**?

e. Calculate the weight-normalized dose (**mg/kg**) of trimethoprim for this patient.

Problem 31

Phone 256-512-1024	DEA# BC -12736280		
<p>Dr. Jerboa Capybara, M.D. 3 Pacarana Ave Zokor, AL</p>			
Name	<u>Agouti Sagebrush-Vole</u>	Age <u>55 yr</u>	Height <u>5 ft 5 in</u>
Address	<u>87 Dormouse Lane, Zokor</u>	Date <u>7/17/07</u>	Weight <u>220.5 lb</u>
<p>R Dopamine hydrochloride 5 µg/kg/min D5W IV stat. Increase dose in increments of 5 µg/kg/min q 30 minutes until desired BP is achieved. Do not exceed 25 µg/kg/min.</p> <p><u>J. Capybara, MD</u></p>			

a. For intravenous injection, vials containing 200 mg dopamine hydrochloride are reconstituted in 500 ml of 5% dextrose in water. Determine the dopamine hydrochloride concentration after reconstitution?

b. What is the initial drug flow rate?

c. What is the initial infusion flow rate in **ml/min**?

d. What is the infusion flow rate (**ml/min**) at the maximum allowable dose?

Problem 32

Cupid Heart Institute			
101 Venus St., Cherub, NY 14210			
Name	Artery Bloch	Age	53
Weight		Weight	80 kg
Address	Lard St, Coronary, NY 12205	Date	2/4/96
		Height	170 cm
Rx Lidocaine HCl. IV Bolus at 1.25 mg/kg stat. Maintenance infusion 25 mcg/(kg min) for 2 ¹ / ₂ hrs <u>Aorta Venacava M.D.</u>			

A monograph on lidocaine hydrochloride is attached. As the attending pharmacist, you have of 20% lidocaine hydrochloride injection available.

a. Is the **maintenance infusion** within the normal dosage range?

b. How would you prepare the infusion fluid for the maintenance infusion?

c. What flow rate should the maintenance infusion be set at?

d. How much lidocaine would be dosed in 2.5 hours?

e. Now consider the total regimen. Is the treatment safe?

Since lidocaine is distributed into milk, the drug should be used with caution in nursing women. Limited data suggest that the amount of drug that potentially would be ingested by a breast-fed infant is small.

Drug Interactions

■ Succinylcholine

In anesthetized individuals, the neuromuscular blocking effect of succinylcholine has been reported to be increased by IV administration of lidocaine prior to or following succinylcholine administration; however, this effect appears to be important only following administration of lidocaine in doses higher than those usually used clinically.

■ Antiarrhythmic Agents

When lidocaine is administered with other antiarrhythmic drugs such as phenytoin, procainamide, propranolol, or quinidine, the cardiac effects may be additive or antagonistic and toxic effects may be additive. Phenytoin may stimulate the hepatic metabolism of lidocaine, but the clinical importance of this effect is not known.

■ Other Drugs

Concurrent administration of lidocaine with cimetidine or propranolol may result in increased serum concentrations of lidocaine with resultant toxicity. Cimetidine and propranolol substantially reduce the systemic clearance of lidocaine, apparently by reducing hepatic blood flow and hepatic extraction of the drug; other mechanisms (e.g., altered distribution or metabolism of lidocaine) may also be involved. If lidocaine and cimetidine or propranolol are administered concurrently, the patient should be closely observed for signs of lidocaine toxicity, and serum lidocaine concentrations should be carefully monitored; reduction of lidocaine dosage may be necessary.

Laboratory Test Interferences

Because IM injection of lidocaine may increase serum CK (CPK) concentrations, isoenzyme separation is necessary when CK determinations are used in the diagnosis of acute myocardial infarction in patients receiving the drug IM.

Dosage and Administration

■ Administration

Lidocaine hydrochloride is administered IM or IV for the treatment of ventricular arrhythmias. Constant ECG monitoring is recommended during therapy with lidocaine hydrochloride; however, in emergency situations when a ventricular arrhythmia is suspected and ECG equipment is not available, a single IM dose may be administered if bradycardia is not present and the potential benefits outweigh the possible risks. The deltoid muscle is the preferred site for IM injection; IM injections should be made after aspiration to avoid possible inadvertent intravascular injection. Injections containing preservatives should not be given IV and *lidocaine solutions that contain epinephrine must not be used to treat arrhythmias*. Lidocaine injections (additive syringes and single-use vials) containing 40, 100, or 200 mg/mL are for the preparation of IV infusion solutions only and must be diluted prior to administration; such solutions must not be administered IV without prior dilution since massive overdosage resulting in cardiac arrest, seizures, and/or death has occurred following inadvertent, direct IV administration (without prior dilution) of such preparations.

IV infusions of lidocaine hydrochloride are prepared by adding 1 g of lidocaine hydrochloride (using 25 mL of a commercially available 4% or 5 mL of a commercially available 20% lidocaine hydrochloride injection) to 1L of 5% dextrose injection to provide a solution containing 1 mg/mL. Alternatively, commercially available 0.2 or 0.4% solutions in 5% dextrose may be used. When fluid restriction is desirable, a more concentrated solution of up to 8 mg/mL may be used. The drug should not be added to blood transfusion assemblies.

When one of the commercially available IV infusion solutions of lidocaine hydrochloride is used, the accompanying labeling should be consulted for proper methods of administration and associated precautions.

■ Dosage

Dosage of lidocaine hydrochloride must be carefully adjusted according to individual requirements and response.

Ventricular Arrhythmias

For the initial treatment of ventricular arrhythmias, lidocaine is usually administered as a bolus IV injection. The usual adult IV bolus dose is 50–100 mg administered at a rate of approximately 25–50 mg/minute. Alternatively, some clinicians recommend an initial IV bolus dose of 1–1.5 mg/kg. If the desired response is not achieved, a second dose may be administered 5 minutes after completion of the first injection. The manufacturers state that *no more than 200–300 mg should be administered during a 1-hour period*. Patients with congestive heart failure or cardiogenic shock may require smaller bolus doses.

Maintenance infusion of lidocaine may be required to maintain normal sinus rhythm if oral antiarrhythmic therapy is not feasible. The infusion may be administered at a rate of 20–50 µg/kg per minute (1–4 mg/minute in an average 70-kg adult). Some clinicians believe that the lower dosage is inadequate and recommend an infusion of 4 mg/minute immediately after the bolus dose. Slower infusion rates should be used in patients with congestive heart failure or liver disease; some clinicians recommend that the infusion rate be kept below 30 µg/kg per minute in patients with congestive heart failure. In patients with liver disease, dosing must be carefully individualized. Major differences in lidocaine pharmacokinetics may exist for different types of liver disease (e.g., cirrhosis, hepatitis) and no consistent correlation has been established between clearance of the drug and severity of liver disease (as determined by liver function tests). No dosing modification appears to be necessary in patients with renal failure. When arrhythmias reappear during a constant infusion of lidocaine, a small bolus dose (e.g., 0.5 mg/kg) may be given to rapidly increase plasma concentrations of the drug; the infusion rate is maintained or increased simultaneously. If the infusion rate alone is increased, a plateau or peak concentration of lidocaine may not be reached for 3–4 half-lives (5–8 hours).

The infusion should be terminated as soon as the patient's basic cardiac rhythm appears to be stable or at the earliest sign of toxicity. If signs of excessive cardiac depression, such as prolongation of the PR interval and QRS complex or the appearance or aggravation of arrhythmias occur, the infusion should be stopped immediately. The manufacturers state that it should rarely be necessary to continue the infusion for longer than 24 hours. Clinical studies have reported continuation of lidocaine infusions for several days; however, there are data which indicate that the half-life of lidocaine may be increased to 3 hours or longer following infusions lasting longer than 24 hours, and dosage may need to be reduced accordingly (e.g., by 50%) to avoid accumulation of the drug and potential toxicity. If maintenance therapy is necessary, therapy should be changed to an oral antiarrhythmic agent such as procainamide.

The usual IM dose of lidocaine hydrochloride is 300 mg in an average 70-kg adult or approximately 4.3 mg/kg. If necessary, a second IM dose may be administered 60–90 minutes after the first injection. When continued therapy with an antiarrhythmic agent is indicated, an IV infusion of lidocaine or oral administration of another antiarrhythmic agent is preferred.

Controlled clinical studies to establish pediatric dosing schedules of lidocaine have not been performed. Some clinicians have suggested that infants and children may be given an initial IV bolus of 0.5–1 mg/kg; this dose may be repeated according to the response of the patient, but the total dose should not exceed 3–5 mg/kg. A maintenance IV infusion of 10–50 µg/kg per minute may be given via an infusion pump. For advanced cardiac life support in children, the recommended dosage is an initial IV bolus of 1 mg/kg. If ventricular tachycardia or ventricular fibrillation is not corrected following defibrillation (or cardioversion) and an initial lidocaine IV bolus, an IV infusion should be started at a rate of 20–50 µg/kg per minute; to ensure adequate plasma concentrations, an additional IV bolus of 1 mg/kg should be given at the onset of the infusion.

Other Uses

For the treatment of status epilepticus†, some clinicians have suggested an initial IV lidocaine hydrochloride bolus dose of 1 mg/kg. If the seizure is not terminated, 0.5 mg/kg may be given 2 minutes after completion of the first injection. A maintenance IV infusion of 30 µg/kg per minute has been given to prevent recurrence of seizures.

Preparations

Lidocaine Hydrochloride

Parenteral injection, for IM injection	100 mg/mL	LidoPen® Auto-Injector (with edetate disodium and methylparaben), Survival Technology
Injection, for direct IV injection	10 mg/mL*	Lidocaine Hydrochloride Injection for Cardiac Arrhythmias, IMS, Lyphomed
	20 mg/mL*	Xylocaine® IV Injection for Ventricular Arrhythmias, Astra
		Lidocaine Hydrochloride Injection for Cardiac Arrhythmias, IMS, Lyphomed
		Xylocaine® IV Injection for Ventricular Arrhythmias, Astra
Injection, for preparation of IV infusion only	40 mg/mL (1 or 2 g)*	Lidocaine Hydrochloride Injection for Cardiac Arrhythmias, Lyphomed, McGuff

CHAPTER 8
MINIMUM WEIGHABLE QUANTITY

NOTES**Minimum Weighable Quantity**

- The **sensitivity requirement** of a balance is the minimum weight that will shift the pointer in a balance by a division.
- The sensitivity requirement of Class A balances used in pharmacy is **6 mg** or better.
- Any weight less than the sensitivity requirement cannot be measured with any accuracy.
- It **DOES NOT** mean that as a pharmacist you should ever try to measure 6 mg! Why?

$$\text{Fractional Error} = \frac{\text{Sensitivity Requirement}}{\text{Amount Weighed}}$$

- As a pharmacist, **your error must be less than 5%**.
- Calculate the minimum weighable quantity from the above formula.

$$\text{Minimum Weighable Quantity} = \frac{\text{Sensitivity Requirement}}{\text{Maximum Fractional Error Acceptable}}$$

- **NEVER** weigh less than **120 mg** on a prescription balance!

Principles For Solving Minimum Weighable Quantity Problems

- You have to solve the problems so that you **NEVER** weigh less than **120 mg**.
- First, a quantity of drug equal or greater than the minimum weighable quantity is weighed.
- The drug is diluted in an appropriate amount of inert diluent such as lactose. Be sure to mix well.
- An aliquot of the diluted mixture which contains the required amount of drug is weighed. This aliquot should also be equal or greater than the minimum weighable quantity.
- To solve minimum weighable quantity problems, the **strategy** used is:

$$\text{Concentration of Drug in Diluted Mixture} = \text{Concentration of Drug in Aliquot}$$

- Since $\text{Concentration of Drug in a Mixture} = \frac{\text{Amount of Drug}}{\text{Total Quantity of Mixture}}$
- We can rewrite the principle in mathematical terms as:

$$\frac{\text{Amount of Drug in Diluted Mixture}}{\text{Amount of Drug} + \text{Amount of Diluent}} = \frac{\text{Amount of Drug in Aliquot}}{\text{Total Quantity of Aliquot}}$$

- The amount of drug in the aliquot is known from the prescription.
- The amount of drug in the diluted mixture is set to a value equal to or greater than the minimum weighable quantity.
- Similarly, the total quantity of the aliquot is also set to a value equal to or greater than the minimum weighable quantity.
- Using algebra, the amount of diluent required is easily calculated.

CAN A PHARMACIST WEIGH ONE GRAIN?

Bellafigliore, I.J., *J. Am. Pharm. Assoc.*, 20, 124 (1959).

No! Pharmacists cannot weigh one grain on a prescription balance. You may say you have been doing it for years and, in fact, that you were taught to do so in college. But the answer is still "NO!".

The Pharmacist had little to guide her in using her balance until Goldstein and Mattocks in 1951 and the N.F.X. in 1955 suggested:

"In order to avoid errors of 5% or more which might be due to the limit of accuracy in the Class A prescription balance, do not weigh less than 200mg. or 3 grains of any material."

Two reasons are given by those who claim they can weigh one grain on a prescription balance, and both reasons are fallacious. (1) The rider scale on the typical balance starts at 1/8 grain. (2) The sensitivity of the balance is 2 mg. Pharmacist may argue that the rider is put there by expects and that it is there to be used. Since the rider starts at 1/8 gr., surely weighing one grain, or 8 times 1/8 gr., must be accurately weighed on the scale, so that 32.5 times 2 mg., which is 65 mg. or one gr., should be extremely accurate. Both arguments are without foundation.

Absolute accuracy means 100% accuracy. In weighing, this is hardly possible to attain. How close to 100% shall we be? Certainly better than 95%! If you think 90% accuracy is good enough, then it means that you would accept a pound of chemical if it has only 14.4 oz. The butcher and grocer could sell you \$9 worth of food and charge you \$10.

Pharmacists should attempt to obtain 99% accuracy.

The 1/8 gr. marking on a rider scale can be compared to the 1/8" marking on a ruler. Where it is necessary for one piece of metal to fit precisely into another, do you honestly think you can accurately measure 8/64" by using the 1/8" mark on a ruler? Or would you use a micrometer? In a similar manner, the 1/8 gr. marking on the rider is worthless as an indication of weight.

Whenever Pharmacists weigh a small quantity, it is probably a small quantity because the substance is a strong drug, probably a poison, and they should weigh poisons more accurately than harmless drugs, not less accurately.

One of the first rules of weighing is that the greater the quantity of a material weighed the more accurate is the weighing. The less weighed the less accurate is the weighing. If a person measures 7 1/8" on a rule and misses by 1/8", the error is less than 2%. But if a person attempts to measure 1/8" and misses it by 1/16" the error is 50%. Always try to weigh as much as possible, not as little as possible.

What does the sensitivity of 2 mg mean? It means that if the balance is perfectly still, with not the least movement of the indicator, and the balance is perfectly balanced, and there is absolutely no draft of air, no disturbance from breath, no vibration of any kind, then 2 mg. of a special weight called a test weight will move the indicator of his balance from the zero point midway towards the first division of the indicator scale.

This reading so delicately made, is never duplicated under the ordinary conditions of weighing. In ordinary weighing the indicator is read when it moves a full division. Remember that division lines are roughly 1/16" apart and who can say where exactly 1/2 of 1/16" is to be found. Further, the reading under the usual conditions of weighing is disturbed by the above factors which are to be avoided in determining the sensitivity. The total error contributed by the sensitivity, drafts,

vibration, hasty reading of the indicator, etc., are estimated to be 10 mg. in each weighing, i.e., there could be as much as 10 mg. on a balance and it still could not be precisely weighed. This is actually the error of the scale.

Ten mg. of error are inherent in all ordinary weighings as a result of the dullness (sensitivity) of the scale and the room and the person making the weighing. On this basis, error in weighing can be computed as follows:

- 10 mg. error in one grain (65 mg.) weighing: 15% error (too much)
- 10 mg. error in a 3 grain (195 mg.) weighing: 5% error (getting better)
- 10 mg. error in a 20 grain (650 mg.) weighing: 1.5% error (better still)

It must be concluded, then, that one grain cannot be weighed with sufficient accuracy on a prescription balance.

To obtain one grain of a drug accurately, use one of these methods: (a) dispensing tablets triturates, if available; (b) weigh at least 3 grains of the drug, then prepare a stock solution in water or a trituration with lactose. Use $\frac{1}{3}$ of the solution or trituration.

In the case of dilutions of narcotics, the extra narcotic can be accounted for by saving the dilution.

PROBLEMS

Problem 1

a. What is minimum acceptable sensitivity requirement for a balance intended for use in a pharmacy?

b. State the commonly used minimum weighable quantity in pharmacy?

c. A balance has a sensitivity requirement of 5 mg and you wish to weigh drugs with an accuracy of $\pm 2.5\%$ or better. Calculate the minimum weighable quantity?

d. A teaspoon was found to measure only 4.25 ml instead of the anticipated 5.00 ml. What is the percentage error incurred this teaspoon is used to deliver a dose of 5 ml (instruction-one teaspoonful) or 20 ml (instruction-four teaspoonfuls).

e. A prescription calls for 2 mg of a biotechnology-generated protein to be given intravenously as a bolus dose. You have a balance that has a sensitivity requirement of 4 mg. What is the minimum amount that you could weigh out to maintain an accuracy of at least 5%?

f. You have a prescription balance with a sensitivity requirement of 6 mg. What is the percent error that would occur if you weighted 30 milligrams on this balance?

Problem 2

a. You are making volumetric measurements in a 10 ml capacity graduated measuring cylinder that is marked every 0.1 ml. What is the minimum volume you should measure in the cylinder to ensure that the percent error is 5% or less.

b. You have a bathroom scale that is has a sensitivity requirement of 1 pound. You decide to use it to measure the weight of your child and want your measurement error to be 2.5% or less. How much should your child weigh (in pounds) in order for this to be feasible?

c. You own two balances, affectionately named Click and Clack by the interns. Click has a sensitivity requirement of 1.5 mg while Clack has a sensitivity requirement of 2.7 mg. Which balance is more sensitive?

d. What values of sensitivity requirement and percent error are assumed in arriving at the “conventional” minimum weighable quantity of 120 mg?

e. Suppose that balance quality has improved by the time you begin practicing as a registered pharmacist. Determine the minimum weighable quantity if the sensitivity requirement is 2.5 mg and maximum tolerable error is $\pm 1.25\%$

f. You have a prescription balance with a sensitivity requirement of 8 mg. What is the minimum weighable quantity if you wanted to keep errors to 2.5% or less?

Problem 3

Phone 555-6765		DEA# AP0365420	
O. M. Winters 101 Spring St., San Francisco, CA 94143			
Name	Autumn Summers	Age	47
Address	Raintree Rd, Season, IL 90210	Date	1/10/95
Rx Warfarin Sodium Lactose qs ad M ft DTD caps #xxiv SA Sig: i qAM		1.5 mg	300 mg

a. Interpret this prescription.

b. What instructions would you give the patient?

c. According to the prescription, how much warfarin (total) is required?

d. What is the least amount of warfarin you would weigh out? Assume a sensitivity requirement of 6 mg and a maximum tolerable error of 5%.

e. **Assume that you have weighed out the minimum weighable amount of warfarin.** How much lactose (diluent) would you use so that the resulting material can be directly dispensed without further dilution.

Problem 4

Bartholomew Simpson 102 Fox St., Springfield, IL 14003			
Name	George Papsmear	Age	47
Address	Rorschasch Ave, Therapi, IL 90210	Date	1/10/95
	Rx Atropine Sulfate		200 mcg
	Phenobarbital		16 mg
	Lactose qs ad.		120 mg
	M ft caps DTD #60. Sig: ii caps qid.		

- a. How many milligrams of lactose are present per capsule?

- b. You weight out the minimum weighable quantity of atropine sulfate consistent with a sensitivity requirement of 6 mg and an error of 5%. How much atropine sulfate would you weigh out?

- c. You mix the minimum weighable quantity of atropine sulfate from (b) above with 2 g of lactose and triturate. You now want to create an aliquot of the triturated mixture containing the exact amount of atropine sulfate for all 60 capsules. What is the weight of this aliquot?

- d. You mix the phenobarbital required for the 60 capsules into the atropine sulfate-containing aliquot in (c). How much phenobarbital would you add?

- e. You then add the remaining lactose needed for 60 capsules into the atropine sulfate and phenobarbital-containing aliquot in (d). How much lactose would you add?

Problem 5

Phone 716-555-1234		DEA# AR -12736280	
Dr. Margarita Whisky Champagne, IL 14002			
Name	Brandy Apertif	Age	63
Address	13 Cordial Rd, Champagne	Date	9/28/97
Rx Prednisone		2.5 mg	
Lactose qs		150 mg	
DTD 24 caps			
Sig: 5 mg/day in two doses			

- a. What instructions would you give your patient?

- b. What is the minimum amount of prednisone that should be weighed out? State your sensitivity requirement and percent error assumptions.

- c. Assume you have weighed out 125 mg of prednisone. How much lactose should be added?

- d. How many **excess capsules** will have you after dispensing the prescription. Assume you used the 125 mg prednisone weighed out in (c) above?

- e. If you balance has a sensitivity requirement of **5 mg**, what is the **percent error** associated with a **150 mg** weight measurement?

Problem continues on next page

Problem (continued)

Phone 716-555-1234		DEA# AR -12736280	
Dr. Etha Noll			
Champagne, IL 14002			
Name	Al Cojol	Age	9
Weight		Weight	30 kg
Address	13 Sherry Rd, Champagne	Date	9/28/97
Height		Height	4 ft
<div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="font-size: 2em; font-weight: bold; margin-right: 10px;">R_x</div> <div> <p>Prednisone</p> <p>m ft SA 24 caps</p> <p>Sig: 250 mcg/(kg day) tid</p> </div> <div style="text-align: right; margin-right: 10px;">qs</div> </div>			
<u>E. Noll.</u>			

f. Can the excess product prepared for Brandy Apertif be dispensed to young Al Cojol?

g. Does the minimum weighable quantity increase or decrease when the sensitivity requirement increases?

h. The pharmacist managing your pharmacy decides on January 1, that she wants to set a new standard for maximum percent error. The new percent error is 3%. Replacing the working Class A prescription balances in the pharmacy is not an option. What would you do to help her fulfil her New Year's resolution

Problem 6

Phone 555-1212		DEA# AK056983			
Immanuel Kant, M.D. 102 Niagara Falls Blvd. Amherst, NY. 14226					
Name	Alfred F. Stone	Age	44 yo	Height	160 cm
Address	15 Stonehenge, Eden, NY	Date	1/10/06	Weight	80 kg
Rx Atropine sulfate 0.0004g Phenobarbital 0.015g Lactose q.s. a.d. 0.4g d.t.d. caps #12 Sig: i q6h					

a. If your balance has a sensitivity requirement of 6 mg, what is the **minimum** amount of atropine sulfate you need to weigh to avoid measurement errors of greater than 5%?

b. How many capsules could you prepare with the minimum weighable quantity of atropine sulfate?

c. What is the daily dose of atropine sulfate?

Problem continues...

Problem (continued)

After weighing out the minimum weighable quantity of atropine sulfate, you decide to use all the atropine sulfate weighed to make a stock bottle containing capsules according to the above formula. Soon afterwards, you are asked to attend to the following prescription from Dr. John Sartre.

Phone 555-1212		DEA# AS0238611			
John Sartre, M.D. 100 Niagara Falls Blvd. Amherst, NY. 14226					
Name	Margaret Bundy	Age	44 yo	Height	160 cm
Address	25 State St, Buffalo, NY	Date	1/10/06	Weight	80 kg
Rx	Atropine sulfate 0.0064g Phenobarbital 0.24 g Lactose q.s. SA div. caps #16 Sig: i q6h				

- e. Could you dispense the previously compounded capsules to Margaret Bundy? Justify your answer with calculations.
-

Problem 7

Phone 716-555-1234		DEA# AT -12736280			
Dr. Sue Litigate, M.D. 3 Court Street, Petition, NC					
Name	Art Craft	Age	55	Height	130 cm
Address	Artisan St, Painted Post, AZ	Date	8/18/97	Weight	71 kg
<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <p>Rx Clonidine 0.3 mg Lactose qs ad 200 mg m ft sa 100 caps Sig: i cap bid for bp</p> </div> <div style="width: 35%; text-align: right;"> <p><u>S. Litigate, MD</u></p> </div> </div>					

- a. What condition is the patient being treated with clonidine for?

- b. If you were to interpret the prescription literally without applying any knowledge of minimum weighable quantity, how much clonidine is required for preparing all the capsules?

- c. What is the percent error that would result if you weighed the amount in part (b) on a prescription balance.

- d. What is the **minimum** amount of clonidine you should weigh out?

- e. How much lactose would you weigh out to dilute the amount of clonidine in part (d)?

Problem 8

Phone 716-555-1234		Dr. Hal O'Ween, M.D.		DEA# AT -12736280	
Name	Tarzan van der Apes	Age	25 yr	Height	5 ft 3 in
Address	8 Buckingham, London, ON	Date	8/18/02	Weight	100 kg
Rx	Levothyroxine sodium Lactose Mft caps sa DTD # 40. Sig: 1qd		2.5 mcg/kg 150 mg		

a. What is the daily dose of levothyroxine?

b. What is the maximum error that is acceptable while compounding a prescription?

c. What is the sensitivity requirement is usually required of a prescription balance?

d. What is the percent error if you weighed out the total amount indicated in the prescription on a prescription balance? Assume that you were ignorant of the minimum weighable quantity principle.

e. Assume you have weighed out the minimum weighable quantity of levothyroxine sodium. How much lactose would you mix it with to get the prescribed mixture?

Problem 9

Phone 716-555-1234		DEA# AS -12736280			
Dr. Anther Sepal, M.D. 3 Pistil Ave, Carpel, NY					
Name	Stamen Calyx	Age	25	Height	130 cm
Address	Corolla Ave, Carpel	Date	8/18/97	Weight	70 kg
<p>Rx Benzalkonium chloride solution 1:10000 w/v m ft sa 1 L for bladder irrigation</p> <p style="text-align: right;"><u>Anther Sepal, MD</u></p>					

- a. Express the benzalkonium chloride concentration in mg/ml.

- b. You have a 1000 ml measuring cylinder that is marked in 25 ml intervals. If you are trying to keep errors to 5% or less, what is the minimum volume you should measure?

- c. If you interpreted the prescription literally without applying any knowledge of minimum weighable quantity, how much benzalkonium chloride is required?

- d. In practice, how would you prepare the product?

Problem 10

Phone 716-555-1234		DEA# AT -12736280	
Dr. Margarita Martini, M.D. 3 Highball Court, Appertif, AZ			
Name	Sherry Kahlua	Age	45 yr
Address	87 Brandy Lane	Date	8/18/97
Height		5 ft 8 in	
Weight		100 kg	
<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="font-size: 2em; font-weight: bold; margin-right: 10px;">R</div> <div> m ft SA 1 liter of 1:20000 w/v benzalkonium chloride in sterile water for irrigation of bladder </div> </div>			
<u>M Martini, MD</u>			

- a. Express the concentration of benzalkonium chloride as a percentage

- b. Express the concentration in mg/ml?

- c. If you were to interpret the prescription literally without applying any knowledge of minimum weighable quantity, how much benzalkonium chloride is required for the preparing the solution?

- d. What is the percent error that would result if you weighed the amount in part (c) on a prescription balance.

- e. What is the **minimum** amount of benzalkonium chloride that should be weighed out?

- f. How would you prepare the solution, if you weighed out the amount in part (e)?

Problem 11

Phone 716-555-1234		Dr. Papel Higiénico, M.D., Flushing, NY		DEA# BH -12736280	
Name	Kim Wipes	Age	45 yr	Height	5 ft 8 in
Address	87 Diaper Lane, Flushing	Date	8/18/97	Weight	100 kg
R		Alprazolam 0.25 mg			
		Lactose qs ad 150 mg			
		dtd # 50. Sig: i cap tid			
		<u>P Higiencio, MD</u>			

a. If you were to interpret the prescription literally without applying any knowledge of minimum weighable quantity, how much alprazolam chloride is required for all the doses in this prescription?

b. What is the minimum amount of alprozalom that should be weighed out to compound all the doses?

c. What is the percent error that would result if you weighed out the minimum weighable quantity on a prescription balance?

d. How much lactose should be weighed out for diluting the alprazolam weighed in part (c)?

e. Express the concentration of alprazolam in parts strength.

f. What is the minimum amount of alprazolam that should be weighed if the percent error on a prescription balance is to be reduced to 2%.

Problem 12

Dr. Billy Rubin, M.D.					
3 Porphyrin Lane, Glucuronide, CO					
Name	Jon Dice	Age	45 yr	Height	5 ft 8 in
Address	87 Melanin Lane	Date	8/18/97	Weight	100 kg
	R Reserpine		0.1 mg		
	Trichlormethiazide	2 mg			
	Lactose qs ad	150 mg			
	DTD #30. Sig i tab bid for bp				

a. How much reserpine is required for all the doses in this prescription if you compound without any knowledge of measurement errors?

b. How much trichlormethiazide is required for all the doses in this prescription if you compound without any knowledge of measurement errors?

c. You decide to first weigh 120 mg of trichlormethiazide and mix it thoroughly (triturate) with 480 mg of lactose. Determine the mass of the **aliquot** that contains the trichlormethiazide required for all the doses.

d. You decide to weigh 120 mg of reserpine and mix it thoroughly (triturate) with 5880 mg of lactose. Determine the mass of the **aliquot** that contains the reserpine required for all the doses.

e. You decide to mix appropriate aliquots of the preparations from part (d) and part (e) together and qs with additional lactose. How much additional lactose is required for all the doses?

Problem 13

Beldar Konehed			
101 Sixpack St., Remulac, NC			
Name	Connie Clorhone	Age	26
Address	Prymat St., Easter Island, NC 14004	Date	1/10/95
	Rx Amiloride hydrochloride		5 mg
	Hydrochlorothiazide		50 mg
	Lactose qs ad		300 mg
	DTD 20# caps		
	Sig 1 bid		

a. According to the prescription, how much amiloride hydrochloride is needed for compounding all the capsules?

b. What is the percent error if you weighed the amount of amiloride hydrochloride indicated in the prescription for all the capsules on a prescription balance?

c. You decide to weigh out 150 mg of amiloride hydrochloride. How much hydrochlorothiazide should be weighed out to compound this amount of amiloride hydrochloride?

d. How much lactose should be weighed out to compound the 150 mg amiloride hydrochloride in Question (d) above?

e. Describe how you would go about compounding and dispensing the dosage form based on your answers to questions (d)-(e).

Problem 14

Phone 555-3784	Docena Dauzaine		DEA# BS0365420		
12 Hierro St., Azuceres, TX 90210					
Name	Limón Gross	Age	23	Wt	80 kg
Address	144 Sal St, Azuceres, TX 90210	Date	1/10/95	Height	5 ft 10 in
R		Benzalkonium chloride 50% w/v concentrate	qs		
		Purified water qsad	1000 ml		
m ft sa 1:20,000 sol. Sig: Irrigate infected deep wounds					

a. Calculate the concentration of the benzalkonium chloride in the **concentrate** in **mg/ml**

b. Calculate the concentration of benzalkonium chloride in the preparation dispensed in **mg/ml**.

c. Calculate the quantity of benzalkonium chloride concentrate required.

d. You have a 10 ml measuring cylinder marked at 0.1 ml intervals. What is the minimum volume that should be measure to ensure that the error is less than 5%.

e. You take 2.5 ml of the 50% w/v benazalkonium chloride solution and “qs-ad” with water to 10 ml. You then withdraw a 2 ml aliquot of the diluted solution. What is the amount and concentration of benzalkonium chloride in the aliquot?

f. In the next step, you plan to further dilute the 2-ml aliquot from (e) above and remove a 2-ml aliquot containing all the drug. Explain the steps involved.

Problem 15

Phone 716-555-1234		Dr. Max Power, M.D.		DEA# AT -12736280	
Name	M. Simpson	Age	52 yr	Height	6ft 2 in
Address	Evergreen Terr, Springfield	Date	8/18/04	Weight	100 kg
Rx Esterified estrogen 0.4 mg Methyltestosterone 1.25 mg Lactose qs ad 200 mg DTD#21. Sig 1 cap qd for 21 days					

You have a prescription balance with a sensitivity requirement of 6 mg and always aim for a measurement error of 5% or less.

a. How much **methyltestosterone** would be required if you were to compound this prescription without any knowledge of minimum weighable quantity?

b. In the first step, you decide to weigh 120 mg of esterified estrogen and mix it with 2380 mg of lactose. What is the mass of the aliquot that contains the exact amount of esterified estrogen required for all the capsules?

c. In the next step, you decide to weigh 120 mg of methyltestosterone and mix it with 1000 mg of lactose. What is the mass of the aliquot that contains the exact amount of methyltestosterone required for all the capsules.

d. In the final step, you decide to mix the aliquots (from part c and part d) containing the required amounts of esterified estrogen and methyltestosterone and add a calculated amount of lactose to make a mixture containing material for compounding all the capsules. How **additional lactose** must be added at this step.

e. What is the concentration of **esterified estrogen** in each capsule in **percent w/w**?

Problem 16

Phone 716-555-1234		Dr. Constantan Steel, MD		DEA# BS -12736280	
Name	Solder Brass	Age	52 yr	Height	6ft 2 in
Address	Evergreen Terr, Springfield	Date	8/18/04	Weight	100 kg
Rx	Esterified estrogen	0.4 mg			
	Methyltestosterone	1.25 mg			
	Lactose qs ad	200 mg			
	DTD#21				
	Sig 1 cap qd for 21 days				
					<u>Constantan Steel, MD</u>

- a. You have a prescription balance with a sensitivity requirement of 6 mg and always aim for a measurement error of 5% or less. What is the minimum weighable quantity?

- b. If you use the prescription balance with a sensitivity requirement of 6 mg **to weigh directly the required amount of esterified estrogen for all capsules**, what is the percent error that may occur?

- c. Considering the minimum weighable quantity, you decide to use the aliquot method to ensure desired accuracy. In the first step, you decide to weigh 120 mg of esterified estrogen and mix it with 2380 mg of lactose. What is the quantity of the aliquot that contains the exact amount of esterified estrogen required for all the capsules?

- d. In the next step, you decide to weigh 120 mg of methyltestosterone and mix it with 1000 mg of lactose. What is the quantity of the aliquot that contains the exact amount of methyltestosterone required for all the capsules?

- e. In the final step, you decide to mix the aliquots (from part c and part d) containing the required amounts of esterified estrogen and methyltestosterone, and add a calculated amount of lactose to make a mixture containing material **for compounding all the capsules**. How much **additional lactose, in gram**, must be added at this step?

Problem 17

Phone 716-555-1234		Dr. Allen Hexkey, M.D.		DEA# AT -12736280	
Name	Phillipa Robertson	Age	17yr	Height	160 cm
Address	8 Ratchet Pl, Flathead	Date	8/18/02	Weight	80 kg
<p>Rx Estradiol 0.6 mg Estrone 2.5 mg Lactose qs ad 200 mg DTD#21 caps. 1 cap qd</p>					

Assume a sensitivity requirement of 6 mg and a maximal measurement error of 5%.

a. If you had no knowledge of minimum weighable quantity, how much estradiol and estrone is required for this prescription?

b. If you use the prescription balance **to weigh directly the required amount of estrone for all capsules**, what is the percentage error that may occur?

c. Considering the minimum weighable quantity, you decide to use the aliquot method to ensure desired accuracy. In the first step, you decide to weigh 150 mg of estradiol and mix it with 1350 mg of lactose. What is the quantity of the aliquot that contains the exact amount of estradiol required for all the capsules?

d. In the next step, you decide to weigh 150 mg of estrone and mix it with 300 mg of lactose. What is the quantity of the aliquot that contains the exact amount of estrone required for all the capsules?

e. In the final step, you decide to mix the aliquots (from part e and part f) that contain the required amounts of estradiol and estrone, and add a calculated amount of lactose to make a mixture **for compounding all the capsules**. How much **additional lactose, in gram**, must be added at this step?

Problem 18

Phone 716-555-1234		DEA# AT -12736280			
Dr. Max Power, M.D.					
Name	M. Simpson	Age	52 yr	Height	6ft 2 in
Address	Evergreen Terr, Springfield	Date	8/18/04	Weight	100 kg
<p>Rx Dextromethorphan hydrobromide 2.5 mg Benzocaine 1 mg Lactose qs ad 200 mg DTD#30 tab Sig 1 tab q4h for cough</p> <p style="text-align: center;">Max Power, MD</p>					

a. How much **dextromethorphan hydrobromide** would be required if you were to compound this prescription without any knowledge of minimum weighable quantity?

b. In the first step, you decide to weigh 125 mg of **dextromethorphan hydrobromide** and mix it with 875 mg of lactose. What is the mass of the aliquot that contains the exact amount of **dextromethorphan hydrobromide** required for all the tablets.

c. In the next step, you decide to weigh 125 mg of benzocaine and mix it with 1875 mg of lactose. What is the mass of the aliquot that contains the exact amount of benzocaine required for all the tablets.

d. In the final step, you decide to mix the aliquots (from part c and part d) containing the required amounts of **dextromethorphan hydrobromide** and **benzocaine** and add a calculated amount of lactose to make a mixture containing material for compounding all the tablets. How **additional lactose** must be added at this step.

CHAPTER 9
DILUTION AND RECONSTITUTION

NOTES**Outline**

- Dilution and Concentration: The two golden rules
- Alligation medial and alligation alternate
- Serial dilution
- Reconstitution

Dilution, Concentration And Mixtures

- In dilution problems only one ingredient brings in drug, the other is a diluent or solvent that does not contain any drug. In concentration problems, the solvent, usually water, is selectively removed, e.g., by evaporation. In mixture, two or more ingredients contain drug.

Dilution and Concentration: The Two Golden Rules

- All dilution and concentration problems can be solved by remembering only two simple principles:
- Amount = Concentration \times Quantity
- Law of conservation of mass.
- Together, these two principles yield the formula:

$$A = C_1 Q_1 = C_2 Q_2$$

- Remember to keep track of units. The units of concentration must be the same on both sides of the equation and units of quantity must be consistent with the units in the denominator of concentration. The units of amount will then be consistent with the units of the numerator of concentration. For example, if the units of concentration are mass/volume, then the units of quantity must be expressed in terms of volume to give amounts in units of mass.

Mixture Problems and Alligation

- Alligation is a fancy name for a calculation method that simplifies certain kinds of mixture problems. It is simply a useful extension of the two golden rules and can be used to solve the following two classes of mixture problems:

Problem Class I: Alligation Medial

- To **determine the composition** of the **product** when **known quantities** of two or more preparations of **known composition** are mixed. The method involves determining the weighted average composition and is called **alligation medial**.
- EXAMPLE: *200 g of 10% w/w, 50 g of 20% w/w and 100 g of 5% w/w zinc oxide ointments are mixed. Determine the composition of the resulting mixture.*

Concentration		Quantity, g	Amount of ZnO, g
10 % w/w	0.1 g/g	200	20
20% w/w	0.2 g/g	50	10
5 % w/w	0.05 g/g	100	5
TOTAL		350	35

Concentration in product = $35\text{g}/350\text{ g} = 0.1\text{ g/g} = 10\% \text{ w/w}$.

- Notice that the resultant product has a composition equal to the weighted average. You cannot merely average the three because each the contribution of each preparation to the final product is different. e.g., the 10% w/w preparation contributes 20 g of ZnO, the 20% w/w preparation contributes 10 g.
- The mathematical basis for alligation medial is the law of conservation of mass. Let $C_1, C_2, C_3\dots$ and $Q_1, Q_2, Q_3\dots$ represent the concentrations and quantities of the individual preparations. These variables are **known**. Let the resultant product have a concentration of C_{product} and be present in quantity Q_{product} .

The quantity of product = $Q_{\text{product}} = Q_1 + Q_2 + Q_3 \dots$ is therefore also **known**.

Amount of drug in product = $C_{\text{product}} Q_{\text{product}} = C_{\text{product}} (Q_1 + Q_2 + Q_3 \dots)$

Because of the law of conservation of mass:

Amount of drug in product = Sum of amounts of drug from each preparation

$$C_{\text{Product}} (Q_1 + Q_2 + Q_3 \dots) = C_1 Q_1 + C_2 Q_2 + C_3 Q_3 \dots$$

$$C_{\text{Product}} = \frac{C_1 Q_1 + C_2 Q_2 + C_3 Q_3 \dots}{Q_1 + Q_2 + Q_3 \dots}$$

Problem Class II: Alligation Alternate

- To **determine the quantities** of the **individual preparations** (**compositions** are assumed **known**) that result in a **product of a given composition** when mixed. The method involves a method called alligation alternate.
- The approach can also be used to determine the ratio in which two liquids of differing specific gravities have to be mixed to yield a mixture with the desired specific gravity.
- EXAMPLE: *How much petrolatum should be mixed with 5% hydrocortisone cream to give 100 g of 1.5% hydrocortisone cream.*

Petrolatum has 0% HC. The alligation problem is usually set up in following form.

5%		1.5 parts
	1.5%	
0%		3.5 parts

The relative ratios required are 1.5 parts of 5% cream and 3.5 parts of petrolatum. This means that $1.5 \times (100/5)\text{ g} = 30\text{ g}$ of 5% HC cream and 70 g of petrolatum are needed.

- The mathematical basis for alligation alternate is (again!) the law of conservation of mass. Let C_1, C_2 and Q_1, Q_2 represent the concentrations and quantities of the individual preparations. Here C_1, C_2 and C_{Product} are **known**, but Q_1 and Q_2 have to be **determined**.

The total quantity of product = $Q_{\text{product}} = Q_1 + Q_2$ is assumed **known**.

Amount of drug in product = Sum of amounts of drug from each preparation

$$C_{\text{Product}} (Q_1 + Q_2) = C_1 Q_1 + C_2 Q_2$$

$$(C_{\text{Product}} - C_1)Q_1 = (C_2 - C_{\text{Product}})Q_2$$

$$\frac{Q_1}{Q_2} = \frac{C_2 - C_{\text{Product}}}{C_{\text{Product}} - C_1}$$

- This means that the relative ratio of the quantities required is inversely proportional to the ratio of the differences in concentration. Since the relative ratios are known, the quantity of each preparation can be calculated.
- Alligation methods assume that the quantities involved are additive. You cannot therefore use alligation methods for volume calculations in which considerable expansion or contraction occurs upon mixing unless the final product is "qs-ed" with one of the liquid components. However, you can always use the approach when quantities are expressed in mass units because the law of conservation of mass always holds true.

Serial Dilutions

- Serial dilution is the repeated usage of a particular dilution procedure. See Figure 9.1.
- Serial dilutions are an accurate method of making solutions of low concentrations by performing a series of dilutions to rapidly reduce the concentrated solution that is given.
- Serial dilutions are frequently used when direct one-step dilution would require very large volumes of diluent. Large volume measuring devices may sometimes not be available. Large one-step dilutions are inefficient because they use large quantities of diluents and consequently generate large volumes of waste for disposal.

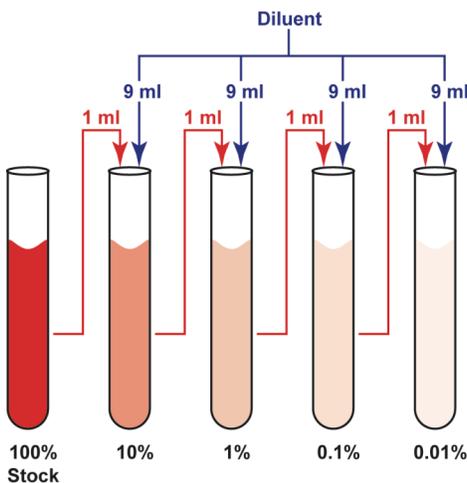


Figure 9.1. Schematic for a 1: 10,000 serial dilution. Ten ml of a 0.01% solution is obtained from 100% stock using 4 steps.

- Serial dilutions are sometimes necessary because of the constraints imposed by minimum weighable quantity: e.g., A pharmacist may need to use 0.1 mL solution containing 100,000 units/mL drug A to prepare a desired 100-mL solution containing 10 units/mL drug A. Given a minimum measurable volume of 1.0 mL, the pharmacist should NOT carry out single dilution by measuring 0.1 mL of the original solution. The pharmacist may

perform two serial dilutions as the follows: In Step 1, Dilute 1 mL of 100,000 units/mL solution in enough diluent to yield a 100 mL solution that contains 1,000 units/mL of drug A. In Step 2, Dilute 1 mL of the solution from Step 1 in enough diluent to yield a 100 mL solution containing 10 units/mL of drug A.

- Serial "ten-fold" dilutions are commonly used. This is shown in Figure 9.1. One ml of the stock is first mixed with 9 ml of diluent to give 10 ml of the first diluted preparation. Good mixing is essential, otherwise errors will propagate. Next, 1 ml of the first diluted preparation is removed and mixed with 9 ml of fresh diluent and mixed to give 10 ml of the second diluted preparation. The process is repeated.
- The output from one dilution is thus used to provide the input to the next. The two “golden rules” still apply for each dilution.
- In the serial dilution Figure above, note that the direct dilution of 1 ml of 100% stock to yield a 0.01% product could potentially result in 10,000 mL of product and use up 9,999 ml of diluent. The serial dilution procedure is elegant and efficient. It uses only 36 ml of diluent.
- A given product can be prepared by using differing serial dilution strategies., i.e., there is not only one right way. Ten-fold dilutions are often preferred because there is less risk of arithmetic errors but other dilution strategies can be valid as well.
- In the first step, calculate the overall dilution factor (DF). The DF is the ratio of the final concentration desired to the concentration of stock solution available.

$$DF = \frac{C_{Stock}}{C_{Final}}$$

- The dilution factor can be viewed as the volume in ml that must be added to 1 ml of stock if the dilution were being done in a single step.
- In serial dilution:

$$DF = DF_1 \times DF_2 \times DF_3 \times DF_4 \dots$$

- By examining the value of DF , determine the number of steps of serial dilution you want to use. In general, the more steps are needed for larger values of DF . For example, for $DF = 1000$, three steps of 10-fold dilution will produce the necessary 10^3 -fold dilution. However, for a $DF = 10,000$, four such steps will be needed.

Reconstitution Of Dry Powders

- Thus far in alligation calculations, we have assumed that volume changes on mixing are negligible. Here, we will explore calculations wherein this assumption is relaxed.
- The more common pharmaceutical applications of reconstitution arise in the case of suspensions and for antibiotics, which are formulated as drug powders that are reconstituted by the pharmacist just prior to dispensing to avoid the potency loss that can

occur in a liquid dosage forms. To enhance the shelf life of these drugs, they are provided to pharmacy in drug powder form for constitution with purified water or other diluent when an order is called.

- Typically, the manufacturer provides labels instructions for reconstitution that when followed yield a specific concentration of preparation. However, prescribers may request a concentration different from those indicated on the label. Reconstitution calculations help you figure what you have to do to get the prescribed concentration using information from product label.
- The calculation strategy is to calculate the volume contributed by the solid on reconstitution. This is obtained from the **label instructions** as the difference between the volume of the **preparation** and volume of **diluent** added. In the next step, the volume of the preparation if the same amount of drug were diluted to the concentration requested in the **prescriber's instructions** calculated. The amount of diluent needed is the difference between this volume and the volume of contributed by the solid.

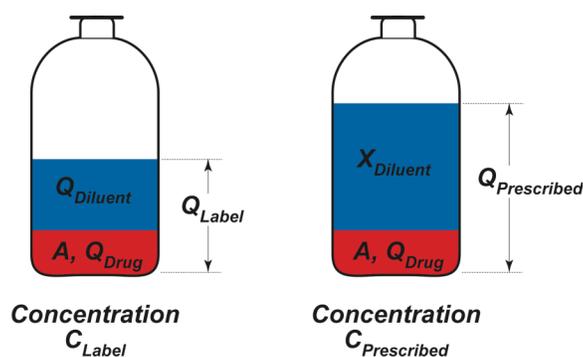


Figure 9.2. Schematic for reconstitution.

- Figure 9.2 is a schematic of the calculation procedure. Read the manufacturer's label instructions. The manufacturers label instructions will provide the amount of drug A , volume of diluent $Q_{Diluent}$ to be added and the resultant concentration C_{Label} . The total volume Q_{Label} , which represents the volume of the preparation when dissolved can be calculated using the concentration definition:

$$A = C_{Label} \times Q_{Label}$$

- Let Q_{Drug} represent the volume contribution to the powder. Note that this is not the volume of the powder, it is the contribution the powder makes to the total volume when it dissolves or upon resuspension:

$$Q_{Drug} = Q_{Label} - Q_{Diluent}$$

- The goal is to calculate the volume of diluent $X_{Diluent}$ to add so that you achieve the prescribed concentration $C_{Prescribed}$. The amount of drug A is unchanged so you obtain $Q_{Prescribed}$, the total volume of the preparation as prescribed from:

$$A = C_{Prescribed} \times Q_{Prescribed}$$

- The volume of diluent $X_{Diluent}$ to add is obtained from:

$$X_{Diluent} = Q_{Prescribed} - Q_{Drug}$$

PROBLEMS

Problem 1

- a. Two rules/laws/formulas are usually sufficient to solve most dilution and concentration problems. State these two rules.

- b. What assumption is made in deriving alligation medial and alligation alternate?

- c. What kind of problem is alligation **medial** used for?

- d. What kind of problem is alligation **alternate** used for?

- e. A pharmacy intern used alligation alternate to compute the relative quantities of two aqueous solutions of ethanol required to produce a desired ethanol-containing product. When she measured the ethanol concentration in the product, she found that the product did not have the desired concentration. Why? Be brief.

Problem 2

Phone 555-3784	DEA# BA0365420
<p>Harry Alopecia 101 Receding St. Clearscalp, TX 14003</p>	
Name <u>Ian Baldy</u>	Age <u>26</u>
Address <u>Thinontop St., Clearscalp, TX</u>	Date <u>1/10/95</u>
<p>Rx Minoxidil tablets qs Ethanol 30 ml Water qs ad 50 ml M. ft. solution SA containing 2% w/v minoxidil. Apply 1 ml solution to affected area bid.</p>	

- a. Calculate the concentration of minoxidil in the dispensed preparation in **mg/ml**.

- b. Calculate the concentration of ethanol in **% v/v**.

- c. Calculate the amount of minoxidil required in **mg**.

- d. You have 10 mg tablets of minoxidil available. How many tablets are required for the preparing the solution?

- e. You have 190 proof ethanol. What volume of 190 proof ethanol would you use?

Problem 3

Phone 555-3784			
Rosemary Oregano			
101 Basil St.			
Cayenne, WY			
Name	Ginger Cumin	Age	32
		Weight	50 kg
Address	Peppertree Ave, Cayenne, WY	Date	9/6/96
		Height	5 ft 6"
R Add 5 ml of parenteral concentrate containing 16 mg/ml trimethoprim and 80 mg/ml sulfamethoxazole to 75 ml of D5W. Infuse mixture IV over 1 hour.			
<u>R. Oregano M.D.</u>			

Sulfamethoxazole and trimethoprim are used in combination because the mixture is a more effective antibacterial than either drug alone. A parenteral concentrate containing **both** drugs in aqueous solution is commercially available. The concentrate is diluted before IV infusion.

- a. What is the concentration of sulfamethoxazole in the concentrate in % w/v?

- b. Determine the total volume of the diluted mixture. Assume that there is no expansion or contraction upon dilution.

- c. Determine the concentration of sulfamethoxazole in the diluted mixture in **mg/ml**.

- d. Determine the total dose of sulfamethoxazole in mg.

- e. Calculate the infusion flow rate in ml/min.

Problem 4

Phone 716-555-1234		DEA# AT -12736280													
<p>James Sulley Sanderson Street Celiamae, NM 2010</p>															
Name	Michael Wazowski	Age	5 yr												
Address	87 Randall Road	Date	10/1/02												
Height			2' 8"												
Weight			20 kg												
<table style="width: 100%; border: none;"> <tr> <td style="font-size: 2em; vertical-align: middle; padding-right: 10px;">R</td> <td style="padding: 5px;">Lidocaine hydrochloride</td> <td style="padding: 5px;">0.5% w/v</td> </tr> <tr> <td></td> <td style="padding: 5px;">Epinephrine</td> <td style="padding: 5px;">1: 200,000</td> </tr> <tr> <td></td> <td style="padding: 5px;">D5W qs ad</td> <td style="padding: 5px;">50 ml</td> </tr> <tr> <td></td> <td colspan="2" style="padding: 5px;">Inject 1 mg/kg lidocaine hydrochloride for anesthesia</td> </tr> </table>				R	Lidocaine hydrochloride	0.5% w/v		Epinephrine	1: 200,000		D5W qs ad	50 ml		Inject 1 mg/kg lidocaine hydrochloride for anesthesia	
R	Lidocaine hydrochloride	0.5% w/v													
	Epinephrine	1: 200,000													
	D5W qs ad	50 ml													
	Inject 1 mg/kg lidocaine hydrochloride for anesthesia														

a. You have a 50 mg/ml solution of lidocaine hydrochloride in D5W. How many ml of this solution are required for this preparation?

b. You have a 1 mg/ml solution of epinephrine in D5W. How many ml of this solution are required?

c. How much many ml of D5W should be added? Neglect volume contributions of solids upon dissolution.

d. What volume of the preparation would you inject?

Problem 5

Phone 867-654-3210		Diana Walker, M.D.		DEA #AA9124366	
		100 W. Guran St			
		Bangalla, CA. 14226			
Name	Jane Tarzan	Age	42	Weight	50 kg
Address	15 N. Forest Road, Tarzana, CA	Date	8/3/08	Height	160 cm
Rx					
		Insulin Human (Regular) Solution		U-40	
		Extended Insulin Human Zinc Suspension		U-100	
Disp. 4 vials of each.					
Sig: Inject sc 4 units of Regular and 10 units of Extended sc 60 min before breakfast.					
Refills: 4					

Insulin, a protein drug used by diabetics, is available in several different formulations that differ in time to onset of pharmacological effect and in duration of action. It is usual for physicians to prescribe a mixture of two formulations so that the patient can have both acute control and extended effects. Diabetic patients usually inject themselves after drawing the prescribed amounts of each formulation into a single syringe.

- a. What concentrations of insulin do the abbreviations U-40 and U-100 represent?

- b. How many **ml** of human insulin (Regular) solution should the patient draw into the syringe?

- c. How many **ml** of Extended insulin human zinc suspension should the patient draw into the syringe?

- d. What instructions would you give the patient?

- e. What is the insulin concentration (units/ml) in the syringe after the both formulations have been drawn and mixed?

Problem 6

Phone 716-555-1234		DEA# AT -12736280			
Dr. Angel Hair-Capellini, M.D. 3 Orzo Ave Rigatoni, NC					
Name	Penne Ditalini	Age	25 yr	Height	5'9"
Address	87 Ziti St, Rigatoni, NC	Date	8/18/97	Weight	50 kg
<div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 10px;">℞</div> <div> Triamcinalone acetoneide 0.1% w/w M ft sa 25 g alb crm Sig aaa tid </div> </div> <div style="text-align: right; margin-top: 10px;"> <u>Angel Capellini, MD</u> </div>					

a. What instructions would you give the patient?

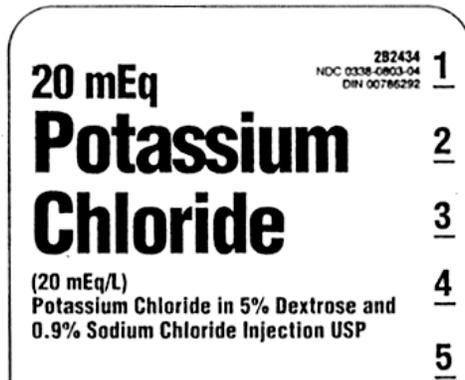
b. You realize that you do not have 0.1% triamcinalone acetoneide cream available. You decide to compound the preparation by mixing 0.5% cream with 0.025% cream. What alligation method could you use to solve this problem?

c. Fill in the following alligation alternate table. Do not solve.

d. How much 0.5% cream is required?

e. How much 0.025% cream is required?

Problem 7



Use the label fragment to answer questions. Potassium chloride ($K^+ Cl^-$) is a crystalline solid.

a. What is the concentration of **Potassium chloride** in mg/ml?

b. What is the concentration of **Sodium chloride** in mg/ml?

c. What is the concentration of **sodium chloride** in mEq/ml?

d. Both sodium chloride and potassium chloride contribute chloride ions to the preparation. What alligation method could be used to calculate chloride ion concentration?

e. What is the concentration of **chloride ion** in mEq/ml?

f. What is the concentration of **chloride ion** in mg/ml?

Problem 8

Phone 867-654-3210	General Hospital	DEA #AA9124366
	100 Guiding Light St	
	Dallas, TX 14226	
Name NEUROSURGERY ICU	Age –	Weight –
Address –	Date –	Height –
R_x	<u>Benzalkonium chloride solution</u> Benzalkonium chloride solution 16% qs Purified water qs ad 2L M ft 1: 500 solution. Label: Stock solution of Benzalkonium chloride.	

a. How much 16% benzalkonium chloride solution is required?

b. This dilution problem can also be solved using alligation alternate. **Set up** (do **NOT** solve) for determining the quantity of 16% benzalkonium chloride solution using the **alligation alternate** method, i.e., Fill in the double underlined blanks in the table below.

c. Using the **alligation alternate** method, determine how much 16% benzalkonium chloride solution is required.

Problem 9

Phone 876-878-2421		DEA# BB -12736280			
Cory Blackfin 12 Puffer St., Danio, AK 50210					
Name	Piranha Black	Age	23 yr	Height	5 ft 10 in
Address	1448 Crystal Tetra Ct, Danio	Date	1/21/05	Weight	80 kg
<p>R Infuse 200 mg ciprofloxacin by IV infusion over 60 minutes q12 hour. Prepare a 1.5 mg/ml infusion solution by adding 10 mg/ml ciprofloxacin lactate parenteral concentrate solution to 250 ml D5W.</p>					

- a. How much ciprofloxacin lactate parenteral concentrate should be added. Do not neglect the volume of the added concentrate?
- _____
- b. Calculate the volume of infusion fluid that must be infused.
- _____
- c. A new nurse inadvertently adds 60 ml of ciprofloxacin lactate parenteral concentrate to a 250 ml D5W infusion bag. Calculate the concentration in the infusion fluid.
- _____
- d. Assume that a supervisor detected this error prior to the start of the infusion. Calculate the volume of the infusion fluid from part (c) that when infused would provide the prescribed dose.
- _____
- e. Now assume that the nurse's error was not detected until the infusion was running for 30 minutes at a flow rate of 2.217 ml/min. The erroneously prepared infusion fluid from part (c) was allowed to continue to run at the infusion flow rate of 2.217 ml/min. However, the infusion was terminated when the full ciprofloxacin dose was administered. Calculate the total time for which this infusion was run.
- _____

Problem 11

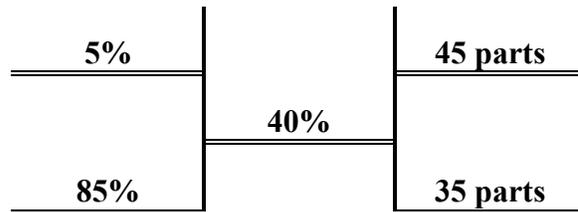
Phone 555-3784	DEA# AM0365420
Diana Palmer-Guran Walker's Table Road, Mesa	
Name Heloise Walker	Age 26
Address Goodmark St., Clarksville, MS	Date 1/10/95
Rx 5% w/v Barium sulfate suspension qs 85% w/v Barium sulfate suspension qs M. ft. SA 1600 ml of 40% w/v Barium sulfate suspension. Administer 500 ml rectally for colon visualization.	

Barium sulfate is opaque to X-rays and is used in radiology for imaging the gastrointestinal tract.

- a. Calculate the concentration of barium sulfate in the final preparation in mg/ml.

- b. Calculate the concentration of barium sulfate in the final preparation in grams/liter.

- c. Set up (do not solve) the problem as an alligation alternate. Fill in the double underlined spaces provided below.



- d. Calculate the volume of 5% barium sulfate solution required to make 1600 ml of the product in ml.
45 parts needed for 80 parts mixture. For 1600 ml, $X = 45 \times 1600/80 = 900$. ml

- e. Calculate the volume of 85% barium sulfate solution required to make 1600 ml of the product in ml.
35 parts needed for 80 parts mixture. For 1600 ml or $X = 35 \times 1600/80 = 700$. ml

Problem 12

Phone 716-555-1234		DEA# BB -12736280																
Derby Bowler Panama Street Green Beret, SC 40210																		
Name	Fedora Gatsby	Age	70															
Address	Bonnet Street, Sombrero, NM	Date	10/1/97															
		Weight	50 kg															
		Height	5' 3"															
<table style="width: 100%; border: none;"> <tr> <td style="width: 10%; vertical-align: top; padding-right: 10px;">Rx</td> <td style="padding: 2px;">Regular attapulgite</td> <td style="text-align: right; padding: 2px;">10% w/v</td> </tr> <tr> <td></td> <td style="padding: 2px;">Colloidal attapulgite</td> <td style="text-align: right; padding: 2px;">3% w/v</td> </tr> <tr> <td></td> <td style="padding: 2px;">Peppermint water</td> <td style="text-align: right; padding: 2px;">qs ad</td> </tr> <tr> <td></td> <td colspan="2" style="padding: 2px;">m ft SA 100 ml of suspension</td> </tr> <tr> <td></td> <td colspan="2" style="padding: 2px;">Sig: 3.9 g attapulgite bid</td> </tr> </table>				Rx	Regular attapulgite	10% w/v		Colloidal attapulgite	3% w/v		Peppermint water	qs ad		m ft SA 100 ml of suspension			Sig: 3.9 g attapulgite bid	
Rx	Regular attapulgite	10% w/v																
	Colloidal attapulgite	3% w/v																
	Peppermint water	qs ad																
	m ft SA 100 ml of suspension																	
	Sig: 3.9 g attapulgite bid																	

a. What is the **total concentration** of attapulgite in the suspension in **grams/ml**?

b. What instructions would you give the patient?

c. **Regular** attapulgite is available in stock as a 30% w/v suspension. Calculate the quantity of this suspension required for the prescription.

d. **Colloidal** attapulgite is available in stock as a 15% w/v suspension. Calculate the quantity of this suspension required for the prescription.

Problem 14

Phone 716-555-1234		DEA# AB -12736280	
Barbie Ninja-Turtle Teletubby, GA 470001			
Name	Elmo Barney	Age	40
Weight		Weight	100 kg
Address	8 Ken Street, Teletubby, GA	Date	10/01/97
		Height	5' 8"
Rx			
	Potassium chloride		0.6
	Potassium bicarbonate		1
	Potassium citrate		0.216
m ft 24 tabs SA			
Dissolve i tab in 8 oz water qd			

Potassium chloride, KCl or K^+Cl^- , has a molecular weight of 75. Potassium bicarbonate, $KHCO_3$ or $K^+(HCO_3)^-$, has a molecular weight of 100. Potassium citrate $K_3^+(C_6H_5O_7)^{3-}$ has a molecular weight of 324. Potassium has an atomic weight of 39.

a. What is the equivalent weight of potassium **citrate**?

b. The units for amounts of the various potassium salts are not indicated in the prescription. If all the salts are solids at room temperature, what units are implied?

c. How many mEq of potassium ions are contributed to each dose by the potassium **chloride**?

d. How many mg of potassium ions are contributed to each dose by the potassium **chloride**?

e. How many mEq of potassium ions are present in each dose

Problem 15

R. Enema					
Emetic, IA 14002					
Name	Ann Algesia	Age	30	Weight	80 kg
Address	Astringent Street, Emetic, IA	Date	9/23/97	Height	5' 8"
R_x Transfuse 2 units of Type AB or Type O whole blood stat <div style="text-align: right;"><u>REnema M.D</u></div>					

A unit of whole blood is 500 ml.

a. Calculate the volume of blood transfused.

b. The concentration of red cells, often referred to as hematocrit, in the infused whole blood is 45% v/v. Calculate the volume of the infused red cells.

c. The patient is hypovolemic (i.e., she has low blood volume) and anemic (i.e., she has a low red cell count). Assume that the patient blood volume is 3500 ml and her hematocrit 30% v/v. Estimate the volume of red cells in the patient before the transfusion.

d. Estimate the hematocrit immediately after the transfusion is complete.

e. How many ml of blood would be required if the physician wanted to attain a final hematocrit of 35% v/v. Again assume that the patient has a blood volume of 3500 ml and a hematocrit of 30%; and that the transfused blood has a hematocrit of 45%.

Problem 16

Phone 716-555-1234		DEA# AR -12736280	
Dr. Rose Garden-Signing Capitol Hill, NC 14002			
Name	Bill Veto	Age	63
Weight		Weight	80 kg
Address	13 Passing Ln, Capitol Hill	Date	9/8/97
Height		Height	5'8"
Rx	Mannitol 1.5 g/kg Infuse 20% w/v mannitol over 60 minutes iv		

Mannitol is a solid that has a variety of medical applications including treatment of cerebral edema and the reduction of intracerebral pressure prior to neurosurgery.

a. What is the infusion flow rate?

b. What is the volume of 20% w/v mannitol needed?

c. You find that you do not have 20% w/v mannitol available. You only have 10% and 25% mannitol for infusion. You decide to compound the preparation. Set up the following alligation table.

d. What volume of **25% mannitol** solution is required?

f. What volume of **10% mannitol** solution is required?

Problem 17

Phone 716-555-1234		Dr. H. Mustard-Dressing		DEA# AR -12736280	
Thousand Island, PA 14002					
Name	Cesar French	Age	9	Weight	30 kg
Address	13 Ranch Rd, T.I.	Date	9/28/97	Height	4 ft
<p>R_x Potassium chloride qs</p> <p>Potassium gluconate qs</p> <p>Water qs ad 100 ml</p> <p>m ft SA solution containing 1 mEq Cl⁻ and a total of 7 mEq K⁺ per 5 ml.</p> <p>Sig: 21 mEq K⁺ per day in three equal doses</p>					

This is a formula for an oral potassium supplement. Here is some additional information: Potassium chloride (K⁺Cl⁻, molecular weight 74.5); potassium gluconate (K⁺ (C₆H₁₁O₇)⁻, molecular weight 234), potassium has an atomic weight of 39.

a. What instructions would you give the patient

b. What is the **potassium chloride** concentration in **mEq/teaspoonful**?

c. What is the **potassium chloride** concentration in **mg/teaspoonful**?

d. What is the **potassium gluconate** concentration in **mEq/teaspoonful**?

e. What is the **potassium gluconate** concentration in **mg/teaspoonful**?

Problem 18

Dr. Uganga Bugisu Sumatra Street, Colombia, SC 14002					
Name	<u>Arabica Peabury</u>	Age	<u>35</u>	Height	<u>5 ft 7 in</u>
Address	<u>Java St, Colombia, SC</u>	Date	<u>9/1/97</u>	Weight	<u>60 kg</u>
<p>Rx 50% w/v Benzalkonium chloride qs Water qs ad m ft 500 ml of 1:750 solution for storing instruments</p> <p style="text-align: center;"><u>Uganga Bugisu</u> M.D.</p>					

a. Express the concentration of the 1:750 product in mg/ml

b. Express the concentration of the 50% w/v solution in mg/ml.

c. What volume of the 50% w/v solution is required?

d. How much water is required?

e. How much benzalkonium chloride does the product contain?

Problem 19

Phone 716-555-1234		DEA# AT -12736280			
Dr. Rachel Jordan, M.D. 3 Seymour Road, Las Vegas, NV					
Name	Ned Flanders	Age	25	Height	130 cm
Address	Maude Ave, Springfield	Date	8/18/97	Weight	71 kg
Rx Potassium chloride qs Potassium bicarbonate qsad 4g m ft sa tablets each containing 50 mEq K+ Disp 100 tablets Sig: Dissolve 1 tablet in 1 glass OJ tid					

Potassium bicarbonate ($K^+HCO_3^-$, Molecular weight 100 g/mole).

- What is the equivalent weight of potassium ion?

- What is the **dose** of potassium ion in each tablet? Express your answer in grams.

- What is the concentration of potassium ion in potassium bicarbonate in **g/g**?

- What is the **concentration** of potassium ion in the product in **g/g**?

- Potassium chloride contains 0.5235 g of potassium ion per gram. Using this information and the answers to the previous questions fill in all five blanks in the following alligation table.
Use four significant figures.

Problem 20

Phone 716-555-1234		DEA# AA -12736280	
Dr. Manjula Apu, M.D. 13 Lovejoy Ave, Flanders, NJ			
Name	Ralph Wiggum	Age	25
Address	Hibbert Ave, Flanders, NJ	Date	8/18/97
Height			130 cm
Weight			70 kg
<div style="font-size: 2em; font-weight: bold; margin-bottom: 5px;">R_x</div> 12.5% Benzalkonium chloride solution qs Water qsad m ft sa 1 L of 1:10000 w/v for bladder irrigation <div style="font-size: 1.2em; font-weight: bold; margin-top: 10px;"><u>Manjula Apu, MD</u></div>			

a. Express the concentration of drug in the final preparation in mg/mL.

b. Calculate the amount of benzalkonium chloride in the final preparation.

c. Calculate the volume of 12.5% benzalkonium required?

d. Fill in the following alligation table for the problem.

e. Calculate the volume of 12.5% benzalkonium chloride stock solution using the data from the alligation table.

Problem 21

Phone 716-555-1234		DEA# AD -12736280			
Dr. Jade Diamond, M.D.					
3 Ruby Ave, Coralville, IA					
Name	Pearl Crystal	Age	28	Height	5 ft 8"
Address	Sapphire Street, Coralville	Date	6/19/07	Weight	76 kg
R_x	1.1 mg/ml sodium fluoride solution qs 4.4 mg/ml sodium fluoride solution qsad 100 ml m ft solution containing 0.2% NaF				

Sodium fluoride (NaF, Molecular weight 42) is used to prevent cavities in teeth.

a. What is concentration of sodium fluoride in the product in mg/ml?

b. What is the concentration of fluoride ion in the final product in mg/ml?

c. Fill in the blanks in the following alligation table.

d. What volume of 1.1 mg/ml sodium fluoride solution is needed?

e. What volume of 4.4 mg/ml sodium fluoride solution is needed?

Problem 22

Phone 716-555-1234	Dr. Charles Burns, M.D.	DEA# AT -12736280
3 Smithers Court Montgomery, AL		
Name	<u>Lily Bancroft</u>	Age <u>45 yr</u>
Address	<u>87 Waylon Way, Springfield, IL</u>	Height <u>5 ft 8 in</u>
	Date <u>4/22/06</u>	Weight <u>100 kg</u>
R m ft SA 6 ml of 0.25% w/v phenylephrine hydrochloride nasal drops Sig: 2 gtt in each nostril q4h prn congestion		

You find that you do not have 0.25% phenylephrine hydrochloride in stock. You only have 0.125% and 0.5% solutions of phenylephrine hydrochloride. After consulting the caregiver, you opt to mix these two solutions and compound the prescribed product.

a. What instruction will you give the patient?

b. Convert the prescribed concentration of phenylephrine hydrochloride to mg/ml.

c. What is the single dose of phenylephrine hydrochloride?

d. Fill in the following alligation alternate table.

e. How much 0.5% phenylephrine hydrochloride solution is needed?

f. How much 0.125% phenylephrine hydrochloride solution is needed?

Problem 23

Phone 716-555-1234		DEA# BO -12736280			
Dr. Listera Ovata, M.D.					
Cambria, DE 70210					
Name	Vampira Dracula	Age	45 yr	Height	5 ft 8 in
Address	87 Encyclia Lane, Cambria	Date	8/18/97	Weight	100 kg
Rx	Potassium bicarbonate		300 mg		
	Sodium bicarbonate		840 mg		
	Citric acid		860 mg		
	dtd # 20. Sig: dissolve i tab in 240 ml water tid				

This is the recipe for an effervescent antacid tablet. Potassium bicarbonate (KHCO_3) has a molecular weight of 100 and sodium bicarbonate (NaHCO_3) has a molecular weight of 84.

- Calculate the concentration of bicarbonate ion (HCO_3^-) in **pure potassium** bicarbonate in g/g.

- Identify the alligation method that can be used determine the concentration of bicarbonate ion (HCO_3^-) in the **effervescent tablet** dispensed.

- Calculate the dose of bicarbonate ion (HCO_3^-) in the **effervescent tablet** dispensed in milligrams.

- Calculate the **concentration** of bicarbonate ion (HCO_3^-) in the **effervescent tablet** dispensed in milligrams/g.

- Calculate the **concentration** of bicarbonate ion (HCO_3^-) after dissolution in the **glass of water** in milligrams/ml. (Assume the chemical reaction that occurs on dissolution does not occur).

Problem 24

Dr. Alba Gallica, M.D. Rosegarden, MD 50210					
Name	Noisette Floribunda	Age	25 yr	Height	5'9"
Address	867 Bermuda St, Rosegarden	Date	8/18/97	Weight	50 kg
R Potassium bicarbonate 312 mg Sodium bicarbonate 958 mg Citric acid monohydrate 832 mg DTD#12. Sig: Dissolve 1 tab in 8 oz water bid prn heartburn					

This is an effervescent antacid tablet. The sodium bicarbonate and the potassium bicarbonate neutralize stomach acid. Sodium bicarbonate ($Na^+HCO_3^-$) has molecular weight 84, potassium bicarbonate ($K^+HCO_3^-$) has molecular weight 100, and citric acid has molecular weight 210.

a. What is the concentration of sodium ion in **pure** sodium bicarbonate in grams/gram?

b. What is the concentration of sodium ion in the tablet?

c. Antacids must be labeled for sodium content if they contain more than 0.2 mEq of sodium per dose. What is the sodium content per dose in milliequivalents?

d. Assuming a glassful (8 ounces) is 240 ml, and that the effervescent reaction causes no change in volume, what is the concentration of sodium ion in the glass.

e. What alligation method would you use to calculate the concentration of bicarbonate in the tablet?

f. What is the concentration of bicarbonate ion in the tablet in grams/gram

Problem 25

Phone 716-555-1234		DEA# AA -12736280			
Dr. Philip Boyes, M.D.					
Name	Christopher Pike	Age	4 yr	Height	5 ft 3 in
Address	8 Enterprise Ave, Deepspace	Date	8/18/02	Weight	20 kg
<p>Rx 2 ml solution/kg of 20% w/v dextrose solution by slow iv injection for symptomatic diabetic hypoglycemia</p> <p style="text-align: right;"><u>P. Boyes, MD</u></p>					

You find you do not have 20% w/v dextrose available. Because this is an emergency, you decide to prepare 20% w/v dextrose by mixing D5W and 40% w/v dextrose injection.

a. Calculate the volume of dextrose solution to be injected?

b. What is dose of dextrose injected?

c. Set up and fill in the blanks of the following alligation table.

d. How much D5W is required for preparing the mixture?

e. How much 40% w/v dextrose solution is required for preparing the mixture?

Problem 26

Phone 716-555-1234		DEA# AT -12736280			
Dr. Charles Boyle, M.D.					
Name	Dalton Gay-Lussac	Age	52 yr	Height	6ft 2 in
Address	8 Van der Waal St, Gaslaw, TX	Date	8/18/02	Weight	100 kg
<p style="text-align: center;">Rx Diatrizoate meglumine 60% w/v Administer 10 ml in left knee joint. Obtain images within 15 min</p>					

This is a drug that is used as a x-ray contrast agent. You find that you do not have 60% w/v diatrizoate meglumine. You decide to make the prescribed preparation by mixing 76% w/v diatrizoate meglumine with 30% w/v diatrizoate meglumine.

a. What alligation method would you use to calculate the quantities of 76% w/v and 30% diatrizoate meglumine required?

b. How much 30% w/v diatrizoate meglumine is needed for compounding this prescription?

c. How much 76% w/v diatrizoate meglumine is needed for compounding this prescription?

Diatrizoate meglumine is an effective contrast agent because it contains iodine. **Pure diatrizoate meglumine contains 47.06% w/v iodine.**

d. What alligation method would you use to compute the iodine content of a preparation containing a mixture of known volumes of 30% w/v diatrizoate meglumine and 76% diatrizoate meglumine?

e. What is the **iodine** concentration in the solution dispensed in the prescription?

Problem 27

Phone 555-3784		DEA# BC0365420	
Christine Chapell Beamup, MS 90210			
Name	Montgomery Scott	Age	23
		Wt	80 kg
Address	144 Spock St, Beamup, TX 90210	Date	1/10/95
		Height	5 ft 10 in
<p>R <u><i>Contrast Agent Concentrate</i></u></p> <p>Ditrizoate meglumine 66% w/v</p> <p>Ditrizoate sodium 19% w/v</p> <p>Purified water qsad 50 ml</p> <p>Sig: Dilute 50 ml of the above preparation with 950 ml of water. Administer 750 ml of diluted solution rectally 1 hour before CT scan</p>			

- a. What is the concentration of ditrizoate meglumine in the diluted solution in **mg/ml**?
- _____
- b. Pure ditrizoate meglumine contains 47.06% iodine w/w and pure ditrizoate sodium contains 59.87% w/w iodine. The iodine is important for its usefulness as a contrast agent. What alligation method would be appropriate for calculating the iodine content of the preparation?
- _____
- c. Using the iodine content for pure ditrizoate meglumine and ditrizoate sodium in part (c) above, calculate the iodine concentration of the **contrast agent concentrate** in mg/ml?
- _____
- d. Pure ditrizoate sodium contains 1.57 mEq sodium per gram. How many milliequivalents of ditrizoate ion are present per gram of pure ditrizoate sodium?
- _____
- e. Use the information in (e) or (d) above to calculate the equivalent weight of pure ditrizoate sodium?
- _____

Problem 28

Phone 716-555-1234		DEA# BF -12736280			
Dr. Lavash Foccacia, M.D.					
Name	French Baguette	Age	52 yr	Height	6ft 2 in
Address	8 Baker Ct, Croissant, NY	Date	8/18/02	Weight	100 kg
<p>Rx Potassium chloride qs</p> <p> Potassium acetate qs</p> <p> M ft 100 ml aqueous solution with 6.7 mEq K+ per 5 ml</p> <p> 1 tablespoon bid</p>					

You find that you do not have this solution available. After consultation, decide to prepare it by mixing a concentrated 0.4 mEq/ml potassium chloride solution with a 2 mEq/ml potassium acetate solution.

a. What is the potassium ion concentration in the dispensed **preparation** in milliequivalents/ml?

b. What is the potassium ion concentration in the dispensed **preparation** in **milligrams/ml**?

c. Fill in the blanks in the following alligation table.

--	--

d. How many milliliters of the potassium chloride solution are needed?

e. How many milliliters of the potassium acetate solution are needed?

Problem 29

Phone 716-555-1234		DEA# AT -12736280			
Dr. Nueve Diaz, M.D.					
Name	Flores Mercado	Age	17yr	Height	160 cm
Address	8 Sierte Pl, London	Date	8/18/02	Weight	80 kg
<p>Rx Castor oil suspension 67% w/v Mft SA 50 ml susp 1 tablespoonful 16 hours before surgery</p>					

You discover you do not have 67% w/v castor oil and opt to make it by mixing suspensions containing 95% w/v castor oil and 60% w/v castor oil. a. What volume of 60% w/v castor oil is required for compounding?

b. What volume of 95% w/v castor oil is required for compounding?

c. What is the dose of castor oil?

d. For a different castor oil suspension prescription, the care provider asks that you mix 25 ml of 36.4% w/v castor oil suspension with 45 ml of 67% w/v castor oil suspension. What alligation method would be appropriate for determining the concentration of castor oil in the resultant castor oil suspension?

e. Calculate the concentration of castor oil in the resultant castor oil suspension in part (e) above.

Problem 30

Phone 125-250-5000	Jennie O' Wampler 12 Turk St., Cranberry	DEA# BS0365420
Name Limon Bird	Age 23	Wt: 80 kg
Address 144 Sal St, Cranberry, TX 90210	Date 1/10/95	Height: 5ft 10in
R Benzalkonium chloride solution 16%	qs	
Purified water qs ad	200 mL	
M ft 1:5,000 solution.		
Label: Stock Solution of benzalkonium chloride		

- a. What is the concentration of benzalkonium chloride in the diluted solution in % w/v?

- b. You find the 16% benzalkonium chloride solution, and decide to carry out serial dilutions. What would be the desired total dilution factor?

- c. You decide to carry out three-step dilutions. In the first step, you start from the 16% benzalkonium chloride solution, and carry out a 1:10 dilution to obtain 200-mL of solution. How many mL of the 16% benzalkonium chloride solution would be used?

- d. From the solution obtained in the first step, you carry out the second dilution (Step 2). The dilution factor is 1:10 and the quantity of diluted solution is 200 mL. What would be the concentration (% w/v) of benzalkonium chloride in the diluted solution obtained in this step?

- e. What would be the dilution factor for the last step dilution?

- f. How many mL of the solution from Step 2 (part d) is needed to prepare the stock solution?

Problem 31

Phone 716-555-1234		DEA# AT-12736280	
Dr. Hunter Gatherer, M.D.			
Name Piper Shepherd		Age 52 yr	Wt 100 kg
Address 8 Baker Ct		Date 8/18/02	Height 6 ft 2 in
<p>\mathcal{R} Potassium chloride solution qs Potassium acetate solution qs M ft 200 mL aqueous solution with 6.5 mEq K⁺ per 5 mL 1 tablespoon bid</p> <p style="text-align: right;">H. Gatherer, M.D.</p>			

a. What is the potassium ion concentration in the dispensed **preparation** in milliequivalents per mL?

b. You find that you do not have the desired solution available. After investigation, you decide to prepare it by mixing a 0.4 mEq/mL potassium chloride solution with a 2.0 mEq/mL potassium acetate solution. You use alligation alternate to determine the quantities of potassium chloride solution and potassium acetate solution. Fill out the **five** boxes in the following alligation table.

Pot. Chloride solution		
Pot. Acetate solution		

c. How many milliliters of the potassium acetate solution are needed?

d. How many milliliters of the potassium chloride solution are needed?

e. What percentage of the total potassium in the preparation is provided by the potassium chloride solution?

Problem 32

To the Pharmacist: Prepare suspension at time of dispensing. Add 9 mL water to the bottle and shake well. This provides 15 mL of suspension. When prepared as directed, each mL contains amoxicillin trihydrate equivalent to 50 mg amoxicillin. Dropper contains 25 mg (1/2 full), or 50 mg (full) of amoxicillin. Children—20 to 40 mg/kg/day in divided doses. Adults—200 to 400 mg b.i.d. or q.i.d. as directed. Shake well before use. See package insert for complete prescribing information. **KEEP BOTTLE TIGHTLY CLOSED. SHAKE WELL BEFORE USING.** • Discard unused portion after 14 days storage at either room temperature or refrigeration. • NDC 0015-7277-16 **READ ACCOMPANYING CIRCULAR**

APOTHECON®
A Bristol-Myers Squibb Company
Princeton, NJ 08540
727716DRL-1
Made in USA

NDC 0015-7277-16 **15 mL BOTTLE**

EQUIVALENT TO
50 mg per mL
when reconstituted according to directions

POLYMOX®
Amoxicillin For Oral
Suspension, USP
Pediatric Drops

CAUTION: Federal law prohibits dispensing without prescription.

When 9 ml of water are added to the bottle of amoxicillin, 15 ml of suspension containing amoxicillin at a concentration of 50 mg/ml result.

- a. Determine the amount of amoxicillin in the bottle.

- b. Calculate the volume displaced by the solids.

- c. What is the volume of a 100 mg/ml suspension prepared from the contents of this bottle?

- d. How much water should be added to prepare a 100 mg/ml suspension?

- e. What is the volume of a 25 mg/ml suspension prepared from the contents of this bottle?

- f. How much water should be added to prepare a 25 mg/ml suspension?

Problem 33

Phone 716-555-1234	DEA# AT -12736280	
<p>Dr. Goldie Copper, M.D. 3 Argon Ave Telluride, CO</p>		
Name <u>Radon Silver</u>	Age <u>25</u>	Height <u>130 cm</u>
Address <u>Nickel Ave, Telluride</u>	Date <u>8/18/97</u>	Weight <u>71 kg</u>
<p>Rx Reconstitute Kefzol in NS according to manufacturer instructions. Administer 500 mg q12h by slow iv injection over 3 min.</p> <p style="text-align: center;"><u>Goldie Copper, MD</u></p>		

The manufacturers instructions read:

Add 2 ml of diluent to 500 mg Kefzol vial to give 225 mg/ml solution.

a. What is the volume of the preparation after dilution?

b. What volume is occupied by the Kefzol?

c. If you wanted to prepare a 250 mg/ml solution from the same vial, how much diluent would you add?

d. Estimate the density of the Kefzol solution in NS. Assume the sodium chloride does not contribute any volume on dissolution

Problem 34

Phone 555-3784					
Dr. Case Western College Station, TX 20210					
Name	Mary William	Age	25	Wt	70 kg
Address	Duke Road, College Station	Date	2/14/96	Height	175 cm
<p>Rx Augmentin suspension. Instruct patient to reconstitute to 200 mg/5 ml Sig 5 ml bid</p>					
<u>Kitty Litter M.D.</u>					

Here is the label for Augmentin:



Augmentin is a combination antibiotic containing amoxicillin and clavulanate potassium. Manufacturer's reconstitution instructions: Mix 67 ml of water to obtain 75 ml suspension contains **125 mg/5 ml** of amoxicillin and **31.25 mg/5 ml** clavulanic acid.

a. Calculate the amount of amoxicillin in the container.

b. Calculate the amount of clavulanic acid in the container.

c. Calculate the volume displaced by the powder.

d. Calculate the **volume of the suspension** when the amoxicillin concentration is 200 mg/5 ml.

- e. Calculate the **volume of the water** to added to obtain an amoxicillin concentration is 200 mg/5 ml.

- f. What is the clavulanic acid concentration in **mg/5 ml** when the amoxicillin concentration is 200 mg/5 ml.

Problem 35

Phone 716-555-1234		DEA# AT -12736280			
Dr. William Alfayyad, M.D.					
Name	Harry Parker	Age	13 yr	Height	5 ft 3 in
Address	8 Buckingham, London, ON	Date	8/18/02	Weight	40 kg
<p>\mathcal{R} 40 mg/kg Ampicillin as 500 mg/ml solution IM 30 min prior to dental procedure</p> <p style="text-align: right;"><u>W. Alfayyad, MD</u></p>					

You have 3 vials each containing 1 gram of sterile ampicillin. The manufacturer’s instructions on each vial are: “For IM use add 3.5 ml of sterile normal saline and the resultant solution contains 250 mg/ml ampicillin”

- a. Calculate the dose of ampicillin. What is the route of administration?

- b. Calculate the volume of ampicillin solution that you should inject into the patient?

- c. What is the volume of the solution in **each vial** after reconstitution according to the **manufacturer’s instructions**.

- d. Calculate the volume displaced by the ampicillin upon dissolution in **each vial**.

- e. How much diluent would you add to each vial to prepare a 500 mg/ml solution?

Problem 36

Phone 716-555-1234		Dr. Sally Cylate, M.D.		DEA# AC -12736280	
Name	Pam E. Diaz	Age	7yr	Height	60 cm
Address	8 Buckingham Pl, London	Date	8/18/02	Weight	20 kg
Rx		Cefaclor suspension		62.5 mg/5 ml	
		Take 5 ml po tid			

The manufacturers instructions for cefaclor suspension are: *Package contains 1.875 grams of cefaclor as dry powder. To reconstitute, add 45 ml of sterile water to bottle to obtain suspension containing 125 mg of cefaclor per 5 ml. Oversize bottle provides extra room for shaking.*

- a. What instructions would you give the patient?

- b. What is the volume of the **suspension** if it were to be reconstituted **according to the manufacturer's instructions**?

- c. What is the **volume of the displaced by the powder** if it were to be reconstituted according to the manufacturer's instructions?

- d. What is the volume of the **suspension** if it were to be reconstituted **according to the instructions on the prescription**?

- e. What volume of sterile water would you add to obtain the concentration of cefaclor **prescribed**?

- f. What volume of sterile water would you add to obtain a suspension containing cefaclor at a concentration of **150 mg/5 ml**?

Problem 37

Phone 716-555-1234		Dr. Poppy Aster, M.D.		DEA# AA12736280	
Name	Begonia Impatiens	Age	18 yr	Height	5ft 4 in
Address	401 Tulip Street, Lilydale	Date	8/18/02	Weight	60 kg
<p>Rx Ticarcillin disodium and clavulanate potassium. Reconstitute with sterile water 30:1 combination so that the concentration is 300 mg/ml of ticarcillin. Dose combination equivalent to 2 g ticarcillin q6h by IV infusion over 30 minutes for UTI</p>					

Ticarcillin disodium and clavulanate potassium is a combination antibiotic that contains the 30:1 ratio of ticarcillin to clavulanic acid. The dosage of the combination is expressed as the sum of the grams of ticarcillin plus grams of clavulanic acid. The manufacturer's instructions for reconstitution of the parenteral concentrate are: *"Each container is labeled as containing 3.1 grams of the combination and contains the potency equivalent to 3g of ticarcillin and 100 mg of clavulanic acid. Add 13 ml of sterile water to obtain a solution containing 200 mg/ml of ticarcillin. Shake vial until drug dissolves."*

- a. What is the volume of the preparation if you diluted a 3.1 gram container of the combination according to the **manufacturer's instructions**? What is the volume of displaced by the powder?

- b. What is the quantity of the preparation when a 3.1 gram container of the combination is reconstituted as **specified by the prescription**.

- c. How much sterile water must be added to a 3.1 gram container of the combination to obtain the concentration **specified by the prescription**.

- d. How much of the reconstituted solution is required for a single dose of the drug? How much clavulanic acid is present in a single dose?

Problem 38

Phone 102-345-6789		Dr. Cromolyn Cortisone		DEA# BC -12736280	
Name	Dana Zol	Age	9 yr	Height	4 ft 4"
Address	40 Dextran Street, Digoxin	Date	2/18/02	Weight	30 kg
<p>R Amoxicillin-clavulanic acid. Reconstitute with sterile water qs ad Reconstituted solution to contain <u>40 mg/mL of amoxicillin</u>. Sig: 25 mg/kg/day of amoxicillin as amoxicillin-clavulanic acid combination. Taken in divided doses 3 times a day at the start of a meal.</p>					

AugMaxcil is a combination of amoxicillin and clavulanic acid. Amoxicillin is a broad-spectrum bactericidal antibiotic, which is active against both Gram-positive and Gram-negative organisms. Clavulanic acid itself has only a minimal antibacterial action by binding irreversibly to the beta-lactamases produced by many strains of resistant organisms it protects the amoxicillin from hydrolysis. The dose of the drug is expressed in terms of amoxicillin.

Directions for reconstitution of AugMaxcil SF: Use 85 mL of water and shake vigorously to prepare a 100 mL oral suspension that contains amoxicillin trihydrate equivalent to 5.0 g amoxicillin and potassium clavulanate equivalent to 1.25 g clavulanic acid.

- Calculate the concentrations of **amoxicillin in mg/mL and clavulanic acid**, in the product if the package is reconstituted according to the manufacturer's instructions.

- If you reconstitute the powder according to the manufacturer's instruction, what would be the volume, in mL, occupied or displaced by the powder?

- What is the quantity, **in mL**, of the preparation when the package is reconstituted to yield the drug concentration specified by the prescription?

- How much sterile water, **in mL**, must be used to reconstitute the package to obtain the product at a concentration specified by the prescription?

- How much, **in mL**, of **the reconstituted solution from Part d** is required for a single dose of the drugs?

Problem 39

Phone 213-878-3131		Dr. Julie Fourstripe, M.D		DEA# AF -12736280	
Name	Adonis Pleco	Age	9 yr	Height	4 ft 4"
Address	4040 Carp Street, Cape Lopez	Date	2/21/04	Weight	30 kg
\mathcal{R} Penicillin G potassium 150,000 units per mL Sodium chloride solution for injection qs 50,000 units/kg IM one hour before surgery and 6 hours later					

According to the package insert: “Each vial contains 2,000,000 units of penicillin G potassium and would yield a solution containing 250,000 units/mL of penicillin G potassium after reconstituted with 7.0 mL of sodium chloride injection solvent.”

- a. If the vial is reconstituted **according to the manufacturer’s instructions**, how many milliliters of solution would you obtain?

- b. If you reconstitute the powder **according to the manufacturer’s instruction**, what would be the volume of solution represented or displaced by the powder?

- c. What is the volume of the preparation when the package is directly reconstituted to yield the drug concentration **specified by the prescription**?

- d. How many milliliters of sodium chloride solution for injection must be used to directly reconstitute the package to obtain the product at a concentration **specified by the prescription**?

- e. A pharmacy intern inadvertently reconstitutes the vial with 15 ml of sodium chloride solution for injection. What is the concentration of the resultant solution?

- f. How much, **in mL**, of **the reconstituted solution from Part e** is required for a single dose of the drugs?

Problem 40

Dr. Tina DeMasajes					
12 Jacuzzi St., Hot Springs, AK 30210					
Name	Calor Burbuja	Age	23 yr	Height	5 ft 10 in
Address	144 Jacuzzi St, Hot Springs, AK	Date	1/21/05	Weight	80 kg
R Cyclosporine 1:5000. Mft 30 ml ophthalmic suspension 1 gtt ou bid for keratoconjunctivitis					

- a. What is the concentration of cyclosporine in the ophthalmic suspension in % w/v?

- b. Initially, you decide to prepare the suspension from an available 10% w/v cyclosporine solution in corn oil. How much of this solution do you need to prepare this suspension?

- c. You find that you do not have a measuring device to measure the small volume in part (b) and therefore decide to use serial dilution to carry out three steps of dilution. In the first step (Step 1), you start from the 10% cyclosporine solution, and carry out a 1:20 dilution to obtain 50-mL of suspension. How many mL of 10% cyclosporine solution is needed for this Step?

- d. What is the concentration (% w/v) of cyclosporine in the diluted solution obtained after Step 1?

- e. In the second step (Step 2), you start from the cyclosporine suspension obtained after Step 1, and carry out a 1:10 dilution to obtain 50-mL of suspension. What is the concentration in the diluted suspension after Step 2?

- f. In the last step (Step 3), you remove the exact volume of the suspension from Step 2 and dilute it to make the prescribed suspension. What volume of the suspension from Step 2 is needed?

Problem 41

Phone 876-878-2421		DEA# BB -12736280			
Dr. Rosy Barb, M.D. 12 Bass St., Cape Cod, MA 30210					
Name	Pearl Danio	Age	23 yr	Height	5 ft 10 in
Address	1448 Cichlid Ct, Cape Cod, MA	Date	1/21/05	Weight	80 kg
\mathcal{R} 0.5 mmoles/ml Potassium phosphate monobasic solution qs 3 mmoles/ml Potassium phosphate dibasic solution qs M ft 200 mL aqueous solution with 22 mmoles K ⁺ per 5 mL 1 tablespoon bid					

Potassium phosphate monobasic has the formula (KH₂PO₄) and potassium phosphate dibasic has the formula (K₂HPO₄).

a. What is the potassium ion concentration in the dispensed **preparation** in millimoles per mL?

b. Noting that each mole of potassium phosphate dibasic has **two** moles of potassium ion, what is the potassium ion concentration in the 3 mmoles/ml potassium phosphate dibasic solution in millimoles per mL?

c. You use alligation alternate to determine the quantities of 0.5 mmoles/ml potassium phosphate monobasic solution and 3 mmoles/ml potassium phosphate dibasic solution. Fill out the five boxes in the following alligation table.

K ⁺ in KH ₂ PO ₄ solution		
K ⁺ in K ₂ HPO ₄ solution		

d. How many milliliters of the 0.5 mmoles/ml potassium phosphate monobasic and 3 mmoles/ml potassium phosphate dibasic solution are needed?

e. What percentage of the total potassium in the preparation is provided by the potassium phosphate dibasic solution?

Problem 42

Dr. Neottia Nidus, M.D. 12 Miltonia St., Apifera, CO 40210					
Name	Vanda Cattleya	Age	23 yr	Height	5 ft 10 in
Address	1448 Ophrys Ct, Lailea, CO	Date	1/21/05	Weight	80 kg
R Potassium bicarbonate 0.5 g Potassium chloride 1.125 g Lysine hydrochloride 0.913 g DTD # 30 effervescent tablet. Sig: dissolve 1 tablet in 1 glass of OJ					

This is an effervescent tablet that is a potassium supplement. Potassium bicarbonate has the formula (KHCO₃) and potassium chloride has the formula (KCl). Lysine hydrochloride has no potassium ion.

a. What is the concentration of potassium ion in **pure** potassium bicarbonate and **pure** potassium chloride % w/w?

b. You are interested in finding the potassium ion concentration in a single tablet. Which alligation method will you use?

c. Calculate the potassium ion concentration in the **tablet** in % w/w.

d. Calculate the **amount** of potassium ion in **each tablet** in milliequivalents.

e. Each glassful of orange juice contains 450 mg of potassium ion. Calculate the concentration of potassium ion in the drug-juice mixture in mg/ml. Assume that the tablet ingredients dissolve completely and do not add volume.

CHAPTER 10
PARENTERAL NUTRITION

NOTES

Outline

- Parenteral nutrition.
- Energy requirements: Harris-Benedict equation and body weight-based methods.
- Protein requirements: Urine urinary nitrogen and body weight-based methods
- Lipid, fluids, vitamins and minerals.

Parenteral Nutrition

- Provision of nutrients (protein, carbohydrate, fat, fluids, electrolytes, vitamins and minerals) via the intravenous route.
- Total parenteral nutrition (TPN) provides all nutrient requirements via the intravenous route. Generally requires a central vein due to high dextrose content.
- Peripheral (or partial) parenteral nutrition provides some nutritional requirements parenterally. Usually is a peripherally administered solution.
- Indicated when the GI tract is unusable or inaccessible. Patient in coma, having trouble swallowing or holding down food for extended periods of time due to vomiting or other gastrointestinal problems may be administered TPN.
- Administered centrally or peripherally dependent on dextrose.
- Central administration refers to directly accessing a vein connected to the superior vena cava. This is a high flow vein that allows administration of hypertonic solutions. Hypertonic solutions > 800 mOsm/L should be administered by a central vein.
- Maximum dextrose content administered peripherally is 10%. Amino acids and intravenous fat emulsions may be administered via a peripheral vein.

Calculation of Nutrient Requirements

- The primary nutrients provided by TPN via the intravenous route are protein, carbohydrate, fat, electrolytes, vitamins and minerals.
- Dextrose is the source of carbohydrates, amino acids are the source of protein and lipid emulsions are the source of fats and essential fatty acids. The excretion of the nitrogen in amino acids results in the production of urea in the urine and can be measured. Each of these nutrients sources provides energy, typically measured in Kilocalories.
- There are generally two methods each for obtaining nutrient requirements for energy and for protein. These can be based on body weight or on more detailed individualization (Harris-Benedict equation for calories and urine urea nitrogen for protein).

Energy Requirements

- There are two approaches, the Harris-Benedict equation and the alternative method based on body weight.

- The **Harris-Benedict Equation** estimates the basal energy expenditure (BEE), amount of energy in kilocalories required to meet resting metabolic requirements. There is a separate equation for males and females. The equations are:

$$BEE\ Male = 66 + 13.8 \times Weight(kg) + 5 \times Height(cm) - 6.8 \times Age(years)$$

$$BEE\ Female = 655 + 9.6 \times Weight(kg) + 1.8 \times Height(cm) - 4.7 \times Age(years)$$

- Requires multiplication by a stress factor to estimate total Kcal requirements
 - Minimal stress: $BEE \times 1.2 - 1.4$
 - Moderate stress: $BEE \times 1.4 - 1.6$
 - Severe stress: $BEE \times 1.6 - 1.8$
- For weight loss or gain the final Kcal amount is adjusted by 500 - 1000 Kcal/day.
- Calculation Example:** Use Harris-Benedict to determine Kcal requirements in the following patient: 34-year old female, 5 feet 5 inches, 134 lbs, moderate stress.

$$Height = 5' 5" = 65", 65\ inches \times 2.54\ cm/inch = 165.1\ cm$$

$$Weight = 134\ lbs \times 1\ kg/2.2\ lb = 60.9\ kg$$

$$BEE = 655 + (9.6 \times 60.9) + (1.8 \times 165.1) - (4.7 \times 34) = 1386\ kcal$$

$$Kcal = BEE \times stress\ factor = 1386 \times 1.4\ to\ 1386 \times 1.6 = 1940 - 2218\ Kcal/day$$

- In the alternative method, the caloric requirement is based on the body weight and the stress level according to the following table:

Stress Level	Kcal/kg/day
Minimal	25 - 30
Moderate	30 - 35
Severe	35 - 40
Obese	20 - 25
Weight gain	40 - 50

- Calculation Example:** Use alternative method to determine Kcal requirements in the following patient: 34-year old female, 5 feet 5 inches, 134 lbs, moderate stress.

$$Weight = 134\ lbs \times 1\ kg/2.2\ lb = 60.9\ kg$$

$$Kcal = 30\ kcal/kg \times 60.9\ kg\ to\ 35\ kcal/kg \times 60.9\ kg = 1827 - 2132\ Kcal/day$$

- Caloric value of proteins, carbohydrate and lipids are listed in below:

Stress Level	Caloric value
Protein	4 Kcal/g
Dextrose	3.4 Kcal/g
Lipids 10% w/v emulsion	1.1 Kcal/ml
Lipids 20% w/v emulsion	2 Kcal/ml
Lipids 30% w/v emulsion	3 Kcal/ml

- **Calculation Example:** Calculate the caloric content of a TPN solution containing 1000 ml 10% amino acids, 500 ml of 70% dextrose and 250 ml of 20% w/v lipid emulsion.

$$\text{Kcal from amino acids} = 1000 \text{ ml} \times 10 \text{ g/100 ml} \times 4 \text{ Kcal/g} = 400 \text{ Kcal}$$

$$\text{Kcal from dextrose} = 500 \text{ ml} \times 70 \text{ g/100 ml} \times 3.4 \text{ Kcal/g} = 1190 \text{ Kcal}$$

$$\text{Kcal from fat} = 250 \text{ ml} \times 2 \text{ Kcal/ml} = 500 \text{ Kcal}$$

$$\text{Total Kcal} = 400 + 1190 + 500 = 2090 \text{ Kcal}$$

Protein Requirements

- There are two approaches for arriving at protein requirements, the Dudrick method and the more individualized urinary urea nitrogen method.
- In the **Dudrick method**, the protein requirement is based on the body weight and the stress level according to the following table:

Stress Level	Grams/kg/day
US Recommended daily allowance	0.8
Minimal	1.0 – 1.2
Moderate	1.4 – 1.6
Severe	1.8 – 2.0
Burns	2.0 – 3.0

- **Calculation Example:** Use Dudrick method to determine protein requirements in the following patient: 45-year old male, 6 feet 2 inches, 210 lbs with severe stress.

$$\text{Weight} = 210 \text{ lbs} \times 0.4536 \text{ kg/lb} = 95.45 \text{ kg}$$

$$\text{Protein} = 1.8 \text{ g/kg} \times 95.45 \text{ kg} \text{ to } 2 \text{ g/kg} \times 95.45 \text{ kg} = 172 - 191 \text{ g/day}$$

- In the **Urine Urea Nitrogen (UUN)** method, the protein requirement is highly individualized and is based on conducting nitrogen balance calculations.
- Protein catabolism results in the production of urea and the majority of urea is excreted in urine. A small amount of urea is lost in sweat, stool and respiratory mechanisms and is corrected for as ‘insensible loss’. The amount of urinary urea and insensible nitrogen loss is thus a measure of the protein catabolism. One gram of urea nitrogen corresponds to 6.25 grams of amino acids or protein.
- The desired nitrogen balance is typically +3 to +6 grams per day. This indicates that the daily nitrogen input via the amino acids in the nutritional formulation exceeds the total nitrogen lost from the body by 3-6 grams.
- In the first step, the amount of urea nitrogen excreted is calculated from the estimated quantity of daily urine output and the urine urea nitrogen (UUN) concentration measured in the urine. The daily urine output is obtained by measuring the volume of urine over a collection period, e.g., 12-hours. The UUN is obtained from laboratory analysis.
- Insensible losses of nitrogen are estimated – typically an insensible loss of 4 g/day is assumed – and added to amount of urine nitrogen excreted. This gives the total nitrogen output for the patient.

- The Nitrogen Balance is defined by:

$$\text{Nitrogen Balance} = \text{Nitrogen input} - \text{Nitrogen Output}$$

- If the desired Nitrogen Balance is known, the nitrogen input can be calculated. The nitrogen input can be converted to the amount of amino acids needed by using the conversion factor 6.25 g amino acids/g nitrogen.
- Alternatively, if the composition and quantity of the nutritional formulation is known, the nitrogen balance can be calculated.
- The non-protein Kcal to nitrogen ratio is a simple ratio of the kilocalories from the dextrose and lipid to the nitrogen input. This parameter is used to describe the relative protein content of a nutritional formula. The lower the number, the higher the relative protein content.
- **Calculation Example:** Calculate the UUN for a patient with a 12-hour urine volume of 875 ml and UUN of 890 mg/dl. Assume insensible losses of 4 g/day. Calculate the protein requirements for a +3 nitrogen balance.

$$\text{Urine volume} = 0.875 \text{ liters}/12 \text{ hours} \times 24 \text{ hours} = 1.75 \text{ L}$$

$$\text{UUN} = 890 \text{ mg/dl} = 8.9 \text{ g/L}$$

$$\text{Amount of urea nitrogen out in urine} = 1.75 \text{ liters} \times 8.90 \text{ g/L} = 15.575 \text{ g}$$

$$\text{Total urea nitrogen out} = \text{Loss in urine} + \text{Insensible loss} = 15.575 + 4 = 19.575 \text{ g}$$

$$\text{Nitrogen in} = \text{Nitrogen out} + \text{Nitrogen balance} = 19.575 + 3 = 22.575 \text{ g nitrogen}$$

$$\text{Amino acids or protein needed} = 22.575 \text{ g} \times 6.25 \text{ g protein/g nitrogen} = 141 \text{ g}$$

- **Calculation Example:** Calculate the nitrogen calculation if the patient in the preceding example were receiving 172 g/day of protein.

$$\text{Nitrogen in} = 172 \text{ g protein}/6.25 \text{ g} = 27.52 \text{ g nitrogen}$$

$$\text{Nitrogen balance} = \text{Nitrogen in} - \text{Nitrogen out} = 27.52 - 19.575 = + 7.945$$

Lipid Requirements

- Lipid in the nutritional formulation is provided as lipid emulsions, e.g., Intralipid. The lipid formulations also provide essential fatty acids.
- The lipid requirements are usually specified in term of the proportion of the non-protein kilocalories from fat. The remaining caloric needs are obtained from dextrose.

Carbohydrate Requirements

- Carbohydrates are a source of energy and are provided by dextrose.
- The dextrose requirements are calculated from the kilocalories that remain upon meeting the protein and lipid specifications.

Fluid Requirements

- Vary depending on the patient's pathologic condition and renal health.
- The Normal range is 30 - 35 ml/kg/day and the Restricted range is 20-25 ml/kg/day of fluids

Electrolyte Requirements

- Typical values for electrolytes are listed below. The values may be adjusted for individuals with specific electrolyte imbalances.

Electrolyte	Amount/1000 Kcal
Sodium	40 - 50 mEq
Potassium	30 - 40 mEq
Chloride	40 - 50 mEq
Magnesium	8 - 12 mEq
Calcium	2 - 5 mEq
Phosphate	12 - 25 mMol

- Sodium and potassium are available as chloride and acetate salts. In general, sodium is usually provided as chloride, potassium as phosphate and acetate used to balance the remaining potassium if needed. Potassium phosphate stock solution measure potassium concentration in mEq/ml and phosphate concentration in mmoles/ml.

Vitamin and Mineral Requirements

- Standard vitamin and mineral formulations are available that meet the needs of the majority of patients receiving TPN solutions. MVI-12 is a standard vitamin additive that provides 12 vitamins in a volume of 10 ml/day. MTE-5 concentrate is a standard trace mineral additive that provides 5 trace elements in a volume of 1 ml/day.
- Thiamine, folate, vitamin K and zinc may be added in cases where specific needs have been identified.
- Frequently, insulin and other medications are added to the TPN solution. These volumes must be taken into consideration when calculating the final TPN volume.

Designing the TPN Formulation

- The sequence of steps in designing a TPN formulation are:
- Identify the amount of protein and kilocalorie needed per day.
- Calculate the volume of amino acids solution to be added.
- Calculate amount of lipid and volume of lipid emulsion to be added.
- Calculate the amount of dextrose that will meet the caloric needs remaining after adding protein and lipid. Calculate the volume of dextrose solution to be added.
- Calculate electrolyte requirements and the corresponding volume to be added.
- Calculate volume of vitamin and minerals supplement added.
- Calculate the total volume of all additions.
- Calculate the total daily fluid requirement.
- Add sufficient 'qs ad' water to meet the total fluid requirements.

Calculation Example

Formulate a TPN for a 45 year-old, 95.45 kg patient with 40 Kcal/kg day. UUN of 890 mg/dl. Dextrose and lipid to each provide 50% of non-protein Kcal. Protein based on +3 nitrogen balance. Fluid 35 ml/kg day. Patient has 12-hour urine volume of 875 ml. Assume insensible losses of 4 g/day. Electrolytes/1000 Kcal: Sodium 40 mEq; Potassium 30 mEq; Magnesium 8 mEq; Calcium 2 mEq; Phosphate 12 mmols. Add 10 ml MVI-12 and 1 ml MTE-5.

- **Protein Requirements:**

Amount of urea nitrogen out in urine = 1.75 liters \times 8.90 g/L = 15.575 g

Total urea nitrogen out = Loss in urine + Insensible loss = 15.575 + 4 = 19.575 g

Nitrogen in = Nitrogen out + Nitrogen balance = 19.575 + 3 = 22.575 g nitrogen

Amino acids or protein needed = 22.575 g \times 6.25 g protein/g nitrogen = 141 g

Volume of 10% amino acid stock solution = 1410 ml

- **Caloric Requirements:**

Using alternate method, Total Kcal = 40 kcal/kg \times 95.45 kg = 3818 Kcal

Protein Kcal = 141 g protein \times 4 Kcal/g = 564 Kcal

Non-Protein Kcal = 3818 – 564 = 3254 Kcal

Lipid Kcal = 0.5 \times 3254 = 1627 Kcal

Dextrose Kcal = 0.5 \times 3254 = 1627 Kcal

- **Lipid Requirements:**

Lipid emulsion 20% w/v volume = 1627 Kcal/(2 Kcal/ml) = 813.5 ml

- **Dextrose Requirements:**

Grams of dextrose = 1627 Kcal/(3.4 Kcal/g) = 478.5 g

Volume of 70% w/v dextrose solution = 478.5 g/(0.7 g/ml) = 684 ml

- **Electrolyte Requirements:**

Sodium required = 3818 kcal \times 40 mEq/1000 Kcal = 153 mEq

Volume of 4 mEq/ml NaCl stock = 153 mEq/4 mEq/ml = 38.2 ml

Magnesium required = 3818 Kcal \times 8 mEq/1000 Kcal = 30.5 mEq

Volume of 4.05 mEq/ml stock solution = 30.5 mEq/4.05 mEq/ml = 7.5 ml

Calcium required = 3818 Kcal \times 2 mEq/1000 Kcal = 7.6 mEq

Volume of 0.46 mEq/ml calcium gluconate = 7.6 mEq/(0.46 mEq/ml) = 16.6 ml

Phosphate required = 3818 Kcal \times 12 mMol/1000 Kcal = 46 mmols

Volume of 3 mmol/ml potassium phosphate = 46 mmol/3 mmol/ml = 15.33 ml

3 mmol/ml potassium phosphate contains mEq/ml of potassium ion.

Potassium from potassium phosphate = $15.33 \text{ ml} \times 4 \text{ mEq/ml} = 61.3 \text{ mEq}$

Total potassium required = $3818 \text{ Kcal} \times 30 \text{ mEq/1000 kcal} = 115 \text{ mEq}$

Potassium remaining = $115 - 61.33 = 53.67 \text{ mEq}$

Volume of 2 mEq/ml potassium acetate = 26.8 ml

Total volume of Electrolytes = $26.8 + 15.33 + 16.6 + 7.5 + 38.2 = 104.4 \text{ ml}$

Volume of MVI-12 and MTE-5 = 11 ml

- **Fluid Requirements:**

Total fluids = $95.45 \times 35 \text{ ml/kg} = 3340.75 \text{ ml}$

Fluids from macronutrients = $1410 + 813.5 + 684 = 2907.5 \text{ ml}$

Fluids from micronutrients = $104.4 + 11 = 115.4 \text{ ml}$

Water needed for qsd = $3340.75 - 2907.5 - 115.4 = 317.85 = 318 \text{ ml}$

Infusion flow rate = $3340.75 \text{ ml/24 hours} = 139.2 \text{ ml/hour}$

PROBLEMS

Formula Sheet

Use the following information for solving problems:

Harris-Benedict Equation

$$BEE\ Male = 66 + 13.8 \times Weight(kg) + 5 \times Height(cm) - 6.8 \times Age(years)$$

$$BEE\ Female = 655 + 9.6 \times Weight(kg) + 1.8 \times Height(cm) - 4.7 \times Age(years)$$

Amino acids are synonymous for protein; Dextrose is synonymous for carbohydrates. Caloric content of macronutrients:

Protein	4 kcal/g
Carbohydrates	3.4 kcal/g
Lipids 20% w/v	2 kcal/ml

1 gram Nitrogen = 6.25 grams protein

Problem 1

- a. Identify 5 key nutrient categories that should be present in a total parenteral nutrition formula.

- b. How are caloric requirements for parenteral nutrition assessed?

- c. The phrase nitrogen balance is used in the context of total parenteral nutrition. What does it represent and why is it significant?

Problem 2

Phone (302) 422-3739	Katherina Petruchio, MD	DEA# BS0365420
12 Hacket St.		
Padua, DE 19806		
Name	<u>Bianca Baptista</u>	Age
		<u>23</u>
Address	<u>144 Hortensio St, Padua, DE 19805</u>	Wt
		<u>80 kg</u>
	Date	Height
	<u>1/10/95</u>	<u>5 ft 10 in</u>
R_x	<p>Make 1 days requirement of TPN solution. Infuse over 24 hours.</p> <p><u>Calories:</u> 35 Kcal/kg. 30% of non-protein Kcal to come from 20% w/v lipid emulsion. Remainder 70% of non-protein Kcal from 70% w/v dextrose solution.</p> <p><u>Protein:</u> 1.8 g/kg/day as 10% w/v amino acid solution</p> <p><u>Fluid:</u> 40 ml/kg</p> <p>Electrolytes, multivitamins, trace elements</p>	

a. How many kilocalories per day should be provided?

b. How many kilocalories come from dextrose?

c. What volume of 70% w/v dextrose is needed?

d. What volume of 20% w/v lipid emulsion is needed?

e. What is the infusion flow rate in ml/minute?

Problem 3

Phone 305-425-6969		DEA# BC -12736280	
Gracilis Obturator, MD 121 Gluteus Avenue, Supinator, IA 20210			
Name	Flexor Digitorum	Age	45
Weight		Weight	88 kg
Address	11 Psoas Street, Supinator, IA	Sex	Female
		Height	190 cm
		Date	2/25/05
 Dx: Radiation enteritis Rx: Infuse 1800 kcal and 84.5 grams of protein in a TPN solution at 85 ml/hr. TPN to contain amino acids, dextrose, electrolytes			

- a. What is the total volume of TPN this patient will receive in 24 hours?

- b. How many grams of dextrose is this patient receiving per day?

- c. What is the final concentration of dextrose in the TPN solution?

- d. How many milliliters of a 70% stock dextrose solution will you need to compound this solution?

- e. The physician has changed the prescription to DECREASE the total Kcal/day to 1500. No change in protein content has been ordered. How many grams of dextrose will you need to compound this new formula?

Problem 4

Phone 555-3784	Dr. Anne Fenton				DEA# BS0365420
12 Robin Road, Windsor, ON					
Name	<u>John Falstaff</u>	Age	<u>23</u>	Wt	<u>80 kg</u>
Address	<u>144 Bardolph Rd, Windsor, ON</u>	Sex	<u>Male</u>	Height	<u>178 cm</u>
<p>R <u>May 1, 2003</u> Make 1 days requirement of TPN solution. Infuse over 24 hours. <u>Calories: 3000 Kcal/day total. 25% of Kcal from 20% w/v lipid emulsion.</u> Remainder of non-protein Kcal from 70% w/v dextrose. <u>Protein: 140 g protein.</u> <u>Fluid: 40 ml/kg</u> Electrolytes, multivitamins, trace elements</p>					

a. The patient is a male. Using the Harris-Benedict equation, determine the basal energy expenditure in kilocalories per day for a **stress factor of 1**? _____

b. Using the information provided, determine the stress factor that was used to compute the kilocalories in the regimen. _____

c. Urine volume over 12 hrs is 800 ml and urinary urea nitrogen is 1000 mg/dl and Insensible loss is 4 g/day. How much protein is needed for a nitrogen balance of zero? _____

d. Determine the actual nitrogen balance being provided by the regimen. _____

e. How many kilocalories are provided by the **protein** in the prescribed regimen?

f. You have a 10% w/v amino acid solution available? What volume of this solution is needed for the TPN prescribed.

g. What is the total volume of the total parenteral nutrition solution infused over 24 hours?

Problem 5

Phone 716-555-1234		DEA# BB -12736280			
Dr. Fender Bender, M.D.					
Name	Otto Collision	Age	24 yr	Height	5 ft 10 in
Address	8 Dent Road, London, VA	Date	8/18/02	Weight	154 lb
Rx M ft TPN. Use stress factor of 1.8 for MVA. Include 500 ml of Intralipid 20% w/v and 2 g protein/(kg day)					

a. Calculate the daily caloric requirement? The patient is male.

b. Estimate the protein requirement.

c. How many calories does the protein contribute?

d. How many calories does the lipid contribute to the TPN?

e. How many calories must come from dextrose?

f. How many grams of dextrose are needed?

Problem 6

Phone (909)675-2404		DEA# BC -12736280	
Dr. Gertrude Claudius, M.D. 72 Guildenstern Court, Elsinore, CA 92532			
Name	<u>Ophelia Hamlet</u>	Age	<u>25 yr</u>
Address	<u>5184 Rosencrantz, St.</u>	Sex	<u>Female</u>
	<u>Elsinore, CA 45900</u>	Weight	<u>165 lb</u>
		Date	<u>10/8/05</u>
Rx M. TPN. Severe burns, stress factor: 1.8 Protein 3 g/kg/day, and 250 ml lipids from intralipids 20% sol.			

The patient had the following urinary urea nitrogen analysis: Total urine volume = 850 ml, collection time = 12 hours, urea nitrogen = 1800 mg/dl. Assume insensible losses of 4 g/day).

a. Calculate the total caloric requirement.

b. Calculate the calories contributed by protein.

c. Calculate the calories contributed by lipids.

d. How many ml of 40% dextrose solution are needed to compound the TPN formula?

e. Calculate the patient's nitrogen balance. You must indicate the mathematical sign.

f. How many grams of protein per day will be required to provide a nitrogen balance of +4?

Problem 7

Phone 305-425-6969		DEA# BC -12736280	
Crista Iliaca, MD 121 Cremaster Avenue, Palmaris, MI 20210			
Name	Latissmus Dorsi	Age	56
Weight		Weight	76 kg
Address	11 Sartorius Street, Palmaris	Sex	Male
		Height	180 cm
		Date	2/25/05
 Dx: Crohn's disease. Infuse TPN containing 120 g amino acids; 425 g dextrose and 65 g lipids intravenously at 100 ml/hour via central line.			

a. What total volume of 20% w/v lipid emulsion is required for this TPN?

b. How many total kilocalories is this patient receiving?

c. How many grams of nitrogen is the patient receiving?

d. The total urine volume for the patient for a 12-hour collection period was 875 ml and the urinary urea nitrogen was 1090 mg/dl. Calculate the patient's nitrogen balance assuming 4 g/day of insensible losses.

e. The physician wants to change the prescription to provide enough protein to achieve a +4 nitrogen balance. How many grams of protein per day will now be required? How many milliliter of 8.5% stock solution of amino acids would be required to compound this new prescription?

Problem 8

Phone 555-3784	Dr. Tara Antula, M.D.	DEA# BS0365420
12 Coneweb St., Huntsman, VA 47149		
Name	Parva Avicularia	Age 23 Wt 80 kg
Address	144 Orbweaver St, Pinktoe, TX 90210	Sex Male Height 5 ft 10 in
<p>Rx <u>Date: January 21, 2005s</u> Make 1 days requirement of TPN solution. Infuse over 24 hours. <u>Calories:</u> Patient has burns: use stress factor 1.75. 30% of non-protein Kcal to come from fat. Remainder 70% from dextrose. <u>Protein:</u> Urine volume over 12 hrs is 800 ml and UUN is 1000 mg/dl. Provide +6 nitrogen balance. Insensible loss: 4 g/day. <u>Fluid:</u> 40 ml/kg Electrolytes, multivitamins, trace elements</p>		

- a. How many kilocalories per day should be provided?

- b. According to the urinary urea nitrogen figures **alone**, how many grams of protein is the patient using per day?

- c. How much protein per day is required to provide nitrogen balance (a balance of zero)?

- d. How much protein per day is required to provide the nitrogen balance prescribed? How many kilocalories are obtained from **protein** in the **prescribed** regimen? You have a 10% w/v amino acid solution available. What volume of this solution is needed?

- e. The patient was **previously** receiving 150 grams of amino acid. What was the nitrogen balance for this regimen.

Problem 9

Phone 716-555-1234		DEA# AT -12736280	
Dr. Juliet Capulet, M.D.			
Name	Paris Escalus	Age	56 yr
Address	196 Montague St, Verona, VT	Date	8/18/02
Height		Weight	
<p>Rx A 56 yo male with Crohn's Disease is receiving the following TPN solution at 100 ml/hr:</p> <p style="padding-left: 40px;">Amino Acids 110 grams</p> <p style="padding-left: 40px;">Dextrose 450 grams</p> <p style="padding-left: 40px;">Lipids 50 grams</p>			

- a. How many total kilocalories is this patient receiving?

- b. How many grams of nitrogen is the patient receiving?

- c. During a 12-hour collection period, 945 ml of urine was collected and urine urea nitrogen analysis was 1200 mg/dl. What is the patient's nitrogen balance, assuming insensible losses of 4 g/day?

- d. The physician wants to change the prescription to provide enough protein to achieve a + 4 nitrogen balance. How many grams of protein per day will now be required? How many milliliters of 8.5% stock solution of amino acids would be required to compound this new prescription?

Problem 10

Phone 860-585-0590		DEA# BS -12736280			
Dr. Alhambra Solitaire, M.D.					
Name	Betsy Ross	Age	38 yr	Height	175 cm
Address	8 Archway, Bristol, CT 06010	Date	8/18/02	Weight	78 kg
Rx	Make 2 days requirement of TPN. Calories 40 kcal/kg; Protein 2 g/kg day; Fluid 35 ml/kg day Lipid 20% of non-protein kcal; Dextrose 80% of non-protein kcal				

- a. How many kcal per day will be provided?

- b. What volume of a 20% w/v amino acid solution is needed to prepare 2-days requirement of the TPN prescribed?

- c. What is the total volume of the preparation?

- d. How many Kcal/day will come from proteins?

- e. How many non-protein Kcal/day will come from dextrose and lipids, respectively?

- f. What volume of dextrose 70% w/v is needed to compound the prescription?

Problem 11

Phone 802-322-4880		DEA# AT -12736280			
Dr. Mori Bombyx, M.D.					
Name	Eloria Noyesi	Age	28 yr	Height	157 cm
Address	8 Dunbar St, Brimstone, VT	Sex	Female	Weight	68 kg
Rx	Prepare TPN. Severe burns use stress factor 1.8. Proteins: 3g/kg/day; Fluids: 35 ml/kg/day Non-protein Kcal from dextrose solution Sodium: 50 mEq/1000 kcal, potassium: 40-mEq/1000 kcal				

- a. Calculate total Kcal using the Harris-Benedict equation. _____

- b. Calculate the Kcal/day contributed by proteins. _____

- c. Calculate the volume of dextrose 50% w/v necessary to compound the TPN formula. _____

- d. Calculate the volume of 10% amino acid solution necessary. _____

- e. Calculate the mEq of sodium and potassium to compound the TPN formula. _____

- f. Calculate the volume contributed by sodium chloride (4 mEq/ml) and potassium phosphate (4 mEq/ml). _____

Problem 12

Phone 775- 347-1950	DEA# AG0365420
<p>Dr. Chip Gamble, MD 12 Casino St., Keno, NV 89501</p>	
Name Jack Black	Age 23 Wt 80 kg
Address 144 Slot St, Roulette, PA 16746	Date 1/10/95 Height 5 ft 10 in
<p>Rx Make 1 days requirement of TPN solution. Infuse over 24 hours. <u>Calories:</u> 35 Kcal/kg. 30% of non-protein Kcal to come lipid. Remainder 70% of non-protein Kcal from dextrose. <u>Protein:</u> 1.8 g/kg/day as 10% w/v amino acid solution <u>Fluid:</u> 40 ml/kg Electrolytes, multivitamins, trace elements</p>	

- a. How many kilocalories per day should be provided?

- b. How many grams/day of protein should be provided? What volume of 10% w/v amino acids is needed?

- c. What is the total volume of the preparation?

- d. What is the concentration of amino acids in the final preparation?

- e. How many kilocalories must come from lipid and dextrose? What is the ratio of non-protein kilocalories to grams of nitrogen?

Problem 13

Phone 310-657-8101		DEA# BB -12736280	
Portia Balthazar, MD 16 Bassanio Avenue, Venice, CA 90293			
Name	Lancelot Gobbo	Age	56
Weight	70 kg	Sex	Male
Address	256 Lorenzo Street, Venice	Height	5 ft 9 in
		Date	2/25/05
R	Small bowel obstruction. Start TPN via central line. Assume stress factor of 1.4.		

a. Calculate the requirements using the Harris-Benedict equation. Assume a stress factor of 1.4.

b. The results of a 12-hour UUN indicate that 16 grams of nitrogen are needed for a +3 nitrogen balance. How many grams of protein are required per day?

c. The prescription requires that non-protein Kcal be administered as dextrose and lipids. Calculate the number of grams of each required if 60% are supplied as dextrose and 40% are supplied as fat.

d. What is the non-protein kilocalories: nitrogen ratio for the above solution?

- e. Calculate the amount of electrolytes required and their respective volumes?

Electrolyte	Requirement per 1000 Kcal	Stock	Volume
Sodium	40 mEq	4 mEq/ml NaCl	
Phosphate	12 mmol	3 mmol/ml Phosphate 4 mEq/ml Potassium	
Calcium	5 mEq	4.6 mEq/10 ml	
Magnesium	12 mEq	4.05 mEq/ml	
Potassium	40 mEq	2 mEq/ml K ⁺ acetate	

- f. The final TPN solution will also contain 10 ml MVI and 1 ml MTE-5C. The patient's fluid requirements are 35 ml/kg/day. Using 10% amino acid, 70% dextrose and 20% lipid stock solutions, calculate the amount of water needed to QS to the final volume.
-

Problem 14

Phone 310-657-8101		DEA# BB -12736280			
Nerissa Stephano, MD 225 Launcelot Avenue, Arragon, GA 30104					
Name	Jessica Antonio	Age	52	Weight	90 kg
Address	15 Tubal Street, Arragon	Sex	Female	Height	5 ft 6 in
		Date	2/25/05		
 Enteritis. Start TPN 75 ml/hour via central line. TPN to contain 2000 Kcal, 80 g protein. 25% of total calories from lipid. To contain Amino acid, lipids, dextrose and electrolytes.					

- a. What is the total volume of TPN this patient will receive in 24 hours?

- b. What is the final concentration of amino acids in the TPN solution? What volume of 10% w/v amino acid stock solution is needed

- c. What volume of 20% w/v lipid emulsion is needed? How many grams of lipids is this patient receiving per day?

- d. How many grams of dextrose is this patient receiving per day?

- e. What is the final concentration of dextrose in the TPN solution? How many milliliters of 70% w/v stock dextrose solution will you need to compound this solution?

- f. The physician has changed the prescription to DECREASE the total Kcal/day to 1900. No change in protein content or percentage of total calories from lipid has been ordered. How many grams of dextrose will you need to compound this new formula?

- g. What value of caloric intake would be predicted by the Harris-Benedict equation for this patient? Assume stress factor of 1.25.

Problem 15

Phone 917 279-4595		DEA# AT -12736280			
Dr. Achilles Heel, M.D.					
Name	Hector Trojano	Age	65 yr	Height	6 ft 1 in
Address	8, Priam St, Troy, NY	Sex	Male	Weight	85 kg
Rx	July 16, 2002 Start on TPN for small bowel obstruction.				
<u>A. Heel, MD</u>					

a. Calculate the kilocalorie requirements for this male patient using the Harris-Benedict equation with a stress factor of 1.4.

b. The results of a 12-hour UUN indicate that 22 grams of nitrogen are needed for a +3 nitrogen balance. How many grams of protein are required per day?

c. The prescription requires that **non-protein Kcal** can be administered as dextrose and lipids. Calculate the number of grams of dextrose and lipid required if 65% of the non-protein Kcal are supplied as dextrose and 35% are supplied as fat.

d. What is the non-protein kilocalories to nitrogen ratio for the above solution?

Problem 16

Phone (505) 589-9097		DEA# AA -12736280			
Dr. Namaqua Adder, M.D.					
Name	Ana Conda	Age	65 yr	Height	6 ft 1 in
Address	28, Asp St, Amarilla, NM	Date	Male	Weight	83 kg
Rx	<u>Date: November 11, 2008</u>				
	Start on TPN with 2500 kcal/day, 100 g protein, 45 g lipids, 35 ml/kg day fluids, 10 ml MVI, 1 ml MTE-5C. Infuse continuously over 24 hours.				
<u>N. Adder, MD</u>					

- a. Calculate the amount of dextrose and the volumes required for each respective additive based on a 2500 kcal solution.

Additive	Requirement	Stock	Volume
Amino acids	100 g	10% w/v	
Dextrose		50% w/v	
Lipids	45 g	30% w/v	
Sodium	40 mEq/1000 Kcal	4 mEq/ml NaCl	
Phosphate	12 mmol/1000 Kcal	3 mmol/ml Phosphate 4 mEq/ml Potassium	
Calcium	5 mEq/1000 Kcal	4.6 mEq/10 ml Ca ²⁺	
Magnesium	12 mEq/1000 Kcal	4.05 mEq/ml Mg ²⁺	
Potassium	40 mEq/1000 Kcal	2 mEq/ml K ⁺ acetate	
Fluid	35 ml/kg	Sterile water	

Problem 17

Phone 520-318-6741		DEA# AT -12736280			
Dr. Emerald Treeboa, M.D. Cascabel, AZ 85602					
Name	Andrea Keelback	Age	75 yr	Height	5 ft 5 in
Address	8, Krait St, Cascabel, AZ	Sex	Male	Weight	64 kg
Rx	<u>Date: 13 May, 2007</u> Hx of abdominal pain for 5 days, vomiting, unable to eat. Start on TPN for bowel obstruction. Calories: Use Harris-Benedict equation with stress factor 1.4. Protein: +4 nitrogen balance with 3 g/day insensible loss. UUN 750 mg/dL, 12-hour urine collection 850 ml.				

a. Calculate the patient's energy requirements using the Harris-Benedict equation.

b. Calculate the grams of protein per day required to produce a +4 nitrogen balance.

c. The patient is beginning an oral diet and the physician would like you to calculate a formula that provides 1100 Kcal and 50 grams of protein. She prescribes protein and carbohydrate only. Calculate the grams of carbohydrates required for this formula. Calculate the volume of 8.5% stock amino acid solution to provide 50 grams of protein.

d. Calculate the non protein Kcal:Nitrogen ratio for the oral diet.

Problem 18

Phone 828-655-9000		DEA# BB -12736280	
Rosalind Frederick, MD 27 Touchstone Avenue, Arden, NC 28704			
Name	Orlando de Boys	Age	67
Weight		Weight	92 kg
Address	729 Ganymede Street, Arden	Sex	Male
		Height	6 ft 2 in
		Date	4/27/05
R	Make TPN for one day. Calories: use stress factor 1.5. Non-protein Kcal from dextrose (80%) and lipids (20%). Protein: provide nitrogen balance of +4 based on insensible loss of 4 g, Urine collection: 1450 ml/24 h, UUN: 1250 mg/dl. Fluids: 35 ml/kg/day		

- a. How many Kcal/day should be provided?

- b. Calculate the grams of protein necessary to provide the indicated nitrogen balance. Calculate the Kcal/day contributed by protein.

- c. Calculate the volume of 20% w/v of amino acids necessary to compound the TPN prescribed.

- d. Calculate the non-protein Kcal/day contributed by dextrose.

- e. How many milliliters of 20% w/v Intralipid lipid emulsion are needed?

Problem 19

PHONE 310-657-8101		DEA# AB -12736280	
URSULA BENEDICK, MD			
27 CONRADE AVENUE, ARAGON, GA 30104			
NAME	BEATRICE LEONATO	AGE	25
		WEIGHT	83 KG
ADDRESS	729 HERO STREET, ARAGON	SEX	FEMALE
		HEIGHT	5 FT 11 IN
		DATE	4/27/05
R	Make 1-day requirement for TPN. Infuse over 24 hours. Calories: 40 Kcal/kg. 30% of non-protein Kcal from 20% w/v lipid emulsion. Remainder 70% of non-protein Kcal from 70% w/v dextrose. Protein: 2.0 g/kg/day as 10% w/v amino acid solution Total fluid: 40 ml/kg Electrolyte, vitamins and trace elements.		

a. How many Kcal/day should be provided?

b. How many Kcal/day come from dextrose?

c. What volume of 80% w/v dextrose is needed to compound the prescription?

d. What is the concentration of dextrose (g/l) in the infusion solution?

Problem 20

Phone (603) 250-1950		DEA# BP -12736280	
Miranda Prospero, MD 1521 Caliban Avenue, Milan, NH 03588			
Name	Ariel Alonso	Age	30
Weight		Weight	83 kg
Address	39 Claribel Street, Naples, FL	Sex	Male
		Height	5 ft 11 in
		Date	3/27/08
	Make 1-day requirement for TPN. Infuse over 24 hours. Calories: 30 Kcal/kg. 25% of non-protein Kcal from 20% w/v lipid emulsion. Remainder 75% of non-protein Kcal from 70% w/v dextrose. Protein: 125 g/day as 10% w/v amino acid solution Total fluid: 40 ml/kg. Electrolyte, vitamins and trace elements. A patient has the following 12-hour Urinary Urea Nitrogen collection: Volume: 650 ml; Urea Urinary Nitrogen: 1120 mg/dL Assume insensible loss: 4 g/24 h		

- a. Calculate the total amount of nitrogen excreted per 24 hours.

- b. Calculate the nitrogen balance.

- c. Calculate the amount of protein required to produce a + 4 nitrogen balance per 24 hours.

- d. Calculate the amount of amino acid solution required to produce a + 4 nitrogen balance per 24 hours.

- e. Calculate the grams of dextrose required for the TPN with a + 4 nitrogen balance if the total kilocalories and the proportion of non-protein kilocalories from lipid are unchanged

Problem 21

UNIVERSITY HOSPITAL School of Pharmacy, 221 Cooke Hall, Buffalo, New York, 14260	
Patient: <u>June Fields</u> Room: <u>844-A</u> Height (circle <u>in</u> / cm): <u>5'4"</u>	DOB: <u>3/22/1944</u> Sex: <u>female</u> Weight (circle <u>lb</u> / Kg): <u>135</u>

DATE/TIME <u>11/6/2006</u>	RECORD ON ADMISSION ONLY, DOCUMENT TYPE OF ALLERGIC REACTION Allergies: <u>NKA</u> Adverse Reactions: _____
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PARENTERAL NUTRITION ORDER FORM

Order must be received in Pharmacy by 12:00 noon in order to initiate or continue treatment. Nutrition solution must be reordered daily.

CONSULT NUTRITION SUPPORT FOR ASSISTANCE IN PRESCRIBING

INFUSION SITE:	<input checked="" type="checkbox"/> CENTRAL	<input type="checkbox"/> PERIPHERAL
INFUSION RATE:	<u>60</u> ml/hr x <u>24</u> hours	

STANDARD FORMULAS

FAAD (Fat Containing Central – 5% Amino Acids, 17.5% Dextrose & 2.5% Fat Emulsion)

SCAAS (Standard Central – 5% Amino Acids & 25% Dextrose)

SPAAS (Standard Peripheral – 5% Amino Acids & 5% Dextrose)

HIGH HCO (High Carbohydrate Central – 5% Amino Acids & 35% Dextrose)

OTHER (specify) FAD, pharmacy to dose, patient post operative &

FAT EMULSION 10% 500 ml daily at 20 ml/hr Sedated

ELECTROLYTE	Contained in each Standard Formula/L	Additional/L	Deletion/L
Na	55 mEq	<u>2</u> mEq	<u>45</u> mEq
K	20 mEq	_____ mEq	<u>20</u> mEq
Ca	4.5 mEq	_____ mEq	<u>4.5</u> mEq
Mg	5 mEq	_____ mEq	<u>5</u> mEq
Cl	55 mEq	_____ mEq	<u>26.92</u> mEq
Phos	15 mM	_____ mM	<u>15</u> mM
Acetate	73 mEq	_____ mEq	<u>33.62</u> mEq

Insulin, Regular Human 25 units / Liter

Other _____ Multivitamins and Trace Elements – standard amount to daily bag.

Nutrition Profile (Mondays & Thursdays): P7, Pre Albumin, Transferrin, Mg Level, Lipid Profile

** Please provide 50 ml overfill for line prime*

PHYSICIAN SIGNATURE: Donald Swartz MD
 (Resident: print last name) _____

SEE ACCOMPANYING MEDICATION ORDER

a. What is this patient's Basal Energy Expenditure?

b. Based upon what is known about this patient's relative activity level, how many Kcal/day will be needed for nutritional sustenance?

c. How many grams of protein will be needed to compound this TPN order?

d. How many Kcal will be provided by the amino acid source?

e. What volume of the 10% w/v amino acid source solution will be needed to compound this TPN order?

f. How many grams of fat will be needed to compound this TPN order?

g. How many Kcal will be provided by the fat source?

h. What volume of the 20% w/v lipid source emulsion will be needed to compound this TPN order?

i. How many grams of carbohydrate will be needed to compound this TPN order?

j. How many kilocalories will be provided by the carbohydrate source?

k. What volume of the 70% w/v dextrose source solution will be needed to compound this TPN order?

l. What will be the total volume of this parenteral preparation?

m. How many mEq of Sodium must be present in this preparation?

n. How many mEq of Potassium must be present in this preparation?

o. How many mEq of Chloride must be present in this preparation?

p. How many mEq of Acetate must be present in this preparation?

q. What volume of the 4 mEq/ml sodium chloride source will be required to compound this TPN order?

CHAPTER 11
ISOTONIC SOLUTIONS

NOTES

Outline

- Where does osmotic pressure come from?
- Why is osmotic pressure important?
- Introduce some important terms and units of osmotic pressure
- Calculations for isotonic preparations:
 - Osmolarity method
 - Freezing point depression
 - Sodium chloride equivalents

Where Does Osmotic Pressure Come From?

- Many pharmaceutical preparations have to be made isotonic to ensure proper product performance. The concept of isotonicity is directly related to osmotic pressure, which we will discuss.

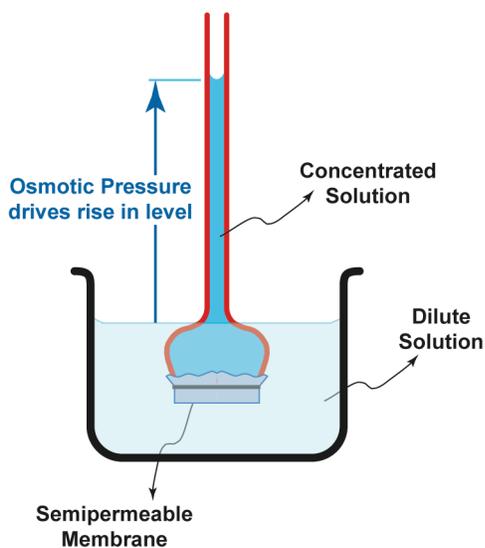


Figure 10.1. Schematic for osmotic pressure

- When a dilute solution and a concentrated solution are separated by a *semi-permeable membrane*, solvent will flow so that the two concentrations will be equalized. This process is called *osmosis*.
- The solute cannot pass through the membrane; therefore, the **concentrated solution is diluted** as the solvent flows. The force driving this movement of solvent is *osmotic pressure*. This is shown in Figure 10.1.
- The solvent flows from the region of high SOLVENT concentrations to the region of low SOLVENT concentration.

Why Is Osmotic Pressure Important?

- Recall from biochemistry that every cell is surrounded by a cell phospholipid bilayer membrane and that bilayers are virtually impermeable to ions. The exclusion of ions makes cell membrane semi-permeable.
- When we administer pharmaceutical solutions, they may be:
 - concentrated solutions (e.g. drugs or salts)
 - dilute solutions (e.g. fluids to replace loss of circulatory volume)
- Examples of body fluids into which pharmaceutical solutions are administered include tears, nasal fluid, blood, intestinal contents.

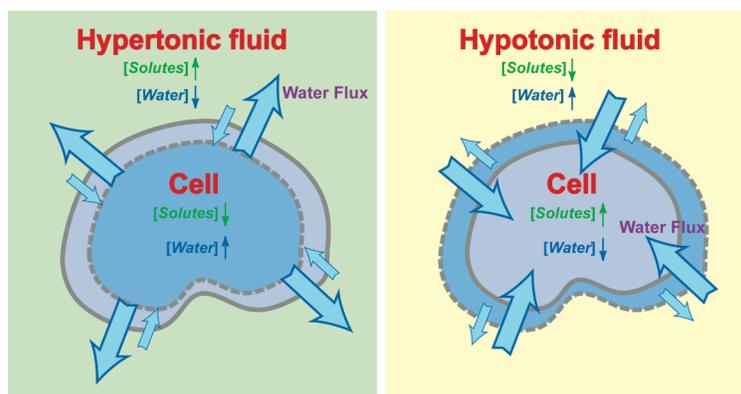


Figure 10.2. Schematic of the effects of non-isotonic solutions on cells. The net water flux is outward from the cell in hypertonic solutions and the cell volume decreases (dashed lines). In hypotonic fluids, the net water flux is inward and the cell volume increases.

- If the *osmotic pressure* of the solutions we administer does not equal the *osmotic pressure* of the body fluid into which the drug is administered, water may enter or leave the cell causing undesirable effects such as:
 - Pain/discomfort, e.g., stinging eyedrops
 - Tissue damage, e.g., hemolysis or destruction of red cells in blood.

Some Important Terms

- If two solutions have the same osmotic pressure, they are: **Isoosmotic**.
- If a solution has the same osmotic pressure as a specific body fluid, it is: **Isotonic**
- “Isotonic” is a relative term that refers to the biological effects of osmotic pressure. Different body fluids may have different compositions and therefore differing osmotic pressure. Therefore, the osmotic pressure of an “isotonic” solution meant for one body fluid may not be the same as the osmotic pressure of an “isotonic” solution meant for a different body fluid. A solution that is isotonic with human blood may not be isotonic with blood from another species such as whale, a fish or frog.

- A solution has a higher osmotic pressure than a specific body fluid is **Hypertonic**
- A solution than has a lower osmotic pressure than a specific body fluid is **Hypotonic**
- “Hypertonic” and “Hypertonic” are relative terms and like “isotonic” and include a reference body fluid. In most cases of pharmaceutical interest, the body fluid of interest is of human origin and frequently human blood or tears.
- Cells such as red cells will swell and break down when placed in a hypotonic solution because water enters the cell from the outside (see Figure 10.2). Cells will shrink or crenate when placed in a hypertonic solution because water leaves the cell and the cell volume decreases.

How Can We Estimate/Calculate Osmotic Pressure?

- Osmotic pressure is a Colligative Property
- Colligative properties: Properties of solutions that depend on the *number* of particles in solution, rather than on the nature of the constituents
- Some colligative properties:
 - Vapor pressure depression
 - Freezing point depression
 - Boiling point elevation
 - **Osmotic Pressure**
- The number of particles in solution depends on whether the substance dissolved is an **electrolyte** or **non-electrolyte**.
- Electrolytes: molecules dissociate into **ions**; (e.g., *NaCl*)
- Nonelectrolytes: non-dissociating molecules; not ionized; (e.g., glucose)
- **Nonelectrolytes** produce one mole of particles per mole of formula weight;
- **Electrolytes** produce more than one mole of particles per mole of formula weight. The number of moles of particles in solution is determined by:
 - the stoichiometry of the molecular formula
 - the degree of dissociation in solution
- Consider the dissociation of sodium chloride: $NaCl \leftrightarrow Na^+ + Cl^-$
- The **stoichiometry** of *NaCl* specifies 2 ions. Thus, upon complete ionization 1 molecule of sodium chloride releases 2 ions, each of which contributes osmotic pressure.
- Now, let us assume the dissociation is incomplete, say 80%. The dissociation of 1 mole of sodium chloride will produce 0.8 mole of Na^+ , 0.8 moles of Cl^- and 0.2 moles of *NaCl* will remain undissociated. Thus, 1 mole of *NaCl* will produce 1.8 moles of particles, which will contribute osmotic pressure.

Isotonicity Calculations

- There are 3 different but equivalent methods for isotonicity calculations. These are:
 - Osmolarity method also known as the *i-factor* method
 - Freezing point depression method also known as the ΔT_f method, because ΔT_f the represents the freezing point depression
 - Sodium chloride equivalent method or SCE method
- In the osmolarity or *i-factor* method, the “number of particles” in the solution is estimated via the molarity calculations.
- In the freezing point depressions measurements of the freezing point depression of a 1% solution or $\Delta T_f^{1\%}$ are used as the basis for the calculations.
- In the sodium chloride method, the osmotic pressure of each ingredient is expressed in terms of sodium chloride.

Osmolarity Method

- Osmolarity is directly related to molarity and can be viewed as “osmotically-active molarity”.
- The unit system used to express osmotic concentration is **osmolarity**, abbreviated OsM. The unit system for amount is Osmole.
- In the osmolarity method for isotonicity calculations, the concentrations of ‘particles’ is estimated from molarity by accounting for the dissociation of electrolytes. Non-electrolytes simply generate one mole of particles for each mole of non-electrolyte.
- **A solution isotonic with normal serum has an osmolarity of 275-296 milliosmoles/liter. We will use the mid-point of this range 286 milliosmoles/liter for calculations.**
- Ideally, it is preferable to do osmotic pressure calculations using Osmolality, which is defined by Osmoles/**kg** of solvent. For comparison, Osmolarity = Osmoles/**liter** of preparation.
- For dilute solutions, the two are usually almost equal (the error is $\leq 1\%$ in physiological range). For concentrated solutions, the two may be very different and osmolality is preferred. To convert from one to the other, one must know the *density* of the solution.
- We will employ osmolarity rather than osmolality calculations in this Workbook, because most pharmaceutical preparations are dilute.
- The *i-factor* is used to convert molar concentrations to osmolar concentrations

$$\text{Osmolarity} = i \times \text{Molarity}$$

- The *i-factor* represents the moles of ‘particles’ produced upon dissociation of 1 mole drug.
- **Nonelectrolytes:** 1 millimole of non-electrolyte produces 1 milliosmole of (units: mOsmole or mOsm). The *i-factor* is 1.

- **Electrolytes:** Assuming complete dissociation, 1 millimole of sodium chloride (NaCl), produces 2 milliosmoles. In reality, dissociation is only 80% complete and the number of milliosmoles from 1 mmole of NaCl is closer to 1.8 mOsm. The *i-factor* for a 2-ion generating electrolyte such as sodium chloride assuming 80% dissociation is 1.8.
- The Table below summarizes the *i-factor* values for two-ion (e.g., sodium chloride $\text{NaCl} \leftrightarrow \text{Na}^+ + \text{Cl}^-$), three-generating (e.g., calcium chloride, $\text{CaCl}_2 \leftrightarrow \text{Ca}^{2+} + 2\text{Cl}^-$) and four-ion generating electrolytes (e.g., aluminum chloride, $\text{AlCl}_3 \leftrightarrow \text{Al}^{3+} + 3\text{Cl}^-$). Each extra ion generated adds 0.8 to the *i-factor* upon 80% dissociation.

Table 10.1. The *i-factor* values for different types of substances

Substance type	<i>i-factor at 100% dissociation</i>	<i>i-factor at 80% dissociation</i>
Non-electrolyte	1	1
Two-ion electrolyte	2	1.8
Three-ion electrolytes	3	$1.8 + 0.8 = 2.6$
Four-ion electrolyte	4	$1.8 + 0.8 + 0.8 = 3.4$

- The *i-factor* for many common solutes can be found in tables (e.g., *Merck Index*). If you do not have such a table, and you will need to estimate it. Assume 80% dissociation unless complete dissociation is explicitly indicated.

Solving Problems Using Osmolarity

- Step 1. Calculate molarity of each ingredient
- Step 2. Use **Osmolarity = $i \times$ Molarity**
- Step 3. Add up osmolarity contributions of each ingredient
- Step 4. Add isotonic salt to make the deficit between 286 mOsm/L and actual osmolarity.
- Step 5. Calculate the molarity of the isotonic salt added, calculate amount to be added.

Freezing Point Point Depression Method

- Osmotic pressure is relatively difficult to measure routinely. However, if we can measure one colligative property, we can calculate the others! This is because all colligative properties are related to the concentration of particles
- Freezing point depression is one of the most convenient properties to measure when calculating osmotic pressure because it is easy to measure.
- **The freezing point of plasma (blood) is -0.52°C . The freezing point depression of blood is 0.52°C .** Therefore, if a solution freezes at -0.52°C , it is isotonic with respect to blood.
- Since Freezing Point Depression, like Osmotic Pressure, is a colligative property: The freezing point depression is proportional to concentration of particles.
- **The total Freezing Point Depression is the sum of the contributions of all the solutes:**

- Tables provide the $\Delta T_f^{1\%}$ values for a large number of buffers and drugs. This is the freezing point depression of a **1% w/v** solution of the drug in water.
- The freezing point depression contribution of ingredient *A* in a solution containing concentration C_A of by can be calculated by expressing the concentration of *A* in % w/v and multiplying by its $\Delta T_f^{1\%}$:

$$\Delta T_{fA} = \Delta T_{fA}^{1\%} C_A$$

- The freezing point depression of a mixture ΔT_f is the sum of all the individual freezing point contributions:

$$\Delta T_f = \Delta T_{fA} + \Delta T_{fB} + \dots = \Delta T_{fA}^{1\%} C_A + \Delta T_{fB}^{1\%} C_B + \dots$$

- The freezing point depression of blood is 0.52°C.
- Calculate the freezing point depression contribution required from the isotonicity adjusting agent by subtracting the total contributions from 0.52°C
- Calculate the concentration of isotonicity adjusting agent by dividing point depression contribution required by the $\Delta T_f^{1\%}$ of the isotonicity adjusting agent.

Solving Problems Using Freezing Point Depression

Step 1. Calculate concentration of each ingredient in % w/v

Step 2. Obtain the $\Delta T_f^{1\%}$ values from the Table

Step 3. Calculate the freezing point contributions of each ingredient with $\Delta T_{fA} = \Delta T_{fA}^{1\%} C_A$

Step 4. Add up freezing point contributions of each ingredient

Step 5. Add isotonic salt to make the deficit between 0.52°C and actual freezing point depression.

Step 6. Calculate the percentage of the isotonic salt added, calculate amount to be added.

- Observe that the overall calculation schemes for Osmolarity, Freezing Point Depression and Sodium Chloride Equivalent method have great similarity.

Sodium Chloride Equivalents (SCE)

- The amount of sodium chloride *NaCl* that has the same osmotic contribution as 1 g of drug or solute.
- That is, 1 gm of the drug or solute has the osmotic effect of how many gm of *NaCl*? The SCE of sodium chloride by definition is 1.
- **A solution isotonic with normal serum has an SCE of 0.9% w/v sodium chloride.**
- SCE can be found in tables. The SCE contribution each species *A* with concentration can be calculated using:

$$NaCl \text{ Contribution of } A = SCE_A C_A$$

- SCE can also be estimated using the following formula, which is derived from the *i*-factor and the molecular weights (*MW*) of drug and sodium chloride. Even though this formula looks complex, convince yourself that its origin is simple and straightforward.
 - Number of ‘particles’ generated by 1 g of drug $\propto i_{\text{drug}}$ ‘ Moles drug $\propto i_{\text{drug}}/MW_{\text{drug}}$
 - Number of ‘particles’ generated by 1 g of *NaCl* $\propto i_{\text{NaCl}}$ ‘ Moles of *NaCl* $\propto i_{\text{NaCl}}/MW_{\text{NaCl}}$
 - Since the SCE is equivalently defined as the grams of sodium chloride that generate the same number of particles as 1 gram of drug or solute, it follows that

$$SCE = \frac{MW_{\text{NaCl}}}{i_{\text{NaCl}}} \frac{i_{\text{drug}}}{MW_{\text{drug}}}$$

Solving Problems Using Sodium Chloride Equivalents

- Step 1. Choose a convenient basis. This could be, e.g., a 100 ml, or the volume the product.
 - Step 2. Calculate the SCE contribution of each ingredient.
 - Step 3. Sum the SCE contributions of all the ingredients.
 - Step 4. Determine by difference, the SCEs required to achieve the equivalent of 0.9% *NaCl*. Add isotonic salt to make the deficit in SCE. If the basis is 100 ml, the value obtained is the % w/v of sodium chloride; if the product volume is used as the basis, the value is the amount of sodium chloride.
 - Step 5. If an agent other than *NaCl* is used for adjusting, divide by SCE required by the SCE factor for that agent (from table) to determine the amount of the agent to be added.
- Again, observe the similarities in overall calculation schemes for all three methods.
 - These calculations can be simplified for preparations containing more than two ingredients, if cast in tabular format. The table columns would list: i) ingredient name, ii) concentration in appropriate units, iii) the values of either *i*-factor, $\Delta T_f^{1\%}$, or SCE depending on the method selected, iv) the contributions of each ingredient as the product of Column (ii) and Column (iii). The contribution needed from the isotonicity-adjusting agent can be computed in column (iv).

Alternative Method For Measuring Osmotic Pressure

- The **Vapor Phase Osmometer** measures vapor depression another colligative property. The method is very fast and accurate the instrument is compact and requires small volumes. It is accurate on solutions of wide molecular weight ranges

Table 10.2. Data For Isotonicity Calculations

Substance	MW	Ions formed	<i>i</i>-factor	$\Delta T_f^{1\%}$	<i>SCE</i>
Acetazolamide sodium	244.2	2	1.8	0.135	0.23
Aminophylline	456.5	3	2.6	0.1	0.17
Ammonium chloride	53.5	2	1.8	0.64	1.08
Amphetamine sulfate	368.5	3	2.6	0.13	0.22
Ampicillin sodium	371.4	2	1.8	0.09	0.16
Antazoline hydrochloride	301.8	2	1.8	0.11	0.18
Antipyrine	188.2	1	1.0	0.1	0.17
Antistine hydrochloride	301.8	2	1.8	0.11	0.18
Apomorphine hydrochloride	312.8	2	1.8	0.08	0.14
Ascorbic acid	176.1	1	1.0	0.11	0.18
Atropine sulfate	694.8	3	2.6	0.07	0.13
Aureomycin hydrochloride	544.0	2	1.8	0.06	0.11
Bacitracin	1423	1	1.0	0.028	0.05
Barbital sodium	206.2	2	1.8	0.171	0.3
Benzalkonium chloride (C ₂₁ H ₃₈ ClN)	340.0	2	1.8	0.096	0.18
Benzethonium chloride	448.1	2	1.8	0.044	0.08
Benzyl alcohol	108.1	1	1.0	0.095	0.17
Boric acid	61.8	1	1.0	0.29	0.5
Bupivacaine hydrochloride	324.9	2	1.8	0.096	0.17
Butacaine sulfate	711.0	3	2.6	0.12	0.2
Caffeine	194.2	1	1.0	0.05	0.08
Calcium chloride. 2H ₂ O	147.0	3	2.6	0.3	0.51
Calcium disodium edetate	374.3	3	2.6	0.12	0.21
Calcium gluconate	448.4	2	1.8	0.09	0.16
Calcium lactate	308.3	2	1.8	0.14	0.23
Carbachol	182.7	2	1.8	0.205	0.36
Chloramphenicol	323.1	1	1.0	0.06	0.1
Chlorobutanol (chloretone)	177.5	1	1.0	0.14	0.24
Citric acid	192.1	1	1.0	0.098	0.18
Clindamycin phosphate	505.0	1	1.0	0.046	0.08
Cocaine hydrochloride	339.8	2	1.8	0.09	0.16
Cyclopentolate hydrochloride	327.9	2	1.8	0.117	0.2
Demecarium bromide	716.6	3	2.6	0.069	0.12
Dexamethasone sodium phosphate	516.4	3	2.6	0.095	0.17
Dextrose, anhydrous	180.2	1	1.0	0.1	0.18
Dextrose. H ₂ O	198.2	1	1.0	0.09	0.16
Dibucaine hydrochloride	379.9	2	1.8	0.08	0.13
Diphenhydramine hydrochloride	291.8	2	1.8	0.158	0.27
Disodium edetate	372.2	3	2.6	0.132	0.23
Diatrizoate sodium	635.9	2	1.8	0.049	0.09
Dyclonine hydrochloride	325.9	2	1.8	0.135	0.24
Emetine hydrochloride	553.6	3	2.6	0.062	0.1
Ephedrine hydrochloride	201.7	2	1.8	0.18	0.3
Ephedrine sulfate	428.5	3	2.6	0.14	0.23
Epinephrine bitartrate	333.3	2	1.8	0.11	0.18

Substance	MW	Ions formed	<i>i</i> -factor	$\Delta T_f^{1\%}$	SCE
Epinephrine hydrochloride	219.7	2	1.8	0.17	0.29
Ethanol	46.1	1	1.0	0.41	0.7
Ethylhydrocupreine hydrochloride	376.9	2	1.8	0.1	0.17
Ethylmorphine hydrochloride	385.9	2	1.8	0.09	0.16
Eucatropine hydrochloride	327.8	2	1.8	0.11	0.18
Fluorescein sodium	376.0	3	2.6	0.18	0.31
Glycerin	92.1	1	1.0	0.2	0.34
Glycine	75.0	1	1.0	0.23	0.41
Homatropine hydrobromide	356.3	2	1.8	0.1	0.17
Idoxuridine	354.1	1	1.0	0.58	0.09
Lactose	360.3	1	1.0	0.04	0.07
Lidocaine hydrochloride	270.8	2	1.8	0.125	0.22
Magnesium sulfate. 7H ₂ O	246.5	2	1.8	0.1	0.17
Mannitol	182.2	1	1.0	0.099	0.17
Meperidine hydrochloride	283.8	2	1.8	0.12	0.22
Methacholine chloride	195.7	2	1.8	0.19	0.32
Methamphetamine hydrochloride	185.7	2	1.8	0.22	0.37
Methylprednisolone sodium succinate	496.5	2	1.8	0.051	0.09
Metycaine hydrochloride (Piperocaine HCl)	292.8	2	1.8	0.12	0.2
Morphine hydrochloride	375.8	2	1.8	0.09	0.15
Morphine sulfate	758.8	3	2.6	0.08	0.14
Naphazoline hydrochloride	246.7	2	1.8	0.16	0.27
Neomycin sulfate	614.7	3.5	3.0	0.06	0.11
Neostigmine bromide	303.2	2	1.8	0.11	0.22
Nicotinamide	122.1	1	1.0	0.15	0.26
Penicillin G potassium	372.5	2	1.8	0.11	0.18
Penicillin G Procaine	588.7	2	1.8	0.06	0.1
Penicillin G sodium	356.4	2	1.8	0.11	0.18
Phenacaine hydrochloride	352.9	2	1.8	0.11	0.2
Phenobarbital sodium	254.2	2	1.8	0.14	0.24
Phenylephrine hydrochloride	203.7	2	1.8	0.18	0.32
Physostigmine salicylate	413.5	2	1.8	0.09	0.16
Physostigmine sulfate	648.5	3	2.6	0.08	0.13
Pilocarpine nitrate	271.3	2	1.8	0.14	0.23
Polyethylene glycol 1500	1500	1	1.0	0.036	0.06
Polyethylene glycol 300	300.0	1	1.0	0.069	0.12
Polyethylene glycol 4000	4000	1	1.0	0.008	0.02
Polymyxin B sulfate	1386	3	2.6	0.049	0.09
Polysorbate 80 (Tween 80)	1310	1	1.0	0.01	0.02
Potassium chloride	74.6	2	1.8	0.45	0.76
Potassium iodide	166.0	2	1.8	0.2	0.34
Potassium phosphate	212.3	3	2.6	0.265	0.46
Potassium phosphate monobasic	136.1	2	1.8	0.25	0.43
Procaine hydrochloride	272.8	2	1.8	0.12	0.21
Proparacaine hydrochloride	330.9	2	1.8	0.086	0.15

Substance	MW	Ions formed	<i>i-factor</i>	$\Delta T_f^{1\%}$	SCE
Propylene glycol	76.1	1	1.0	0.262	0.45
Quinine hydrochloride	396.9	1	1.0	0.08	0.14
Scopolamine hydrobromide	438.3	2	1.8	0.07	0.12
Silver nitrate	169.9	2	1.8	0.19	0.33
Sodium benzoate	144.1	2	1.8	0.24	0.4
Sodium bicarbonate	84.0	2	1.8	0.38	0.65
Sodium bisulfite	104.1	2	1.8	0.36	0.61
Sodium borate.10H ₂ O	381.4	5	4.2	0.25	0.42
Sodium chloride	58.5	2	1.8	0.58	1
Sodium citrate (Trisodium citrate)	258.1	4	3.4	0.178	0.31
Sodium dibasic phosphate. 7H ₂ O	268.1	3	2.6	0.17	0.29
Sodium iodide	149.9	2	1.8	0.23	0.39
Sodium lactate	112.1	2	1.8	0.315	0.55
Sodium nitrate	85.0	2	1.8	0.39	0.68
Sodium phosphate dibasic, anhydrous	142.0	3	2.6	0.31	0.53
Sodium phosphate dibasic. 12H ₂ O	358.2	3	2.6	0.126	0.22
Sodium phosphate dibasic. 2H ₂ O	178.1	3	2.6	0.244	0.42
Sodium phosphate monobasic. 2H ₂ O	156.0	2	1.6	0.36	0.36
Sodium phosphate monobasic. H ₂ O	138.0	2	1.8	0.228	0.4
Sodium propionate	96.1	2	1.8	0.36	0.61
Sodium sulfite, exsiccated	126.1	3	2.6	0.38	0.65
Sodium thiosulfate	158.1	3	2.6	0.18	0.31
Sorbitol. 1/2 H ₂ O	191.2	1	1.0	0.094	0.16
Streptomycin sulfate	1457	5	4.2	0.04	0.07
Sucrose	342.3	1	1.0	0.05	0.08
Sulfacetamide sodium	254.3	2	1.8	0.14	0.23
Sulfadiazine sodium	272.3	2	1.8	0.14	0.24
Sulfamerazine sodium	286.3	2	1.8	0.14	0.23
Sulfanilamide	172.2	1	1.0	0.13	0.22
Sulfathiazole sodium	304.3	2	1.8	0.13	0.22
Tetracaine hydrochloride	300.8	2	1.8	0.11	0.18
Tetracycline hydrochloride	480.9	2	1.8	0.08	0.14
Tetrahydrozoline hydrochloride	236.7	2	1.8	0.162	0.28
Ticarcillin disodium	428.4	2	1.8	0.113	0.2
Tobramycin	1425	1	1.0	0.038	0.07
Tripeleminamine hydrochloride	291.8	2	1.8	0.17	0.3
Tromethamine	121.1	1	1.0	0.152	0.26
Urea	60.1	1	1.0	0.35	0.59
Xylometazoline hydrochloride	280.8	2	1.8	0.121	0.21
Zinc chloride	139.3	3	2.6	0.37	0.62
Zinc sulfate.7H ₂ O	287.6	2	1.8	0.09	0.15

MW: Molecular Weight; **Ions formed:** Number of ions resulting on complete dissociation; ***i-factor*:** Number of particles from partial (80%) dissociation of one molecule; $\Delta T_f^{1\%}$: Freezing point depression of a 1% solutions; **SCE:** Sodium chloride equivalents.

Data compiled from several sources including the *Merck Index*, *Physical Pharmacy*, James Martin, and *Pharmaceutical Calculations*, Howard C. Ansel.

PROBLEMS

Problem 1

a. What is the osmolarity of an isotonic solution?

b. What is the *i-factor*?

c. What is the **freezing point** of an isotonic solution?

d. What is the concentration of an isotonic solution of sodium chloride?

e. Define a colligative property?

f. Give two examples of colligative properties.

g. Give an example of a property that is **not** colligative.

Problem 2

- a. You are taking care of Shamu, a baby whale at the local marine mammal center. The body fluids of a whale are isotonic with seawater, which is approximately 3% sodium chloride. Calculate the osmolarity of seawater in **mOsmoles/Liter**.

- b. A patient enters the emergency room with edema (swelling due accumulation of fluid) of the eye. The physician orders the application of a few drops of pure glycerin. Given what you know of isotonicity, does this make sense? Will the edema increase, stay the same or decrease?

- c. An eye drop solution freezes at -0.4°C . What is the freezing point depression of the solution? Is the eye drop solution hypo- hyper- or isotonic with respect to lachrymal fluid?

- d. You have an eye drop solution with a freezing point depression of 0.74°C . If you mix 1 volume of this eyedrop solution with 1 volume of water, what will the freezing point depression of the diluted solution be? Will the resulting solution be hypotonic, isotonic, or hypertonic with respect to lachrymal fluid?

- e. A solution has a freezing point of -0.87°C . Is this solution hypertonic, isotonic or hypotonic? Two ml of the solution is mixed with 1 ml of water. Is the resulting solution isotonic, hypertonic or hypotonic?

Problem 3

Phone 615-515-1234	Cherry Melon, M.D.			DEA# AM -12736280	
Cantaloupe Street					
Orange, NJ 14226					
Name	<u>Peach Berry</u>	Age	<u>5</u>	Weight	<u>20 kg</u>
Address	<u>Pearson Street, Orange</u>	Date	<u>10/01/97</u>	Height	<u>2' 8"</u>
<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="font-size: 2em; font-weight: bold; margin-right: 10px;">R_x</div> <div style="text-align: center;"> <p>2.5% sodium chloride solution</p> <p>m ft 100 ml</p> <p>Sig: ii gt os q4h</p> </div> <div style="text-align: right; margin-right: 50px;"> <p><u>Cherry Mellon, M.D.</u></p> </div> </div>					

a. Is this solution isotonic, hypotonic or hypertonic?

b. Will cells expand, contract or stay the same in this solution?

c. Calculate the osmolarity of this solution. Assume the molecular weight of sodium chloride to be 58.5.

d. Calculate the freezing point depression of this solution.

Problem 4

Magma Felsic, MD					
Crater Rock, HI 14002					
Name	<u>Ash Andesitic</u>	Age	<u>30</u>	Weight	<u>80 kg</u>
Address	<u>11 Dome Street, CR</u>	Date	<u>9/23/97</u>	Height	<u>5' 8"</u>
R_x Irrigate with 1L of 0.45% sodium chloride solution					
<u>M.Felsic</u> <u>M.D</u>					

a. What abbreviation frequently used denote 0.45% sodium chloride?

b. Is this solution isotonic, hypotonic or hypertonic?

c. Would red cells lyse, shrink or stay unaffected in this solution?

d. Calculate the osmolarity of this solution.

e. Calculate the freezing point depression of this solution.

Problem 5

Phone 415-678-6969		DEA# BH -12736280	
Dr. Ashbury Haight 13 Oak Street San Francisco, CA 94143			
Name	<u>Richmond Castro</u>	Age	<u>15</u>
Address	<u>169 Noriega Street, San Francisco</u>	Date	<u>10/01/97</u>
		Weight	<u>45 kg</u>
		Height	<u>4' 8"</u>
Rx Boric acid Sterile water qsad m ft SA isotonic solution Sig: ii gt ou q4h		qs	50 ml

- a. What is the freezing point depression of a 1% boric acid solution?

- b. What is the sodium chloride equivalent of boric acid?

- c. Calculate the concentration of boric acid required for an isotonic solution using the freezing point method.

- d. Calculate the amount of boric acid required using the freezing point method.

- e. Calculate the amount of boric acid required for an isotonic solution using the sodium chloride equivalent method.

Problem 6

Phone 415.810.1286		DEA# BC -12736280	
Beryl Cinnabar, MD 121 Jade Avenue, Telluride, CO 81435			
Name	Galena Jasper	Age	19
Weight		Height	88 kg
Address	11 Mica Street, Telluride	Date	2/25/05
Height			190 cm
 1.5 g/kg Mannitol 15% over 30 min for reducing intraocular pressure.			

Mannitol is used as an osmotic agent and increases diuresis by increasing osmotic pressure. Mannitol is a non-electrolyte and has a molecular weight of 182.

a. Calculate the molarity of the mannitol solution.

b. What is the *i-factor* for mannitol?

c. Calculate the osmolarity of 15% mannitol solution. Is it hypotonic, isotonic or hypertonic?

d. Calculate the molar concentration of mannitol in an isotonic solution of mannitol.

e. Calculate the percent concentration of mannitol in an isotonic solution of mannitol.

Problem 7

Phone 716-555-1234		DEA# BC -12736280			
Dr. Sela Chimorpha, M.D.					
Name	Mako Longfin	Age	18 yr	Height	5'4" ft
Address	8 Whitetip St, Wobbegong, WI	Date	8/18/02	Weight	125 lb
Rx Sodium bicarbonate solution 4.2%					
Infuse 16 ml/kg daily by slow IV infusion					
<u>S. Chimorpha, MD</u>					

Sodium bicarbonate ($NaHCO_3$) is used for treating acidosis.

- a. What is freezing point depression of a 1% solution of sodium bicarbonate?

- b. What is the freezing point depression of the 4.2% solution of sodium bicarbonate? What is the freezing point of the 4.2% solution of sodium bicarbonate?

- c. What **concentration** of **sodium chloride** would have the same osmotic pressure as a **1% solution** of sodium bicarbonate?

- d. What is the sodium chloride equivalent of the 4.2% sodium bicarbonate solution. Express your answer as a **concentration** of sodium chloride.

- e. Sodium bicarbonate is a 2-ion generating electrolyte. What is the *i*-factor for sodium bicarbonate? Calculate the osmolarity of the 4.2% sodium bicarbonate solution.

Problem 8

Phone 716-767-1234		DEA# BB -12736280			
Dr. Angel Bullhead, M.D.					
Name	Bramble Sawshark	Age	52 yr	Height	6ft 2 in
Address	8 Thresher Pl, Hammerhead, CT	Date	8/12/05	Weight	100 kg
Rx Sulfacetamide sodiumqs Sterile water qs ad 100 ml M ft SA isotonic solution; 2 gtt ou q3h					

- a. What is the freezing point depression of a 1% solution of sulfacetamide sodium?

- b. What is the concentration of sulfacetamide sodium in the isotonic preparation? Use the freezing point depression method. Sulfacetamide sodium is a solid.

- c. What concentration of sodium chloride would have the same osmotic pressure as a 1% w/v solution of sulfacetamide sodium?

- d. What is the concentration of sulfacetamide sodium in the isotonic preparation? Use the sodium chloride equivalent method.

- e. What is the concentration of sulfacetamide sodium in the isotonic preparation? Use the osmolality or *i*-factor method. Assume sulfacetamide sodium is a 2-ion electrolyte. Express your answer in percent strength.

Problem 9

Phone 305-425-6969		DEA# BC -12736280	
Coquina Dolomite, MD 121 Anthracite Avenue, Flint, MI 20210			
Name	Breccia Obsidian	Age	19
Address	11 Shale Street, Flint	Date	2/25/05
		Weight	88 kg
		Height	190 cm
 Infuse 1L of D5W IV over 2 hours.			

Assume that the dextrose concentration in D5W refers to anhydrous dextrose and not dextrose monohydrate (dextrose•H₂O). Anhydrous dextrose is a non-electrolyte that has a molecular weight of 180 g/mole.

a. Calculate the molarity of anhydrous dextrose in D5W

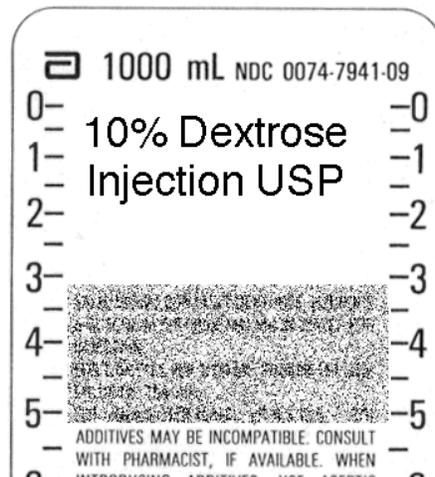
b. Calculate the osmolarity of D5W.

c. Express the concentration of dextrose in D5W in terms of percent w/v of dextrose monohydrate.

d. What is the freezing point depression of the solution?

e. What is the sodium chloride equivalent of the solution as % w/v?

Problem 10



Use the label above to answer the following questions. Dextrose is a non-electrolyte. The 10% refers to anhydrous dextrose, which has a molecular weight of 180.

a. Calculate the dextrose concentration in molarity.

b. What is the *i*-factor for dextrose? What is the osmolarity of the solution?

c. Dextrose is usually available as a monohydrate (dextrose•H₂O). What is the percent concentration of dextrose monohydrate?

d. What is the freezing point **depression** of the solution?

e. What is the concentration of the solution in sodium chloride equivalents? Is this solution isotonic, hypertonic or hypotonic?

Problem 11

Phone 716-555-1234		DEA# AW -12736280	
Kelly Walsh, MD 15 Melrose Ave, Beverly Hills, CA 90210			
Name	Donna Scanlon	Age	5
Address	225 Wilshire Blvd, Beverly Hills	Date	10/01/97
		Weight	20 kg
		Height	2' 8"
R Atropine sulfate Boric acid Sterile water qsad m ft SA isotonic solution Sig: ii gt ou q4h		0.5% qs 50 ml	

- a. What is the freezing point depression of a 1% atropine sulfate solution? What is the contribution of the atropine sulfate to the freezing point depression of the solution?

- b. Calculate the freezing point contribution required from boric acid to make the solution isotonic.

- c. Calculate the concentration of boric acid required using the freezing point method.

- d. Calculate the sodium chloride equivalents contributed by the atropine sulfate.

- e. Calculate the sodium chloride equivalents contribution required from the boric acid.

- f. Calculate the amount of boric acid required using the SCE method.

Problem 12

Phone 888-859-8003		DEA# BS -12736280	
Fox Scully, MD 121 Flukeman Street Newark, NJ 14226			
Name	Dana Mulder	Age	15
Address	Calusari Street, Quantico	Date	10/01/97
		Weight	50 kg
		Height	5' 3"
Rx Neomycin sulfate Polymixin B sulfate Boric acid Sterile water qsad m ft SA isotonic solution Sig: ii gt os bid		0.5% 10,000 units/ml qs 75 ml	

Polymyxin B sulfate has a specific activity of 6000 units/mg. The freezing point depression of a 1% solution is 0.04°C and the sodium chloride equivalents is 0.1.

- a. Calculate the concentration of polymyxin B sulfate in % strength. Determine the amount of polymyxin B sulfate needed.

- b. Calculate the boric acid required using the SCE method.

- c. Calculate the boric acid required using the freezing point method.

Problem 13

Phone 716-555-1234		DEA# BC -12736280	
Xena Cyrene, MD Draco Street, Amphipolis, CA 94122			
Name	Gabrielle Iolaus	Age	28
Address	Callisto Street, Hercules	Date	1/15/05
		Weight	75 kg
		Height	5' 8"
R	Phenylephrine hydrochloride		0.12%
	Zinc sulfate 7H ₂ O		0.25%
	Sodium chloride		qs
	Sterile water qs		100 ml
	m ft isotonic solution. Sig: i gt ou qid		

a. Calculate the sodium chloride required using the osmolarity method. Assume all three ingredients to be two-ion generating salts.

b. Calculate the sodium chloride required using the sodium chloride equivalents method.

c. Calculate the sodium chloride required using the freezing point depression method.

d. Calculate the expected freezing point if the pharmacist forgot to add the sodium chloride required.

Problem 14

Phone 716-555-1234		DEA# BT -12736280	
SIRIUS TOLIMAN, MD CENTAURI STREET, CAPELLA, WI 34122			
Name	Mira Pegasi	Age	35
Weight	135 lb	Date	10/31/06
Address	12 Mimosa Street, Capella	Height	170 cm
R Ephedrine sulfate Sodium chloride Purified water qsad m ft isotonic. Sig: ii gtt each nostril q6h		1.5% qs 30 ml	

a. What instructions would you give to the patient?

b. How much ephedrine sulfate is needed for this preparation?

c. Use the sodium chloride equivalent method to determine the amount of sodium chloride needed.

d. Use the freezing point depression method to determine the amount of sodium chloride needed

Problem 15

Phone 212-345-6789		DEA# AW -12736280	
Montana Washington, MD			
144 Michigan Avenue, New York, NY 14122			
Name	Caroline North	Age	19
Weight		Weight	75 kg
Address	12 Delaware Ave, New York	Date	1/15/05
Height		Height	180 cm
<div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 10px;">R_x</div> <div> <p>40 mEq of KCl in 0.9% sodium chloride.</p> <p>Infuse 1L of solution over 4 hrs</p> </div> </div>			

Assume that all electrolytes are 80% dissociated.

a. What is the molarity of potassium chloride in the solution?

b. What is the osmolarity contribution of potassium chloride?

c. What is the osmolarity contribution of sodium chloride?

d. Is this solution hypotonic, isotonic, or hypertonic, with respect to blood? Would the freezing point of the solution be higher, equal to, or lower than -0.52°C ?

Problem 16

Phone 305-577-9809		DEA# AP -12736280	
Amber Pearl, MD 11 Agate Street, Coral Gables, FL 33114			
Name	Ruby Spinel	Age	62
Weight		Weight	75 kg
Address	121 Garnet Street, Amethyst	Date	1/15/05
Height		Height	150 cm
R Atropine sulfate 1% Boric acid QS Purified water qsad 50 ml Sterile water QS m ft sterile isotonic sol. No preservative. Sig: i gtt od before Next appointment			

- a. What is the freezing point depression of atropine sulfate in the solution?

- b. What is the freezing point depression contribution needed from boric acid?

- c. What is the concentration of boric acid based on the freezing point depression method?

- d. What is the sodium chloride equivalent contribution (in % w/v *NaCl*) needed from boric acid?

- e. Calculate the boric acid concentration using the sodium chloride equivalent method?

Problem 17

Phone 716-555-1234		DEA# BC -12736280	
Xena Cyrene, MD Draco Street, Amphipholis, CA 94122			
Name	Gabrielle Iolaus	Age	35
Weight		Weight	166 lb
Address	Callisto Street, Hercules	Date	6/15/03
Height		Height	166 cm
<p><i>R</i> Ephedrine Sulfate 2.0%</p> <p>Sodium Chloride qs</p> <p>Purified Water qs ad 100</p> <p>Ft. isotonic</p> <p>Sig: ii gtt each nostril q6h</p>			

a. What is osmolarity contribution of ephedrine sulfate assuming it is a three-ion generating electrolyte.

b. What is concentration of sodium chloride in mg/ml needed using the osmolarity method?

c. What is the concentration of sodium chloride based on the freezing point depression method?

d. What is the concentration of sodium chloride based on the sodium chloride equivalent method?

Problem 18

Phone 716-555-1234		DEA# AF -12736280	
Wilma Flintstone 142 Boulder Avenue Bedrock, SD 14226			
Name	Betty Rubble	Age	70
Address	Pebbles Street, Bedrock	Date	10/01/97
Weight	50 kg	Height	5' 3"
Rx	Chloramphenicol 0.5% w/v Sodium chloride qs Sterile water qsad 50 ml m ft SA 50 ml of isotonic solution i gtt od qid for 48 hours		
<u>W Flintstone M.D.</u>			

- a. What instructions would you give the patient?

- b. What is the **freezing point** of a 1% solution of chloramphenicol in water?

- c. What is the sodium chloride equivalent of chloramphenicol?

- d. How much sodium chloride is required to compound this prescription? Use the sodium chloride equivalent method.

- e. Assume you are going to add normal saline to provide the sodium chloride. How much normal saline is required?

Problem 19

Dr. Barry Hubris Tick Road, New York City, NY 14002					
Name	Janet Jungle	Age	1 day	Height	35 cm
Address	Feralboy St, Blissville, IL	Date	8/18/08	Weight	3.5 kg
R_x Silver nitrate 1% w/v Sodium acetate qs Sterile water qs ad 200 ml m ft SA isotonic solution Sig: Administer 2 gtt ou					

Silver nitrate solution is widely administered to newborns to prevent eye infections. Sodium acetate has a molecular weight of 82, a $\Delta T_f^{1\%}$ of 0.25°C and a sodium chloride equivalent of 0.45.

- a. Calculate the amount of silver nitrate required to compound this prescription.

- b. Determine the freezing point depression of the silver nitrate solution **prior** to the addition of sodium acetate.

- c. Calculate the concentration of sodium acetate in the isotonic solution using the freezing point depression method.

- d. Calculate the amount of sodium acetate required to compound this prescription?

Problem 20

Phone 835-687-1234		DEA# BJ -12736280																			
Rosie Jetson, MD Skypad, NM 470001																					
Name	<u>Cosmo Spacely</u>	Age	<u>40</u>																		
Address	<u>8 Orbit St, Skypad, NM</u>	Date	<u>10/1/07</u>																		
		Weight	<u>100 kg</u>																		
		Height	<u>5' 8"</u>																		
<table style="width: 100%; border: none;"> <tr> <td style="width: 10%; vertical-align: top;">R_x</td> <td style="padding: 5px;">Zinc sulfate</td> <td style="text-align: right; padding: 5px;">0.25%</td> </tr> <tr> <td></td> <td style="padding: 5px;">Benzalkonium chloride</td> <td style="text-align: right; padding: 5px;">1: 10,000</td> </tr> <tr> <td></td> <td style="padding: 5px;">Sterile water qs ad</td> <td style="text-align: right; padding: 5px;">50 ml</td> </tr> <tr> <td colspan="3" style="padding: 5px;">m ft 24 tabs SA</td> </tr> <tr> <td colspan="3" style="padding: 5px;">Dissolve i tab in 8 oz water qd</td> </tr> <tr> <td colspan="3" style="text-align: right; padding: 5px;"><u>R Jetson, M.D.</u></td> </tr> </table>				R_x	Zinc sulfate	0.25%		Benzalkonium chloride	1: 10,000		Sterile water qs ad	50 ml	m ft 24 tabs SA			Dissolve i tab in 8 oz water qd			<u>R Jetson, M.D.</u>		
R_x	Zinc sulfate	0.25%																			
	Benzalkonium chloride	1: 10,000																			
	Sterile water qs ad	50 ml																			
m ft 24 tabs SA																					
Dissolve i tab in 8 oz water qd																					
<u>R Jetson, M.D.</u>																					

This is a recipe for an eyewash product. Benzalkonium chloride has a sodium chloride equivalent of 0.16 and the freezing point depression of a 1% solution is 0.09°C. It is a preservative.

a. Express the concentration of benzalkonium chloride in % w/v.

b. What is the freezing point depression of the solution?

c. Calculate the number of sodium chloride equivalents **in 100 ml** of the solution.

d. Is this eyewash solution isotonic, hypotonic, or hypertonic?

Problem 21

Phone 716-555-1234		Dr. Chanterelle Porcini 169 St. Georges, PA 14002		DEA# AR -12736280	
Name	Maitaki Shiitake	Age	9	Weight	30 kg
Address	13 Portobello Rd. SG	Date	9/28/97	Height	4 ft
Rx Phenylephrine hydrochloride 0.12% Zinc sulfate.7H ₂ O 0.25% Water qs ad 100 ml m ft isotonic solution Sig: ii gtt od qid					

- a. What is the **freezing point** of a 1% solution of phenylephrine hydrochloride?

- b. What is the contribution of phenylephrine hydrochloride to the **freezing point depression** of the **preparation**?

- c. What is the **freezing point** of 1% solution of zinc sulfate.7H₂O?

- d. What is the contribution of zinc sulfate.7H₂O to the **freezing point depression** of the **preparation**?

- e. What is the **freezing point depression** of the **preparation**? Is the solution isotonic, hypertonic or hypotonic?

Problem 22

Phone 716-555-1234		DEA# AM -12736280	
Dr. Gala McIntosh Duchess Street, Cortland, WA 14002			
Name	Pippin Cox	Age	35
Address	Empire Road, Cortland	Date	9/8/97
		Weight	60 kg
		Height	5' 7"
R_x Potassium chloride 4 mg/ml Boric acid qs Water qs ad m ft 1000 ml of isotonic eyewash solution			

- a. Express the concentration of potassium chloride in % w/v.

- b. What is the SCE of the potassium chloride?

- c. What is the SCE contribution of potassium chloride? Express your answer in % strength of sodium chloride.

- d. What SCE is required from boric acid? Express your answer in % strength of sodium chloride.

- e. What is the concentration of boric acid in the product?

- f. What is the concentration of boric acid in a preparation that is isotonic but contains only boric acid?

Problem 23

Dr. Hal O'Ween, M.D.				DEA# AT -12736280	
3 Treat Street					
Eerie, PA					
Name	Jack O'Lantern	Age	55	Height	170 cm
Address	66 Trick St, Eerie, PA	Date	10/31/07	Weight	71 kg
Rx Sulfacetamide sodium 15% w/v m ft sa sterile ophthalmic sol 1 gtt ou q4h H. O'Ween, MD					

a. What is the site of administration?

b. What is the **freezing point** of a 1% sulfacetamide solution?

c. What is the **freezing point** of the sulfacetamide solution in the preparation?

d. Is the solution isotonic, hypotonic or hypertonic? **Why?**

e. How much is sulfacetamide is present in a single dose.

Problem 24

Phone 716-555-1234		DEA# BF -12736280			
Dr. Ekas Fearow, M.D. 3 Squirtle Ave, Marill, CO					
Name	Pidgey Wigglytuff	Age	25	Height	130 cm
Address	Kakuna Ave, Marill	Date	8/18/97	Weight	71 kg
R_x	Boric acid 1.1%				
	Sodium borate 10H ₂ O qs				
	m ft 500 ml of isotonic solution				

a. What is the sodium chloride equivalent of boric acid?

b. What is the sodium chloride contribution of 1.1% boric acid. Answer in % sodium chloride.

c. What is the sodium chloride equivalent of sodium borate 10H₂O?

d. For isotonicity, what sodium chloride equivalent contribution is required from sodium borate 10H₂O?

e. Calculate the sodium borate 10H₂O concentration in the isotonic preparation. Calculate the amount of sodium borate 10H₂O required for the preparation.

Problem 25

Phone 716-555-1234		DEA# BB -12736280			
Dr. Bill Bronco, M.D. 3 Astro Ave Mariner, WA					
Name	Raven Brown	Age	25	Height	130 cm
Address	9, Jet Ave, Mariner	Date	8/18/97	Weight	70 kg
R_x Sodium phosphate 12H ₂ O qs m ft 500 ml of isotonic solution <p style="text-align: right;"><u>Bill Bronco, MD</u></p>					

a. What is the freezing point depression of a 1% w/v solution of sodium phosphate 12H₂O?

b. What is sodium chloride equivalent of sodium phosphate 12H₂O?

c. Is a 1% solution of sodium phosphate 12H₂O isotonic, hypotonic or hypertonic?

d. Calculate the concentration of sodium phosphate 12H₂O in the isotonic solution? Express your answer in % w/v. Use the freezing point depression method.

e. Calculate the concentration of sodium phosphate 12H₂O in the isotonic solution? Express your answer in % w/v. Use the sodium chloride equivalent method.

Problem 26

Phone 716-555-1234		DEA# AB -12736280			
Dr. Ariel Bookman, M.D. 3 Geneva Ave, New York					
Name	Nadianne Palatino	Age	25	Height	130 cm
Address	Helvetica Ave, New York	Date	8/18/97	Weight	70 kg
<div style="display: flex; align-items: flex-start;"> <div style="font-size: 2em; margin-right: 10px;">℞</div> <div> <p>Zinc sulfate 7H₂O 0.25%</p> <p>Phenylephrine hydrochloride 0.12%</p> <p>Sodium chloride qs</p> <p>m ft sa 100 ml of isotonic solution.</p> <p>ii gtt os tid</p> </div> </div> <div style="text-align: right; margin-top: 10px;">A Bookman, MD</div>					

a. Calculate the **freezing point depression** of the preparation in the absence of sodium chloride.

b. Calculate the freezing point contribution necessary from sodium chloride to ensure isotonicity.

c. Calculate the concentration of sodium chloride in the isotonic preparation using the freezing point depression method.

d. Calculate the concentration of sodium chloride in the isotonic preparation using the sodium chloride equivalent method.

Problem 27

Phone 716-555-1234		DEA# AT -12736280			
Dr. Derma Titus, M.D. 3 Pimple Court, Edema, AZ					
Name	Dan Druff	Age	45 yr	Height	5 ft 8 in
Address	87 Acne Lane	Date	8/18/97	Weight	100 kg
R 6 ml of solution containing 0.125% w/v phenylephrine hydrochloride with 25 mg/ml zinc sulfate.7H ₂ O. m ft isotonic using sodium chloride SA Sig: 2 gtt ou q4h prn eye irritation					

- a. Convert the concentration of zinc sulfate to percent strength.

- b. How many milligrams of sodium chloride would the osmotic pressure of 1 milligram of zinc sulfate.7H₂O be equivalent to?

- c. Determine the sodium chloride equivalents contributed to by the zinc sulfate.7H₂O concentration in the preparation. Express your answer as a concentration of sodium chloride.

- d. Determine the sodium chloride equivalents contributed to by the phenylephrine hydrochloride concentration in the preparation. Express your answer as a concentration of sodium chloride.

- e. Determine the concentration of sodium chloride added to make the preparation isotonic.

- f. Determine the dose of phenylephrine hydrochloride.

Problem 28

Phone 716-555-1234		DEA# AR -12736280			
Dr. Cornea Rods-Cone, M.D.					
Retina, NY					
Name	Iris Sclera	Age	45 yr	Height	5 ft 8 in
Address	87 Pupil Lane, Retina	Date	8/18/97	Weight	100 kg
R	Phenylephrine hydrochloride		10%		
	Atropine sulfate			2%	
	Sterile water qs ad			5 ml	
	Sig: i gtt os qid for glaucoma				
C Rods-Cone, MD					

- a. What is the freezing point depression of a 1% solution of phenylephrine hydrochloride?

- b. Calculate the contribution of phenylephrine hydrochloride to the freezing point depression of the preparation.

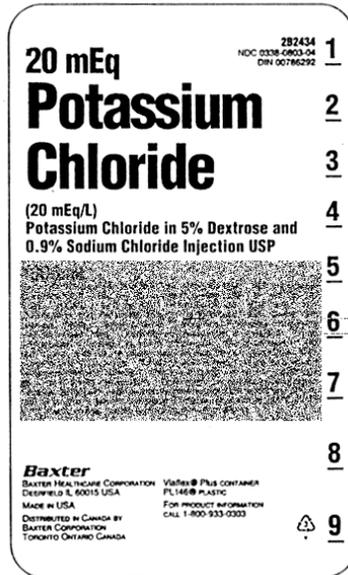
- c. Calculate the contribution of atropine sulfate to the freezing point depression of the preparation.

- d. Determine the freezing point depression of the preparation.

- e. Determine the **freezing point** of the preparation.

- f. Is this preparation isotonic, hypotonic or hypertonic?

Problem 29



This is a preparation of 20 mEq/L potassium chloride ($K^+ Cl^-$) in 0.9% sodium chloride ($Na^+ Cl^-$) and 5% anhydrous dextrose. Potassium chloride and sodium chloride are electrolytes and dextrose, a non-electrolyte. Assume anhydrous dextrose has a molecular weight of 180.

a. What is the concentration of potassium chloride in molarity?

b. What is the concentration of dextrose in molarity?

c. What is the *i-factor* for potassium chloride and for dextrose?

d. What is osmolarity contribution of potassium chloride?

e. What is the osmolarity of the preparation?

Problem 30

Phone 716-555-1234		DEA# AR -12736280	
Dr. Tim Buktu, MD Kensington Street Buffalo, NY 14226			
Name	Ken Tucky	Age	5
Address	Harlem Street, Buffalo	Date	10/01/97
		Weight	20 kg
		Height	2' 8"
Rx Sulfacetamide sodium Sterile water qs ad m ft SA isotonic i gtt ou q2h conjunctivitis		qs	50 ml
<u>Tim Buktu, MD</u>			

- What is the freezing point depression of a 1% solution of sulfacetamide sodium?

- Using the freezing point depression method, determine the concentration of sulfacetamide sodium in the isotonic solution.

- What is the **freezing point** of a 2% solution of sulfacetamide sodium in water?

- Calculate the concentration of sulfacetamide sodium in the isotonic preparation using the sodium chloride equivalents method.

- Calculate the amount of sulfacetamide sodium in the isotonic preparation using the sodium chloride equivalents method.

Problem 31

Dr. Scooter Po, M.D.					
22 Rabbit Row, Bibberly, MS					
Name	Dipsy Cowprint	Age	25 yr	Height	5'9"
Address	464 Tubbytronic St, Bibberly	Date	8/18/97	Weight	50 kg
 Sulfacetamide sodium ophthalmic solution 10% w/v S Po, MD					

This is a bacteriostatic antibiotic. Treat it as a 2-ion electrolyte that is 80% dissociated.

a. From the table, what is the molecular weight of sulfacetamide sodium?

b. What is the concentration of sulfacetamide sodium in millimoles/liter

c. What is the usual *i-factor* for a 2-ion electrolyte?

d. What is the osmolarity of the solution in milliosmoles/liter?

e. What is the freezing point depression of the 10% solution prescribed? Is this solution hypertonic, isotonic or hypotonic?

f. What concentration of sodium chloride solution would have the same osmotic pressure as the 10% sulfacetamide solution prescribed?

Problem 32

Phone 716-555-1234		DEA# BF -12736280			
Dr. Bistecca Florentine, M.D.					
3 Dolce Ave, Bresaola, NE					
Name	Tortelli DiZucca	Age	25 yr	Height	5'9"
Address	87 Cannelloni St, Bresaola, NE	Date	8/18/97	Weight	70 kg
\mathcal{R} Physostigmine salicylate 0.25% Pilocarpine nitrate 2% Water qs ad 100 ml M ft ophthalmic solution Sig ii gtt ou qid for glaucoma					

- a. What instructions would you give the patient?

- b. What is the freezing point depression of a 1% physostigmine salicylate solution?

- c. What is the freezing point depression **contribution** of the physostigmine salicylate to the preparation in the prescription?

- d. What is the freezing point depression **contribution** of the pilocarpine nitrate to the preparation in the prescription?

- e. What is the freezing point depression of the preparation?

- f. Is the preparation isotonic, hypotonic or hypertonic?

Problem 33

Phone 555-3784	Stelline Rigatoni, MD	DEA# BR0365420												
13 Lumache St.														
Orzo, NJ														
Name	Marille Maccheroni	Age 26												
Address	169 Trofie St., Orzo, NJ 14004	Date 1/10/95												
<table style="width: 100%; border: none;"> <tr> <td style="width: 10%; vertical-align: top;">R_x</td> <td style="width: 60%;">Dextrose.H₂O</td> <td style="width: 30%; text-align: right;">qs</td> </tr> <tr> <td></td> <td>Sterile water qsad</td> <td style="text-align: right;">2400 ml</td> </tr> <tr> <td></td> <td>M ft SA isotonic solution</td> <td></td> </tr> <tr> <td></td> <td>Infuse 2400 ml over 24 hours</td> <td></td> </tr> </table>			R_x	Dextrose.H ₂ O	qs		Sterile water qsad	2400 ml		M ft SA isotonic solution			Infuse 2400 ml over 24 hours	
R_x	Dextrose.H ₂ O	qs												
	Sterile water qsad	2400 ml												
	M ft SA isotonic solution													
	Infuse 2400 ml over 24 hours													

- a. What is the freezing point depression of a 1% w/v dextrose.H₂O solution?

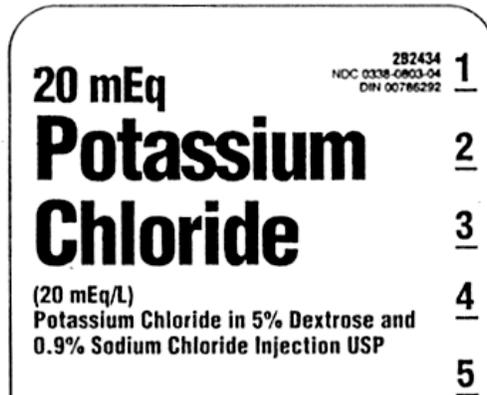
- b. Calculate is the concentration of dextrose.H₂O in the preparation using the freezing point depression method.

- c. From the table, what is the sodium chloride equivalent of dextrose.H₂O?

- d. Using the sodium chloride equivalent method, what is the concentration of dextrose.H₂O in the preparation?

- e. Calculate the concentration of dextrose.H₂O in the preparation in **percent strength (%w/v)** using the osmolarity method?

Problem 34



Use the label fragment to answer the questions as needed.

a. Is this solution isotonic, hypotonic or hypertonic? Explain why?

b. What is the contribution of sodium chloride to the freezing point depression of the preparation?

c. What is the contribution of dextrose to the freezing point depression of the preparation? For simplicity, assume that the 5% dextrose is 5% w/v dextrose.H₂O.

d. What is the concentration of potassium chloride in percent strength?

e. What is the freezing point depression of the preparation?

Problem 35

Phone 716-555-1234		DEA# AT -12736280			
Dr. Miles Furlong, M.D.					
Name	Angstrom Lightyear	Age	25 yr	Height	5 ft 3 in
Address	8 Infinity, Beyond, ON	Date	8/18/02	Weight	100 kg
Rx Sodium chloride 3% w/v Infuse for 1 hour at 100 ml/hr					
<u>Miles Furlong, MD</u>					

a. Is this solution isotonic, hypertonic or hyptonic, why?

b. Will red cells lyse or shrink in this solution? Which direction will the net flow of water occur: from red cells to solution or from solution into red cells?

c. What is freezing point depression of this solution?

d. What is the molar concentration of sodium chloride?

e. What is the osmolarity of the solution?

f. What is the dose of sodium chloride?

Problem 36

Phone 716-555-1234		DEA# BB -12736280			
Dr. Rapunzel Bleubead, M.D.					
Name	Jack Beanstalk	Age	13 yr	Height	5 ft 3 in
Address	8 Cendrillon, Cenerentola, ON	Date	8/18/02	Weight	40 kg
Rx Sodium bicarbonate qs Sterile water for injection qs ad 500 ml M ft sa isotonic sol. Infuse 2 mEq/kg iv over 4 hours <div style="text-align: right;">R. Bleubead, MD</div>					

Sodium bicarbonate ($Na^+(HCO_3)^-$) is used to correct metabolic acidosis.

a. Calculate the dose of sodium bicarbonate in milliequivalents and the dose in grams.

b. What is the sodium chloride equivalent of sodium bicarbonate?

c. Calculate the concentration of sodium bicarbonate in the infusion fluid. Use the sodium chloride equivalent method.

d. What is the freezing point depression of a 1% w/v sodium bicarbonate solution?

e. Calculate the concentration of sodium bicarbonate in the infusion fluid. Use the freezing point depression method.

Problem 37

Phone 555-3784		DEA# BS0365420			
Sid Phillips 12 Bopeep St. Bullseye, TX 90210					
Name	<u>Andy Davis</u>	Age	<u>23</u>	Wt	<u>80 kg</u>
Address	<u>144 Woody St, Bullseye, TX 90210</u>	Date	<u>1/10/95</u>	Height	<u>5 ft 10 in</u>
R Benzocaine Antipyrine Purified water qsad		1.4% 5.4 % 25 ml			
Sig: 4 gtt au q2h					
Refill	<u>Sid Phillips M.D.</u>				

Benzocaine has a molecular weight of 165.19. Its $\Delta T_f^{1\%}$ is 0.12 and its SCE value is 0.20.

a. What instructions would you give the patient?

b. Calculate the **contribution** of **benzocaine** to the freezing point of the preparation.

c. Calculate the **contribution** of **antipyrine** to the freezing point of the preparation.

d. Calculate the **freezing point depression** of the **preparation**? What is the freezing point of the preparation?

e. Is the solution hypotonic, hypertonic or isotonic? If red cells were to be placed in this solution, would the cells shrink, swell or remain the same?

Problem 38

Phone 555-3784		DEA# BS0365420			
Tempest Hawker, MD 12 Wildcat St. Banshee, WY 60210					
Name	Douglas Skyray	Age	23	Wt	80 kg
Address	144 McDonnell St, Delta Dagger, MS	Date	1/10/95	Ht	5 ft 10 in
R_x Pilocarpine nitrate Epinephrine bitartrate Purified water qsad		4% w/v			
		1:100 w/v			
Sig: 2 gtt ou q6h for glaucoma		25 ml			
Refill	<u>T Hawker, M.D.</u>				

- a. What instructions would you give the patient?

- b. Calculate the **contribution** of **pilocarpine nitrate** to the freezing point of the preparation.

- c. Calculate the **concentration** of **epinephrine bitartrate** in percent strength.

- d. Calculate the **contribution** of **epinephrine bitartrate** to the freezing point of the preparation.

- e. Calculate the **freezing point depression** of the **preparation**? What is the freezing point of the preparation? Is the solution hypotonic, hypertonic or isotonic?

Problem 39

Phone 716-555-1234		DEA# BM -12736280			
Dr. Timon Meerkat, M.D.					
Name	Poomba Warthog	Age	18 yr	Height	5'4" ft
Address	8 Peccary Street, Pride Rock	Date	8/18/02	Weight	125 lb
Rx Calcium chloride, 2H ₂ O 10% w/v Infuse 7 mEq IV very slowly over 10 minutes					

Calcium chloride dihydrate ($CaCl_2 \cdot 2H_2O$) is used for treating cardiac emergencies, magnesium intoxication, hyperkalemia and during blood transfusions.

a. Calcium chloride dihydrate is a 3-ion generating electrolyte. What is the *i-factor* for calcium chloride?

b. Calculate the osmolarity of the 10% w/v calcium chloride dihydrate solution.

c. What is the **freezing point** of a **1% solution** of calcium chloride dihydrate? What is the **freezing point depression** of the **10% w/v solution** of calcium chloride dihydrate solution prescribed?

d. What **concentration** of **sodium chloride** would have the same osmotic pressure as a **1% solution** of calcium chloride dihydrate?

e. What is the sodium chloride equivalent of the 10% w/v calcium chloride dihydrate solution. Express your answer as a **concentration** of sodium chloride.

Problem 40

Phone 555-3784	Dr. Dama Caballero			DEA# BC0365420	
21 Cisterna St.					
Cadena, AZ 90210					
Name	<u>Chico Novia</u>	Age	<u>23</u>	Wt	<u>80 kg</u>
Address	<u>441 Abrazar St, Cadena, AZ 90210</u>	Date	<u>1/10/95</u>	Height	<u>5 ft 10 in</u>
<div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 10px;">R_x</div> <div> <p>Sulfacetamide sodium solution 150 mg/ml</p> <p>Administer 2 gtt ou q6h for glaucoma</p> </div> </div>					
Refill					

- a. What is the freezing point depression of the sulfacetamide sodium solution?

- b. Is the sulfacetamide sodium solution isotonic, hypertonic or hypotonic? Also, if red blood cells were to be placed in this solution, will the cells shrink, stay unchanged or swell?

- c. Calculate the concentration of sulfacetamide sodium in **millimoles/ml**.

- d. Sulfacetamide sodium is a 2-ion electrolyte. What is its *i*-factor?

- e. What is the freezing point of the preparation?

- f. Is the solution hypotonic, hypertonic or isotonic?

Problem 41

Phone 716-555-1234		DEA# AT -12736280			
Dr. Tom Ahawk, M.D.					
Name	Apache Falcon	Age	18 yr	Height	5'4"
Address	8 Sidewinder Street, Hornet, TN	Date	8/18/02	Weight	125 lb
Rx	Sodium acid phosphate monohydrate (NaH ₂ PO ₄ H ₂ O)				0.46 % w/v
	Sodium phosphate anhydrous 0.46% w/v				
	Sodium chloride qs				
	Sterile water qsad 100 ml				
	M ft SA isotonic solution				
<u>T. Ahawk, MD</u>					

- a. Calculate the concentration of sodium chloride that would exert the same osmotic pressure as the **sodium acid phosphate monohydrate** concentration in the preparation? Calculate the concentration of sodium chloride that would exert the same osmotic pressure as the **sodium phosphate anhydrous** concentration in the preparation?

- c. What is the concentration of the sodium chloride added to make the solution isotonic?

- d. A pharmacy technician weighs each of the three ingredients correctly but inadvertently makes the final volume up to 50 ml with sterile water (instead of the 100 ml prescribed). Calculate the freezing point depression of the resultant solution?

- e. The pharmacy technician who made the error in part (d) above was fired and the pharmacist began testing a candidate who applied for the position. This candidate was given the same task. However, this candidate did all the calculations correctly. However, the candidate forgot to add the sodium chloride. All other steps were correctly done. Calculate the freezing point depression of the resulting preparation.

Problem 42

Phone 403-555-1234		DEA# BS0365420	
Dr. Skipper Walleye, M.D.			
Name	Desna Jayhawk	Age	23 yr
Height		Weight	5 ft 10 in
Address	8 Petrel Street, Condor, AZ	Date	1/11/03
Rx Calcium chloride·2H ₂ O		10% w/v	
Infuse 7 mEq IV very slowly over 10 minutes			
<u>S. Walleye, MD</u>			

a. Calcium chloride dihydrate is a 3-ion electrolyte. What is the probable *i*-factor for calcium chloride?

b. Given the *i*-factor value for calcium chloride from Part a, what percentage of calcium chloride is dissociated in this solution?

c. Calculate the molarity of this 10% w/v calcium chloride dihydrate solution.

d. Calculate the osmolarity of the 10% w/v calcium chloride dihydrate solution

e. What is the **freezing point**, in °C, of the calcium chloride dihydrate solution prescribed?

f. What **concentration** of **sodium chloride, in % w/v**, would have the same osmotic pressure as the prescribed of calcium chloride dihydrate solution? Use the sodium chloride equivalent method.

Problem 43

Phone 403-555-1234		DEA# AI12736280			
Dr. Tosa Inu, M.D. St. Bernard Ave, Labrador					
Name	Shih Tzu	Age	52 yr	Height	6 ft 2 in
Address	8 Beagle Ct, Labrador, CA	Date	1/11/03	Weight	100 kg
Rx Pilocarpine nitrate		2% w/v			
Epinephrine bitartrate		1:200 w/v			
Sodium chloride		qs			
Purified water qs ad		50 mL			
Make isotonic solution					
Sig: 2 gtt ou q6h for glaucoma					

a. Calculate the freezing point depression contributed by pilocarpine nitrate to this preparation.

b. Calculate the concentration of epinephrine bitartrate in percentage strength. Calculate the freezing point depression **contributed by epinephrine bitartrate** to this preparation.

c. Calculate the **freezing point depression** of a preparation containing **only** pilocarpine nitrate and epinephrine bitartrate at the respective prescribed concentrations.

d. What concentration (% w/v) of sodium chloride in the preparation would make the preparation isotonic? Use the freezing point depression method.

e. You find that you have a 0.9% w/v sodium chloride solution. How many mL of this solution should be used for compounding this preparation?

Problem 44

Phone 609-393-8086		Dr. Florence Napoli, M.D. 64 Siciliano St, Trenton		DEA# AI12736280	
Name	Venezia Milanese	Age	52 yr	Height	6 ft 2 in
Address	8 Genovese Ct, Trenton, NJ	Date	1/11/03	Weight	100 kg
\mathcal{R} Phenacaine hydrochloride 1% Chlorobutanol 0.5% Boric acid q.s. Purified water, ad 50 mL Make isoton. sol. Sig. one drop in each eye.					

a. Calculate the sodium chloride equivalent concentration (in percent strength) contributed by the phenacaine hydrochloride and the chlorobutanol in the preparation?

b. Calculate is the sodium chloride equivalent concentration contribution (in percent strength) required from boric acid to make this preparation isotonic?

c. Calculate the concentration of boric acid in the isotonic preparation. Use the sodium chloride equivalent method.

d. Calculate the amount of boric acid needed for compounding this preparation.

e. During the Board Exam, a student did all the calculations for the preparation right. However, the student inadvertently made up the final volume to 100 ml. What is the freezing point depression of the solution?

Problem 45

Phone 609-393-8086	Dr. Domingo Cerrado		DEA# BC12736280		
11 Miercoles St, Sustantivos, NM					
Name	Salida Abierto	Age	23 yr	Height	5 ft 10 in
Address	121 Entrada Ct, Sustantivos, NM	Date	11/1/06	Weight	80 kg
\mathcal{R} Sulfacetamide sodium 15% w/v Mft 50 ml sol 2 gtt ou q3h					

a. Sulfacetamide sodium is a 2-ion electrolyte. What is the probable *i*-factor for sulfacetamide sodium?

b. What is freezing point depression of a 1% w/v solution of sulfacetamide sodium?

c. What is the freezing point depression of the 15% w/v sulfacetamide sodium solution?

d. What is the freezing point of the 15% w/v sulfacetamide sodium solution?

e. What is the molarity of the sulfacetamide sodium solution?

f. What is the osmolarity of the sulfacetamide sodium solution?

Problem 46

Phone 609-393-8086		Dr. Barbera Bordeaux 11 Zinfandel St, Pinotage		DEA# BB12736280	
Name	Shiraz Chianti	Age	52 yr	Height	6 ft 2 in
Address	121 Merlot St, Pinotage, ND	Date	11/1/06	Weight	90 kg
<p>R 15% w/v sulfacetamide sodium qs</p> <p>Purified water qs ad 50 mL</p> <p>Make isotonic solution</p> <p>Sig: 2 gtt ou q6h for glaucoma</p>					

a. Calculate the concentration of sulfacetamide sodium in the isotonic solution of sulfacetamide sodium. Use the freezing point depression. Express your answer in % w/v.

b. Sulfacetamide sodium is a 2-ion electrolyte. Calculate the concentration of sulfacetamide sodium in the isotonic solution of sulfacetamide sodium using the osmolarity method. Express your concentration in millimoles/ml.

c. Express the concentration of sulfacetamide sodium in the isotonic solution in % w/v.

d. Using the sodium chloride equivalent method, calculate the concentration of sulfacetamide sodium in the isotonic solution of sulfacetamide sodium.

e. How many mL of the 15% solution of sulfacetamide sodium should be used for compounding this preparation? Use your answer from part (e) above.

CHAPTER 12
GRAPH INTERPRETATION

CHAPTER 12
GRAPH INTERPRETATION

NOTES

Outline

- Definitions of exponential and logarithm functions.
- Operations and behaviors of the functions
- Linear and semi-logarithmic graphs
- Slopes, intercepts, interpretation

Important Mathematical Functions in Pharmacy

- The **exponential function** is widely used in pharmacokinetics, in characterizing bacterial growth and in describing drug stability.
- The **logarithmic function** is the inverse of the exponential function. It is used in physical pharmacy because pH and pK_a are logarithmic in nature. Some pharmacological dose-response curves are also logarithmic in nature.
- The **hyperbolic function** is widely used to describe the relationships between drug concentration and drug receptor occupancy. The familiar Michaelis-Menten equation used for describing enzyme kinetics and dose-responses is hyperbolic in nature. The hyperbolic function will not be covered in this workbook.

General Approaches To Understanding Functions

- Plot the function on graph paper and watch how it changes when the value of x is changed.
- Determine its value at $x = 0$.
- Determine its value at $x = \infty$. Even though the value $x = \infty$ is physically unattainable, such an analysis often provides insight into how the function will behave at large values of x .
- Determine its rate of change at $x = 0$. Is the plot initially steep? When does it "slow" down?
- Determine its rate of change at $x = \infty$. Does the plot reach an asymptote?
- Determine the maximum and minimum values of the function.
- What operations are legal? Which operations are illegal? Which operations seem legal but really are not?
- Why is this function useful? What characteristics make it useful for describing the physical processes for which it is used?

The Exponential Function

- In general terms, the exponential function can be expressed in the form $y = a^x$. The number a is called the **base** and the number x is called the **exponent** or **index**.
- The natural base e and 10 are the most frequently encountered bases. The base 2 is frequently used in the area of computers and information processing.
- The natural base e has a numerical value of 2.718.
- Some general rules:

$a^1 = a$	$a^2 = a \times a$	$a^n = a \times a \times a \dots n \text{ times}$
$(1/a) = a^{-1}$	$a^{1/2} = \sqrt{a}$	$a^0 = 1$
$a^n \times a^m = a^{n+m}$	$(a^n)/(a^m) = a^{n-m}$	$(ab)^m = (a^m b^m)$
$(a/b)^m = (a^m/b^m)$	$(a^n)^m = a^{nm}$	

The Exponential to Base e

- The exponential function to the natural base e is a special case of the general exponential form $y = a^x$. For convenience we will write it in the form $C = C_0 e^{kt}$, where C is the concentration, C_0 is the concentration at time $t = 0$. This form of function is frequently used for expressing time-dependence of drug concentrations.

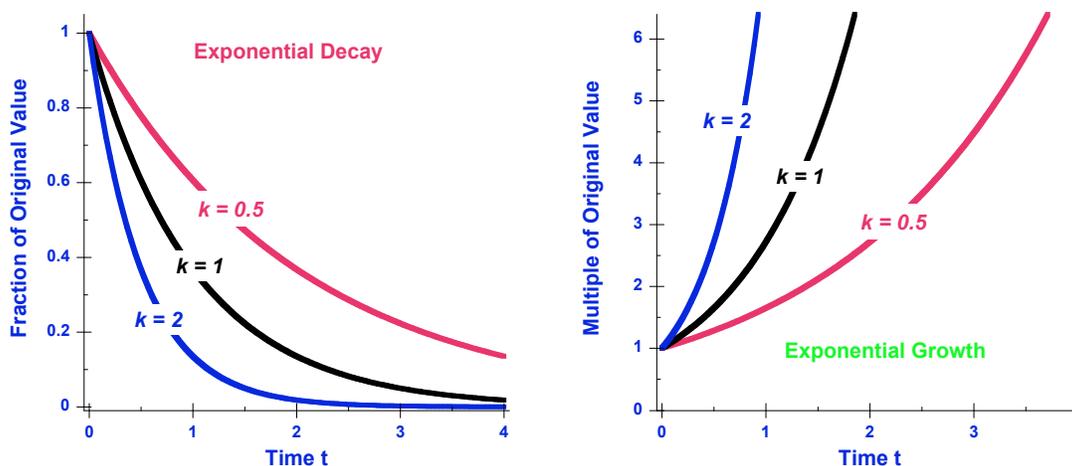


Figure 13.1. Graphs of exponential decay (on left) and exponential growth (on right) illustrating the time dependence of the processes on rate constant. Exponential processes with large values of rate constant decay or grow faster.

- When k is positive, a function of the form $C = C_0 e^{kt}$, increases monotonically and represents exponential growth (Figure 13.1). Exponential growth describes the growth of many bacteria, cell cultures and tumors.
- An exponential function with negative exponent of the form: $C = C_0 e^{-kt}$ decreases monotonically and represents exponential decay (Figure 1). Exponential decay describes the drug stability and the pharmacokinetics of many drugs when administered intravenously.
- The k is called the rate constant. It has units of time^{-1} . The reciprocal of the rate constant is called the time constant τ .

$$\tau = \frac{1}{k}$$

- The *half-life* $T_{1/2}$ is the time interval over which the exponential decay process reaches one-half of its original value.

$$T_{1/2} = \frac{\ln 2}{k}$$

- Likewise, doubling time is the time interval over which the exponential growth process achieves twice its original value.

$$T_2 = \frac{\ln 2}{k}$$

- The rate constant and the time constant can be easily obtained from the half-life (or doubling time) of an exponential process.
- As illustrated in Figure 1, the rate constant (and the time constant) define the time scale over which the most salient changes in the exponential process occur. Exponential decay processes with large values of rate constant decay sooner than exponential processes with small values of time constant.

The Logarithmic Function

- The logarithm of a number to a given base is the power (or exponent) to which the base must be raised to yield the number. In $y = a^x$, x is the logarithm of y to the base a . Formally, this is written as $x = \log_a y$.

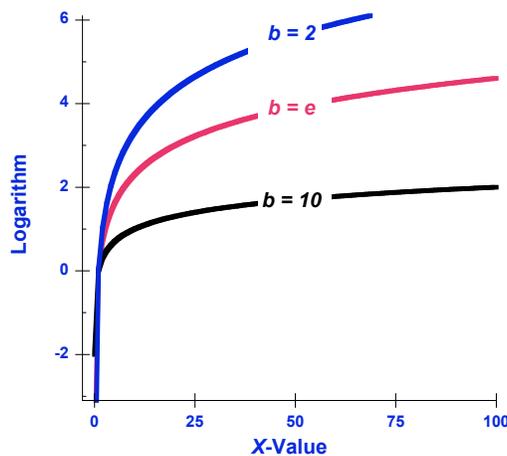


Figure 13.2. Graph of the logarithmic function to base 2, base e and base 10. Note that the logarithm to each base are proportional to each other.

- If the base is not specified, it is usually assumed to be 10. Logarithms to the base ten are called common logarithms. In calculus, if the base is not specified, it may refer to the logarithm to the natural base.
- The logarithm of a number to a the natural base e is often written as $\ln y$. Thus:

$$x = \log_e y = \ln y$$

- The logarithm function for different bases is plotted in Figure 13.2. The logarithms to each base are related to each other via a proportionality constant. For example:

$$\ln y = (\log_{10} y) / (\log_{10} e) = 2.303 (\log_{10} y)$$

- Some general rules:

$\log_b 1 = 0$	$\log_b (xy) = \log_b x + \log_b y$	$\log_b (x/y) = \log_b x - \log_b y$
$\log_b x^n = n \log_b x$	$\log_b x = \log_a x / \log_a b$	$\log_b x = \log_b a \log_a x$

GRAPHING

- Remember the goal of all graphing is to obtain information and to communicate data.
- Most graphing is now conducted in computer programs. Familiarize yourself with a graphing program and its features. Learn how obtain effective graphs with these programs and to fit regression lines and obtain equations.
- The goal of the graphing exercises in this Workbook is to improve your ability to interpret graphs more effectively. Do not use a computer program for these exercises.

Linear graphs – Dos and Don'ts

- I am assuming that you are fairly familiar with linear graphs.
- The equation for a linear graph is of the general form: $y = mx + c$
- The constant m is the slope, and the constant c is the intercept.
- Select the horizontal axis for the independent variable and the y -axis for the dependent variable
- Always label axes with both the variables and the units.
- Choose ticks marks that are reasonable and if possible round numbers to avoid errors and to speed calculations.
- Do not leave huge empty spaces. Adjust the range of the axes so that the graph occupies almost all the graph paper.
- All the data points should be visible. Use a distinct circle, square or other symbol to identify data points.
- Slope and equation should be calculated from the line, not the data points. Slopes calculated from points that are far apart are more accurate from points that are closely spaced.

Semi-Log Graphing

- Used to plot exponential functions. The x -axis has a linear scale whereas the y -axis is marked according to a logarithmic scale
- Any function of the form $y = Ac^{bx}$ yields a straight line on semi-log graph paper. The numbers A , b and c are constants.
- The basis for the linearity is shown below by taking logarithms on both sides:

$$\log y = \log A + (k \log c)x$$

- Semi log graph paper has a logarithmic scale on one axis and a linear scale on the other.

- Since the y-axis is a log axis, this equation is of the form that represents a straight line ($y = mx + c$)
- The constant A, can be calculated from the intercept, and the rate constant k , can be calculated from the slope (which equals $k \log c$).
- Unlike linear graphs, you cannot arbitrarily assign values to a y-axis. You should learn how to label the axes. The labels change by an order of magnitude in each cycle, e.g., if the first cycle is labeled 1, 2, 3,..., 9, the next cycle is labeled 10, 20, 30,...90.
- The slope of the graph is determine using the formula:

$$Slope = \frac{\log y_2 - \log y_1}{x_2 - x_1}$$

PROBLEMS

Problem 1

- a. Simplify the following expression containing exponents. Do not provide the numerical value of the expression.

$$\frac{10^2 \times e^7}{10^{-7} \times e^{-2}}$$

- b. What is the value of $\log_2 1$?

- c. What is the value of $\log_{10} 0$?

- d. What are maximum and minimum values of the function $y = e^{-x}$ for values of x greater than or equal to zero? Is y ever negative?

Problem 2

a. Simplify the expression: $\log_{10}(100x^7y^7)$.

b. Express $\log((a^m)^n)$ in terms of m , n , $\log a$.

c. Express the value of $\log((xy)^{1/z})$ in terms of x , y , and z and their logarithms?

d. What is the value of $\log 10^{-xy}$?

Problem 3

a. Will the equation $y = 15x + 3.14$ result in a straight line on semi-log graph paper?

b. Will the equation $y = 15x^4$ result in a straight line on semi-log graph paper?

c. Will the equation $y = 15e^{22x}$ result in a straight line on semi-log graph paper?

d. Will the equation $y = 15e^{-\pi x}$ result in a straight line on semi-log graph paper?

e. Will the equation $y = 152^{22x}$ result in a straight line on semi-log graph paper?

f. Will the equation $y = (15e^{-\pi x})^3$ result in a straight line on semi-log graph paper?

g. Will the equation $y = 15^x e^{-\pi x}$ result in a straight line on semi-log graph paper?

Problem 4

- a. A pharmacist in a drug company is studying the effects of two drugs, Abracadabramycin and Gobledygookmycin, on tumor growth. Tumor size (as a percent of initial tumor size) in the presence of these drugs was measured as function of time (in days). The relationships obtained after a systematic experimental study were well summarized by the following exponential equations:

$$\text{Abracadabramycin} \quad \% \text{Size} = 100e^{-0.1t}$$

$$\text{Gobledygookmycin} \quad \% \text{Size} = 100e^{0.05t}$$

Which of these two drugs inhibits tumor growth? Why?

- b. A medicinal chemist has synthesized two previously unknown antibiotics, gibberishcillin and baloneycillin, which decay in aqueous solution according to the following exponential equations. Identify the drug that decays more rapidly.

$$\text{Gibberishcillin} \quad \% \text{ Remaining Intact} = 100e^{-0.03t}$$

$$\text{Baloneycillin} \quad \% \text{ Remaining Intact} = 100e^{-0.1t}$$

Identify the drug that decays more rapidly.

Problem 5

Ampicillin, like many other antibiotics, is unstable in aqueous solutions. The fraction of intact ampicillin remaining after t days of incubation can be described by the following exponential equation:

$$\text{Fraction remaining intact} = e^{-0.02t}$$

a. What are the units of the rate constant?

b. What is the value of the rate constant?

c. What is the value of the time constant?

d. The shelf life of a drug is frequently determined by calculating the time required for 10% of the drug to decay (i.e. only 90% of the drug remains intact). Determine the shelf life of the ampicillin solution.

Problem 6

For many drugs, the serum drug concentration (C) as a function of time (t) during an intravenous infusion can be expressed by the following equation:

$$C = C_{ss}(1 - e^{-kt})$$

In the above equation, C_{ss} is a constant and k is a rate constant.

- a. According to the equation, what is the serum concentration after a relatively “long time”, i.e., $t = \infty$.

- b. According to the equation, what is the initial serum concentration?

- c. At what value of kt will the serum concentration, C, reach 99% of C_{ss} .

Problem 7

The degradation of the antibiotic, amoxicillin, in solutions is described by the following equation:

$$f\% = 100e^{-0.03466t}$$

In the equation, $f\%$ is the percent of drug remaining intact and t is time in hours.

a. Identify the rate constant for amoxicillin degradation. Clearly indicate the units.

b. Calculate the time constant.

c. How long does it take for 50% of the initial drug to degrade?

d. How long does it take for 90% of the initial drug to degrade?

e. How much time does it take for degradation to proceed from 50% to 75% completion?

Problem 8

Two patients Alfred and Cathy were administered the same dose of warfarin, an anti-coagulant drug and the drug concentrations in plasma were measured as a function of time were found to be described by the following exponential equations. The time t , in the equation is in hours and concentrations, C , are in $\mu\text{g/ml}$.

Alfred	$C = 1.4e^{-0.02t}$
Cathy	$C = 2.1e^{-0.01t}$

a. Which patient has the higher initial concentration of warfarin?

b. In which patient does the drug have a **shorter half-life**?

c. What is Cathy's rate constant for warfarin? Be sure to indicate units.

d. What is the half-life of the drug in Cathy's plasma?

Problem 9

The pharmacokinetics of two triazolobenzodiazepines, triazolam and alprazolam, in humans are described by the following equations:

Triazolam $C = 5e^{-0.231t}$

Alprazolam $C = 50e^{-0.0462t}$

In these equations, C is the concentration of the drug in ng/ml and t is time in hours.

a. Which drug has **higher** initial concentration? Explain your answer.

b. Which drug is **more rapidly** degraded in humans? **Explain your answer.**

c. Which drug has the **longer** half-life? Explain your answer.

d. What are the units of the number 50 in the equation for alprazolam $C = 50e^{-0.0462t}$.

e. What are the units of the number 0.0462 in the equation for alprazolam $C = 50e^{-0.0462t}$.

Problem 10

An oncologist has 3 patients, Patient A, Patient B, and Patient C. She is monitoring the progress of their brain tumors using magnetic resonance imaging (MRI), which allows the volume of the tumors to be measured. She analyzes the volumes of the tumor as a function of time (t) and identifies the following relationship:

Patient A Tumor volume $V_A = 2500 e^{0.05t}$

Patient B Tumor volume $V_B = 1200 e^{0.1t}$

Patient C Tumor volume $V_C = 3600 e^{-0.005t}$

a. Which tumor is growing at the **fastest rate**?

b. Which patient currently has the largest tumor?

c. Whose tumor is most likely to decrease with time?

Problem 11

A scientist is comparing three antibiotics. He sets up an experiment to test their efficacy by monitoring their effect on the growth of *Streptococcus pneumoniae*, the bacterium that causes pneumonia. In the presence of the same concentration of the three drugs, the bacterial count (N) follows the following relationships

Anathemamycin $N_A = 1 \times 10^8 e^{-2t}$

Bugkillamycin $N_B = 1 \times 10^8 e^{-5t}$

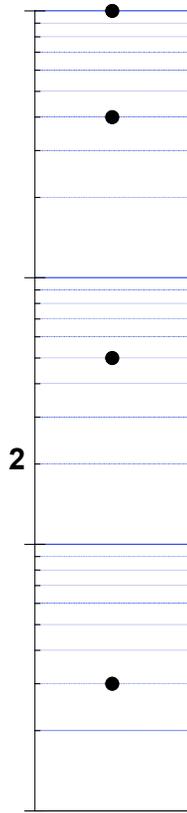
Clinicamycin $N_C = 1 \times 10^8 e^{-0.0005t}$

- a. Consider only Anathemamycin and Bugkillamycin. Which is the more effective antibiotic.

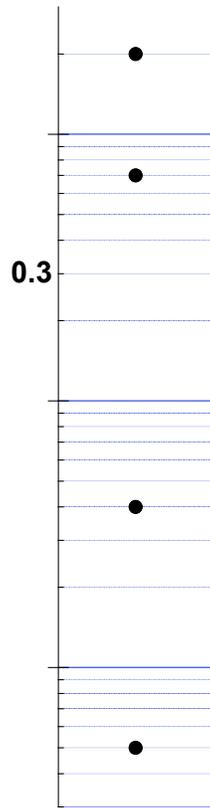
- b. Which antibiotic is best described as a bacteriostatic, i.e., it prevents the multiplication of bacteria but does not kill bacteria?

Problem 12

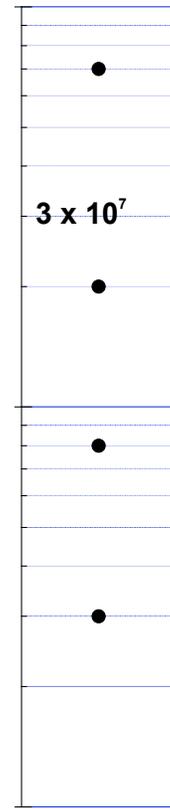
The following Figures contain the Y-axes of semi-logarithmic graphs with a single labeled tick. Use the information to label the ticks marked with the filled circles.



Axis 1

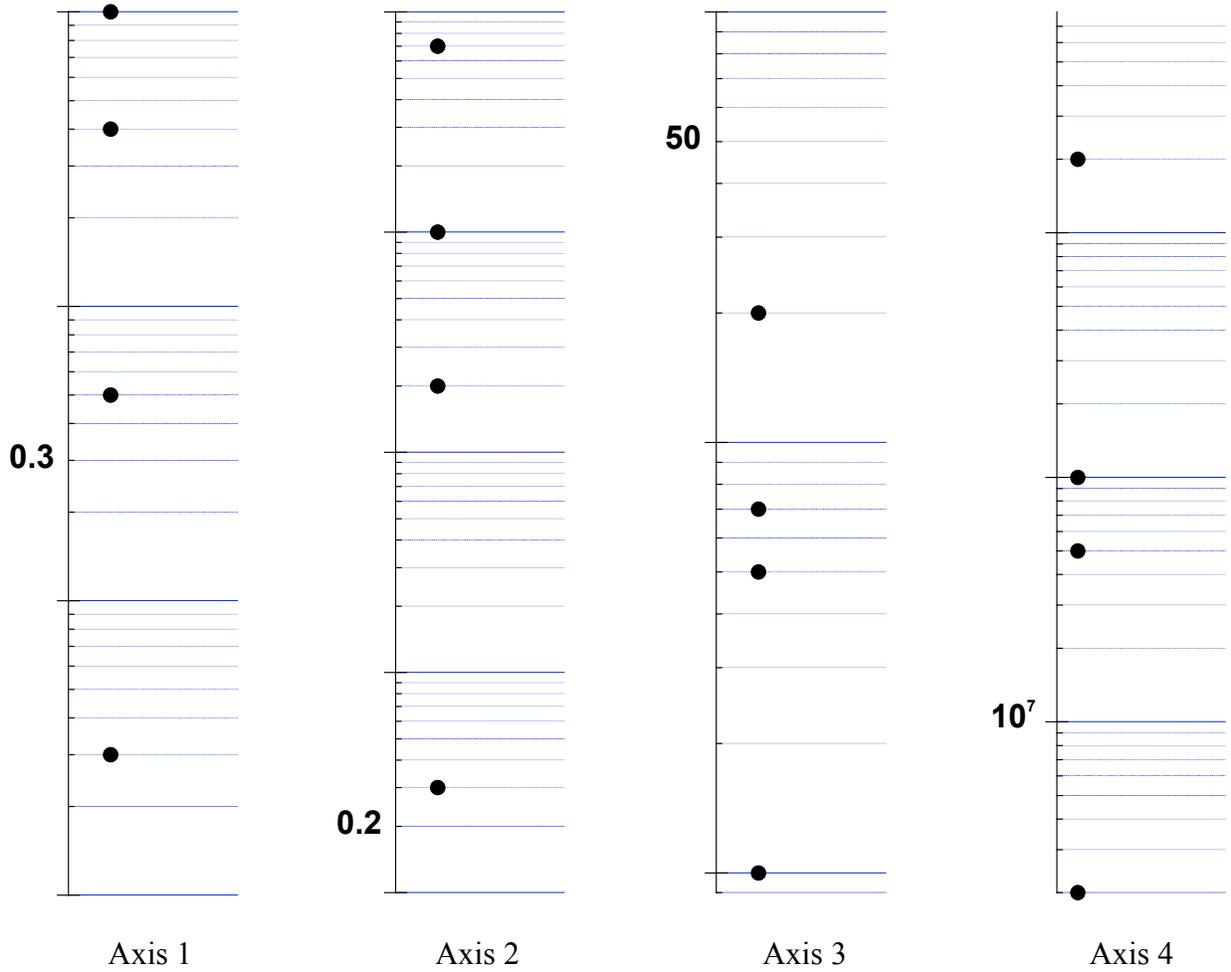


Axis 2



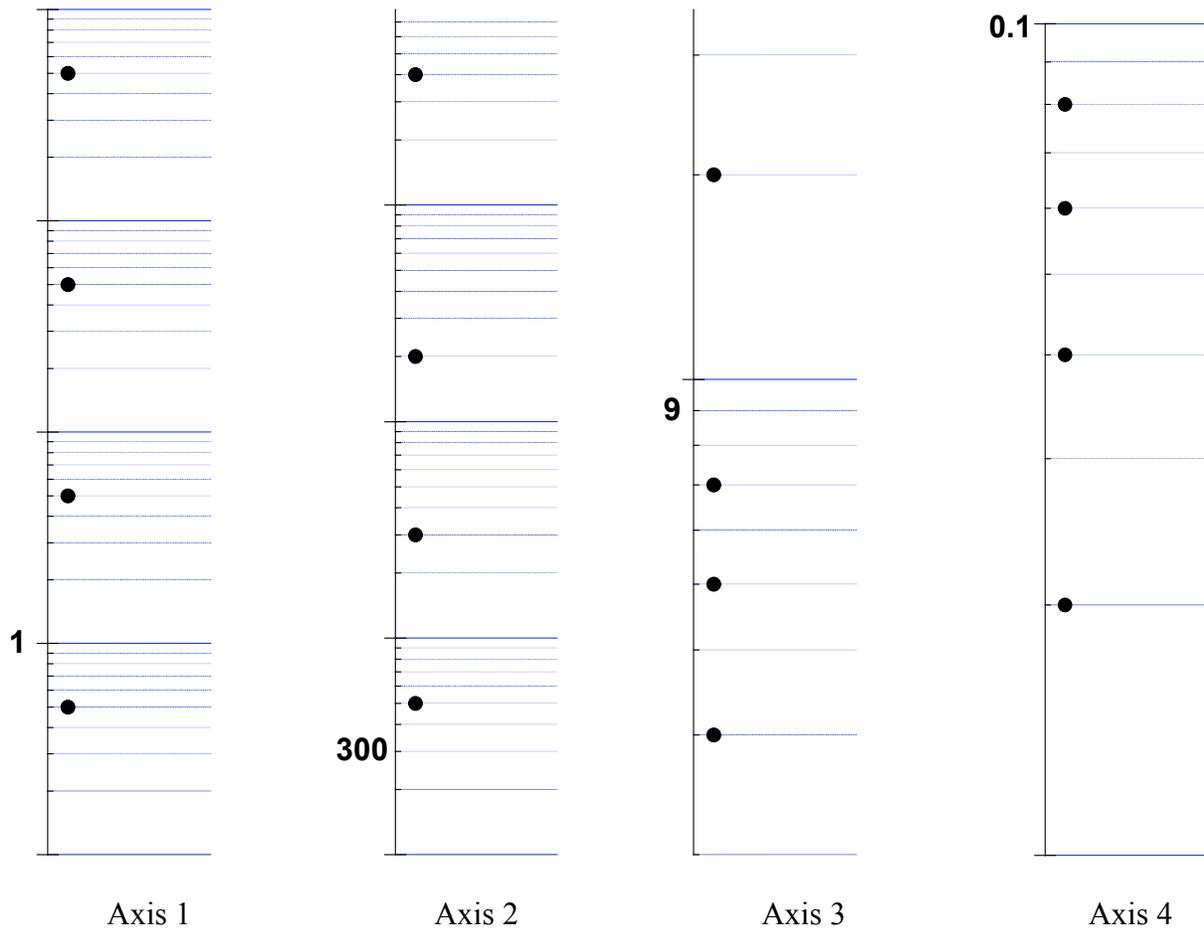
Axis 3

Problem 13



Label the logarithmic *y*-axis of Axes 1, 2, 3 and 4 at the points marked with the filled circles. Use the one tick that is labeled as a reference. Mark your answers directly on the figures.

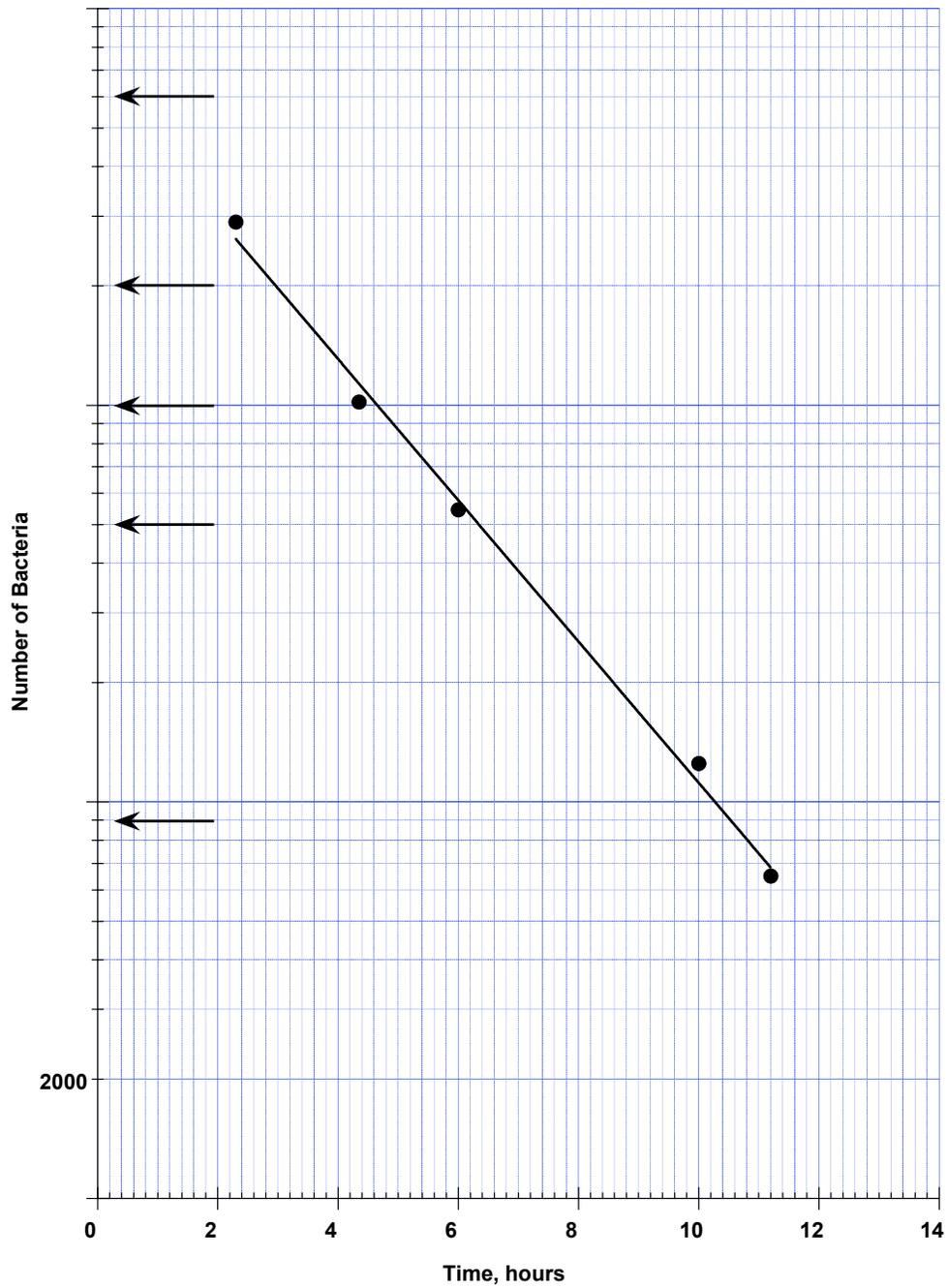
Problem 14



Label the logarithmic y-axis of Axes 1, 2, 3 and 4 at the points marked with the filled circles. Use the one tick that is labeled as a reference. Mark your answers directly on the figures.

Problem 15

The following shows the effect of an antibiotic on bacteria growth. It plots the number of bacteria as a function of time on semi-log graph paper.



- a. Label the five tick marks indicated by the arrows. One tick is labeled as reference.

b. Calculate the slope of the line. Be sure to show your work.

c. Calculate the intercept.

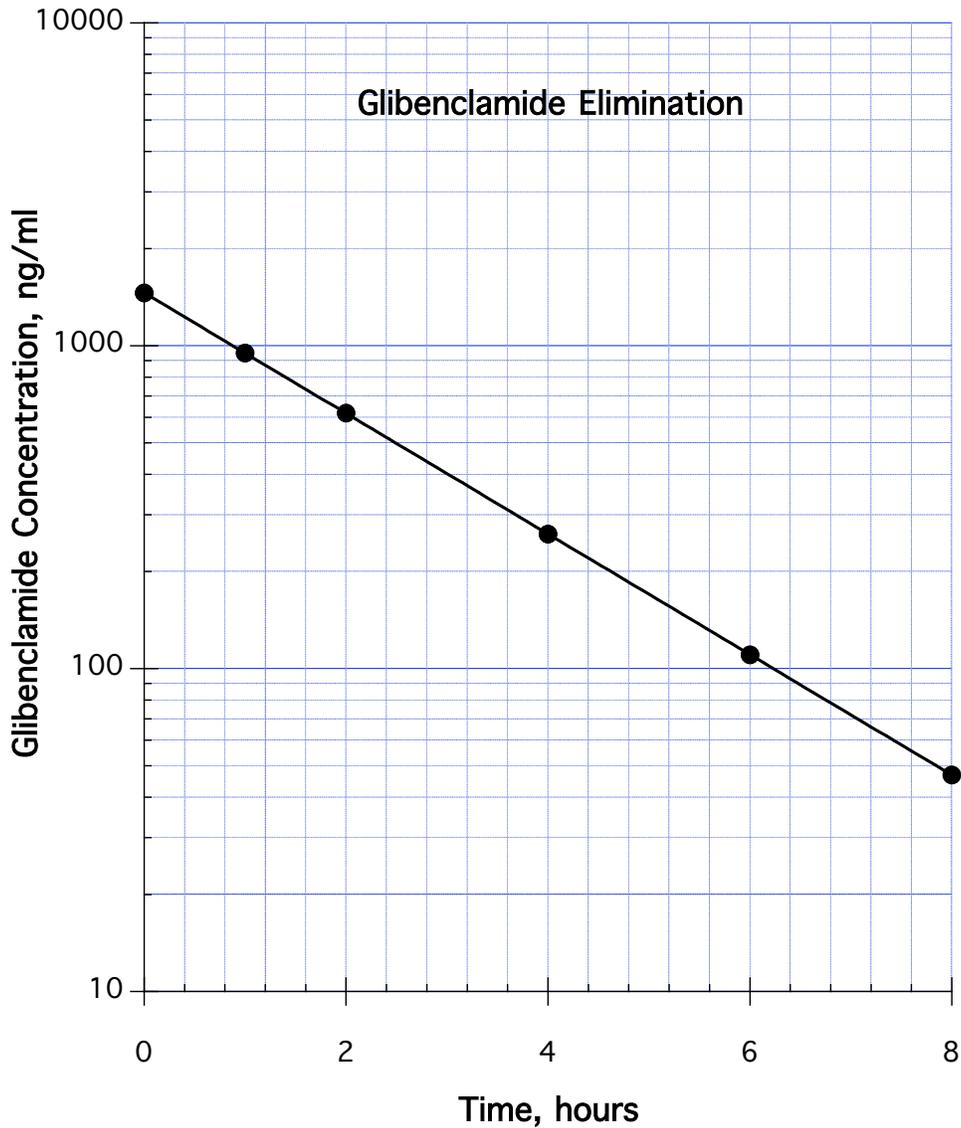
d. Calculate the rate constant

e. How many bacteria are present initially?

f. Write out the exponential relationship that describes the number of bacteria in the presence of the antibiotic.

Problem 16

Glibenclamide is a poorly soluble, oral hypoglycemic drug that is used for patients with non-insulin dependent diabetes. Savolainen et al. (*Pharmaceutical Research*, 15, 11, 1998, 1696) studied the pharmacokinetics of intravenously administered glibenclamide prior to comparing various dosage forms. The following graph describes the kinetics of glibenclamide elimination.



a. Calculate the slope of the graph.

b. What are units of the slope?

c. Calculate the rate constant from the graph.

d. What is the concentration of drug at time $t = 0$?

e. State the equation that describes the elimination of glibenclamide.

f. From the graph, determine the half-life of glibenclamide elimination.

Problem 17

As many of you are aware, computers and microprocessors have revolutionized healthcare and pharmacy. Some the changes can be attributed to the rapid increase in the speeds of microprocessors and a statement informally called Moore’s law, which states:

“the number of transistors on a chip will double every two years”

Gordon Moore, the Chairman of Intel Corp., made this prediction in 1975 and it has proven uncannily prophetic. In fact, if Moore’s law applied to automobiles, a car would cost less than a dollar today!

Given: a Pentium II chip had 7.5×10^6 transistors in 1997.

a. Fill in the following Table using Moore’s law

Year	Number of Transistors/chip
1997	7.5×10^6
1995	
1993	
1989	

b. Plot Moore’s law for the period on semi-logarithmic graph paper for the period 1980 to 2000. Use at least 4 points.

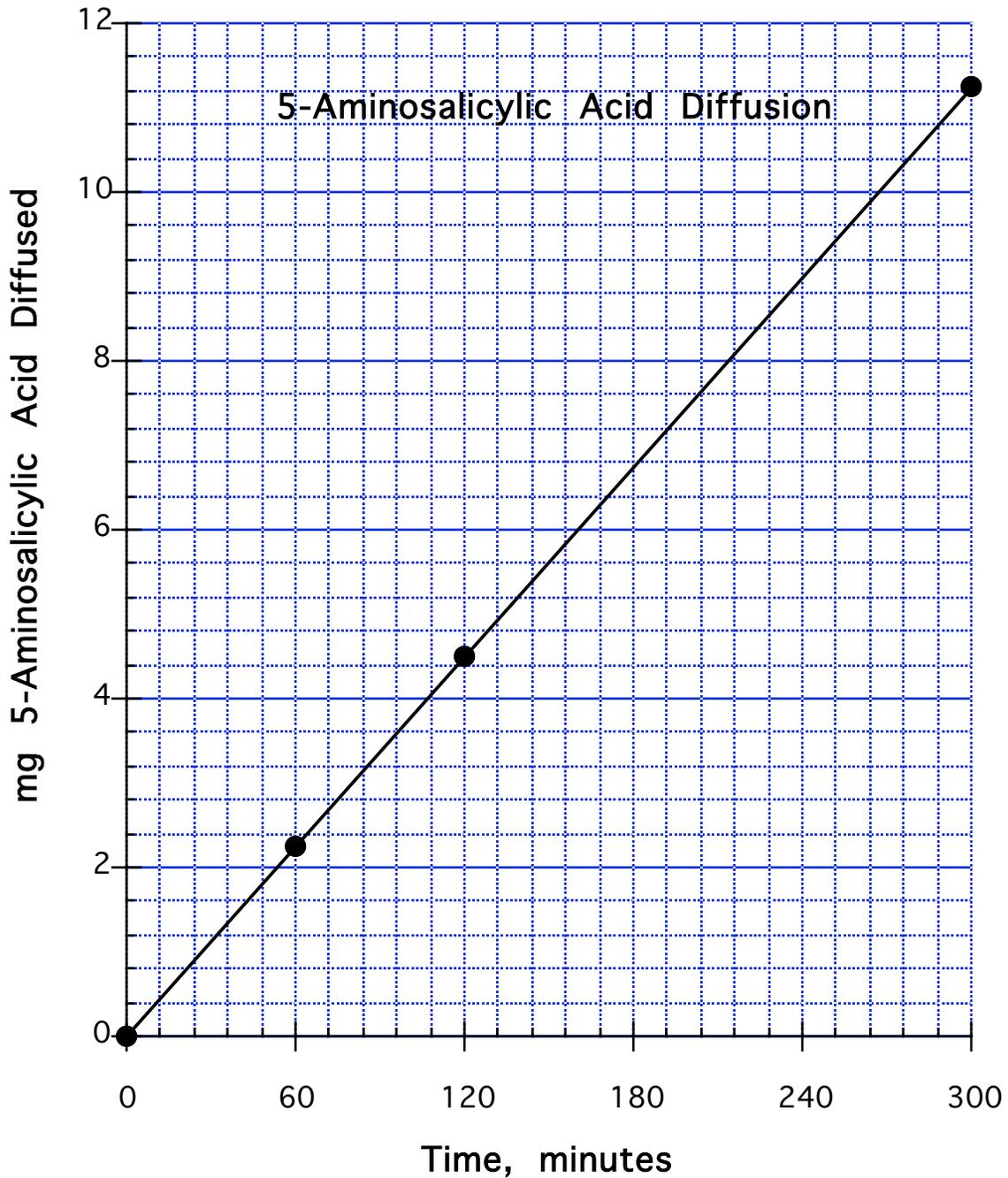
c. Does Moore’s law follow a straight line on semi-log graph paper?

d. If your answer to (c) is yes, what does it mean?

e. Calculate the slope of the graph.

Problem 18

Solid dosage forms for oral delivery to distal parts of the gastrointestinal tract are often required for the treatment of diseases such as ulcerative colitis and Crohn’s disease. 5-Aminosalicylic acid (5-ASA) tablets coated with a pH sensitive polymer such as ethyl cellulose can be used. Rubenstein et al. (*Pharmaceutical Research*, 14, 4, 1997) studied the diffusion of 5-ASA across ethyl cellulose films and presented their finding in a graph similar to the following.



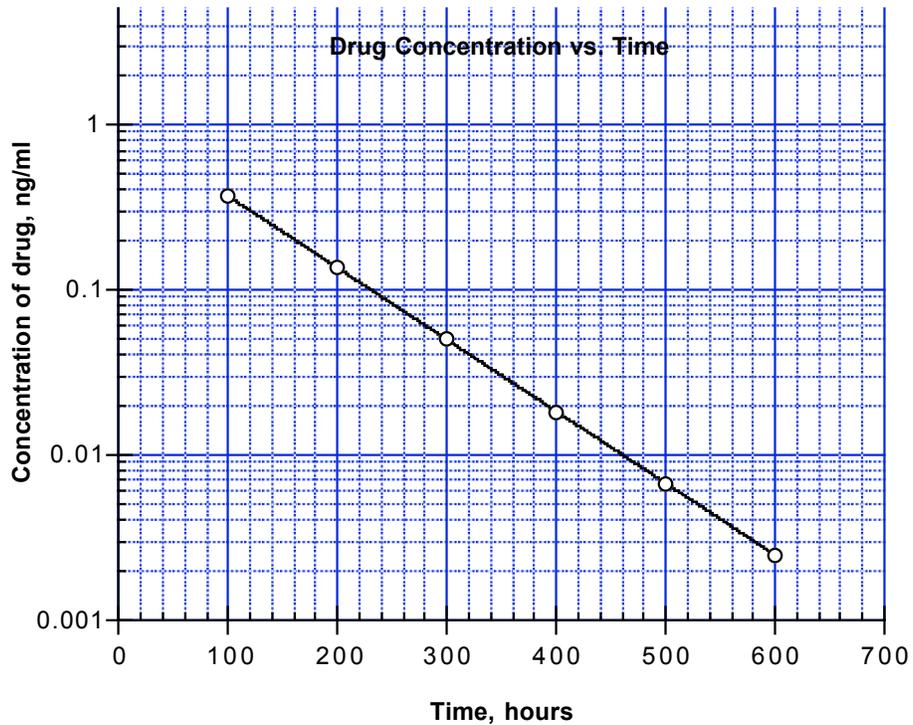
- a. Is this graph plotted on semi-logarithmic paper?

b. What is the equation of the line? Assume the y-intercept is zero.

c. What is the rate of 5-aminosalicylic acid diffusion through ethylcellulose?

Problem 19

The stability of a new drug is measured and the concentration of drug as a function of time is described by the following graph that is linear on semi-log graph paper.



a. The graph shown follows a straight line on semi-log graph paper. What does this tell you?

b. What is the initial concentration of drug in the experiment?

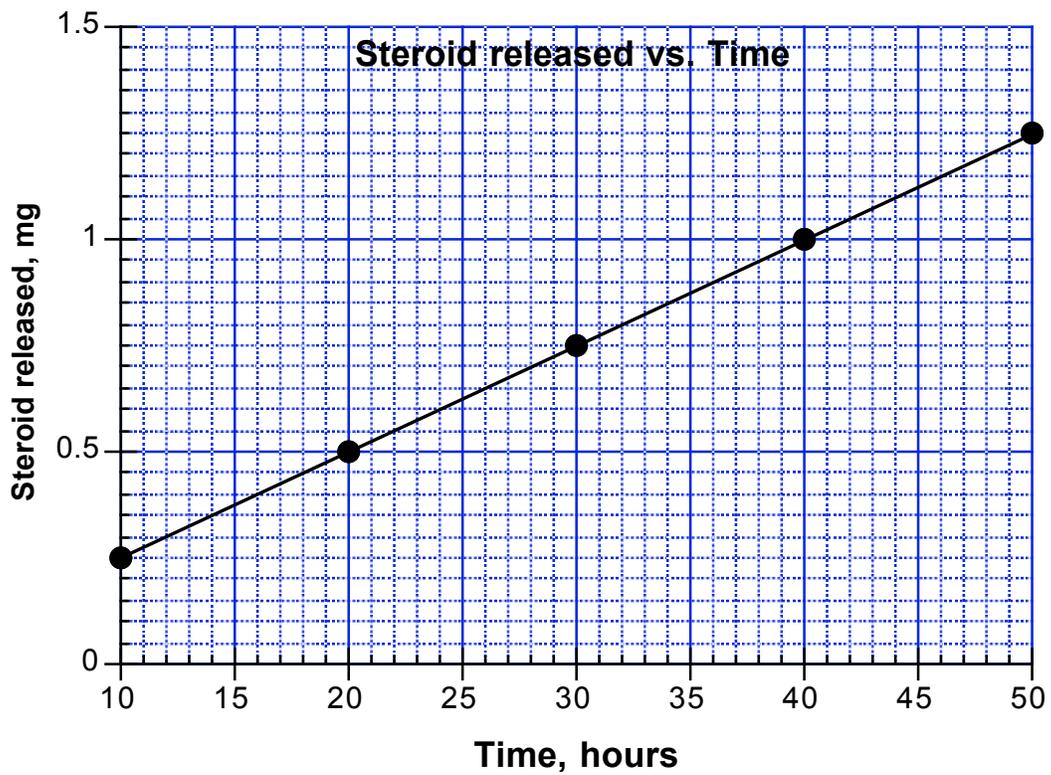
c. What is the slope of the straight line?

d. What is the rate constant?

e. Write the equation that describes the findings of the experiment. Use the numbers that you obtained from the graph.

Problem 20

The release of a steroid drug from a matrix preparation is described by the following graph.



a. Is this a linear graph or a semi-log graph?

b. Determine the slope.

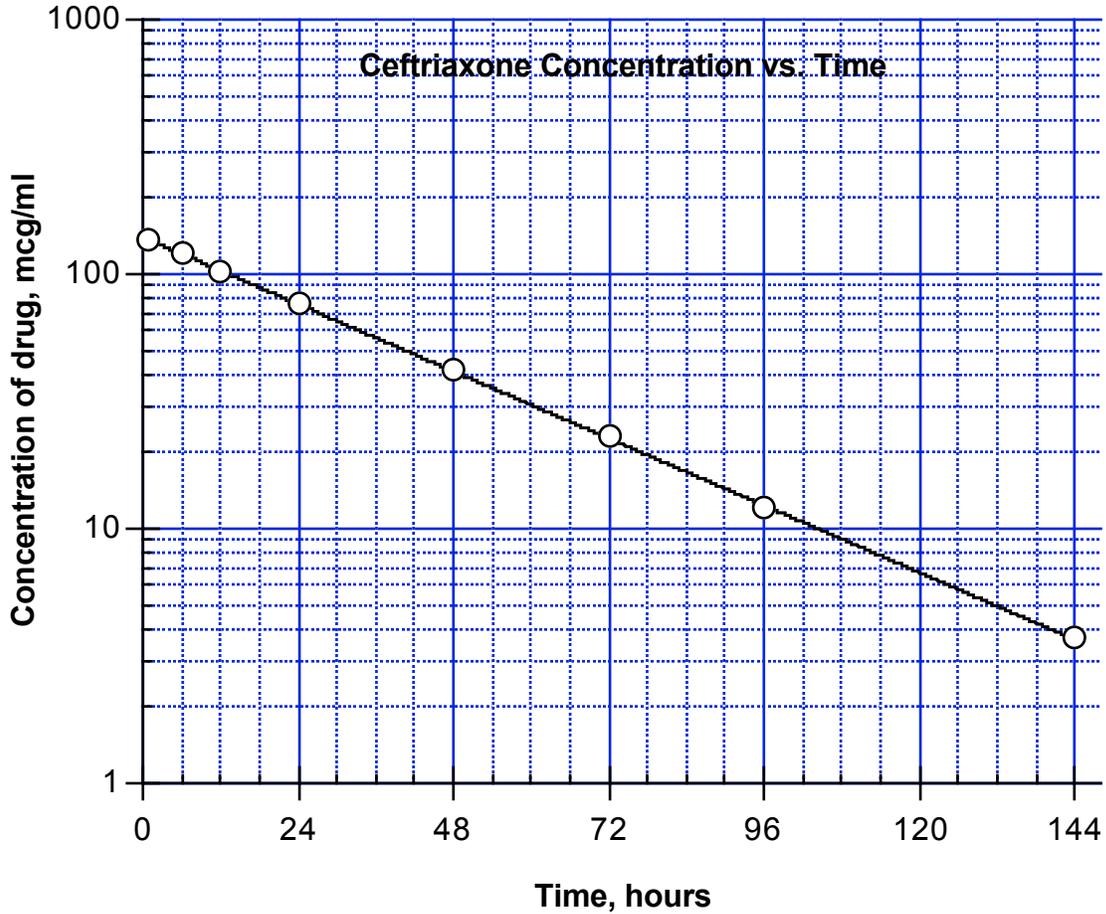
c. What is the rate of drug release from the matrix.

d. What is the equation of the line?

e. What is the value of the y intercept?

Problem 21

The concentration of an antibiotic, ceftriaxone, after an intravenous bolus in a newborn infant is described by the following graph (U.B. Schaad, W.L. Hayton and K. Stoeckel, *Clinical Pharmacology and Therapeutics*, 37, 522, 1985).



a. Does this graph represent a growth or decay process?

b. Is this plot on linear or semi-log paper?

c. What is the initial concentration of drug in the experiment?

d. What is the slope of the straight line?

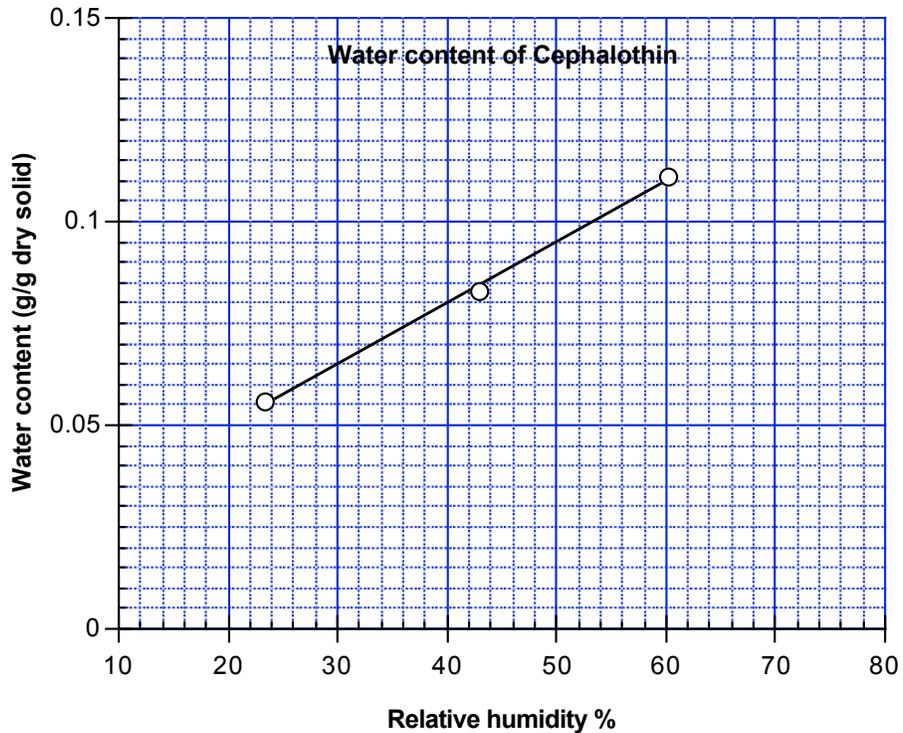
e. What is the rate constant?

f. Write the equation that describes the findings of the experiment. Use the numbers that you obtained from the graph.

g. Determine the half-life of ceftriaxone from the graph.

Problem 22

The absorption of water by dried cephalothin at various humidities is shown in the following graph.



a. Is this a linear graph or a semi-log graph?

b. What are the units of the slope? Give answers specific for this graph.

c. What are the units of the intercept? Give answers specific for this graph

d. Determine the slope.

e. Determine the intercept.

f. What is the equation of the line?

Problem 23

A novel genetically engineered monoclonal antibody, Daclizumab, is an effective immunosuppressive agent that reduces the risk of rejection (F. Vicenti et al., *New England Journal of Medicine*, 338, 161, 1998). The concentration of Daclizumab decreases according to an exponential function and the drug has a half-life of 20 days in humans. At time $t = 0$, the concentration in blood of patient Jane Doe is $20 \mu\text{g/ml}$.

a. What is the concentration at time $t = 20$ days?

b. If the initial concentration of daclizumab in blood is $20 \mu\text{g/ml}$, what is the concentration at time $t = 40$ days.

c. Set up and label the linear axis of the semi-log graph paper to plot Daclizumab concentrations between time $t = 0$ and $t = 80$ days.

d. Set up and label the semi-log axis of the semi-log graph paper to plot Daclizumab concentrations between time $t = 0$ and $t = 80$ days.

e. Plot the graph using at least 3 points. Draw a straight line through the points.

See graph

f. Determine the slope of the graph **from the plot**.

g. Determine the rate constant from the slope.

Problem 24

Salicylate, the active ingredient in aspirin, can cause severe intoxication at high doses. The following data show the relationship between serum salicylate levels in micrograms/ml at various times following ingestion under conditions in which severe intoxication occurs.

Time, hours	Serum salicylate, $\mu\text{g/ml}$
6	850
12	720
24	500
36	350
48	240

- a. Label the linear x -axis and the ticks of the semi-graph paper provided in preparation for plotting time. Label the y -axis and the ticks of the semi-graph paper provided in preparation for plotting serum salicylate concentration.

- b. Plot the points and visually draw a line that fits the data.

- c. Calculate the slope of the line from the graph. Be sure to indicate units.

- d. Calculate the rate constant. Be sure to indicate units.

- e. Calculate the serum salicylate concentration at time $t = 0$.

- f. From the graph or by calculation determine the half-life of serum salicylate.

Problem 25

Acinetobacter baumannii (acinetobacteria) is an opportunistic pathogen that utilizes ferric ions to control several metabolic processes related to growth and host-invasion. The growth of *acinetobacter baumannii* in ferric ion-supplemented medium can be described by the semi-log graph on the next page that plots the number of bacteria/ml of medium versus t , the time in hours.

- a. Calculate the slope of the line from the graph. Be sure to indicate units.

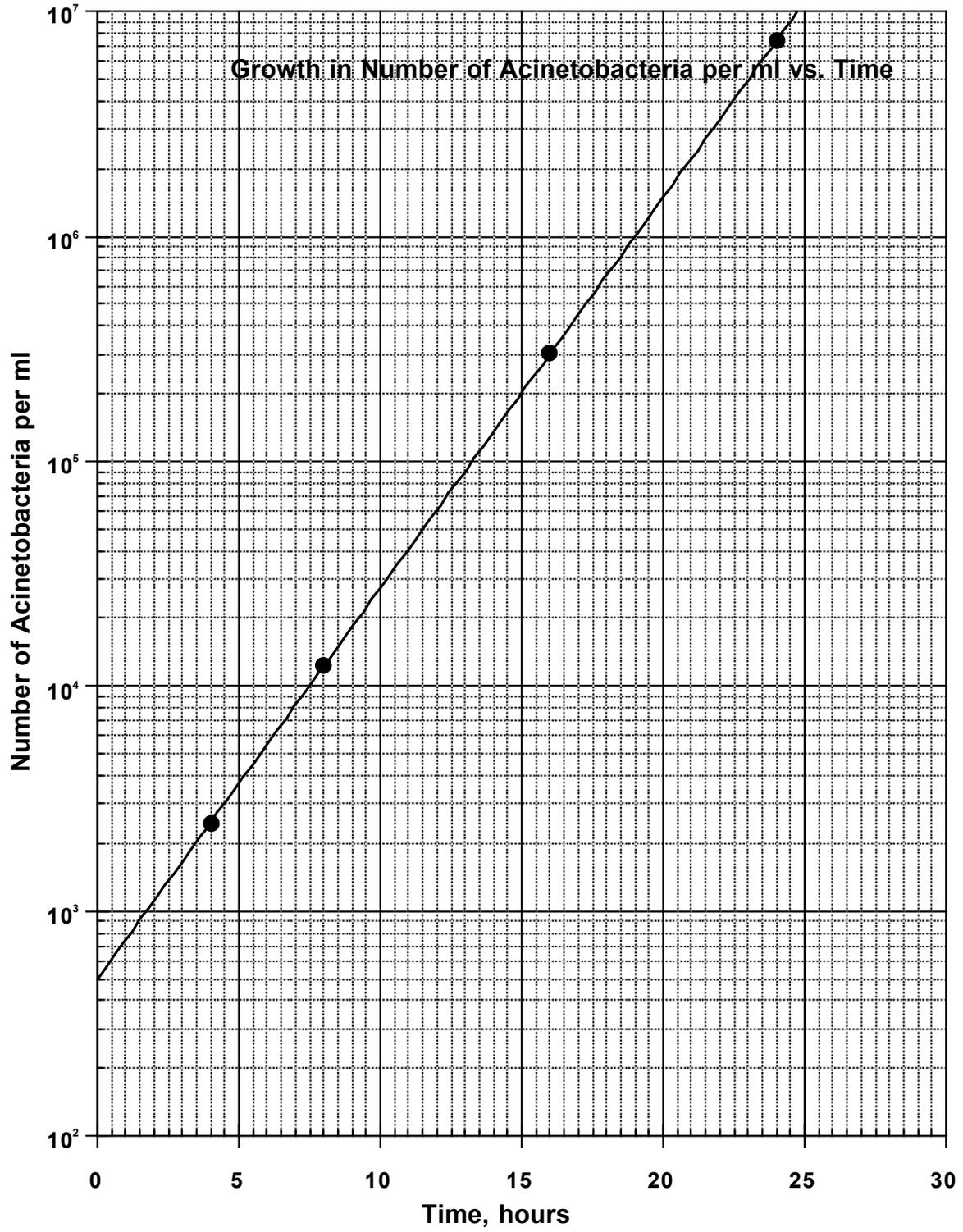
- b. Calculate the rate constant. Be sure to indicate units.

- c. Calculate the number of bacteria/ml of acinetobacteria at time $t = 0$. Be sure to indicate units.

- d. Write the equation for the exponential function that describes the straight line on semi-graph paper.

- e. From the graph or by calculation determine the doubling time of the acinetobacteria.

Graph



Problem 26

Cefotaxime is used to treat the meningitis caused by *neisseria meningitidis* (meningococcus). The following table shows the relationship between colony-forming units of meningococcus per milliliter of cerebrospinal fluid (CFU/ml of CSF) at various times following a bolus intravenous injection of cefotaxime.

Time (h)	CFU/ml of CSF
6	1.6×10^5
12	5.2×10^4
24	5.6×10^3
30	1.8×10^3
42	2.0×10^2

- a. Label the linear x -axis and the ticks of the semi-graph paper provided in preparation for plotting time. Label the y -axis and the ticks of the semi-graph paper provided in preparation for plotting. Plot the points and visually draw a line that fits the data.
- _____
- b. Calculate the slope of the line from the graph. Be sure to indicate units.
- _____
- c. Calculate the rate constant. Be sure to indicate units.
- _____
- d. Calculate the CFU/ml of meningococci in CSF at time $t = 0$. Be sure to indicate units.
- _____
- e. Write the exponential function that describes the straight line on semi-graph paper.
- _____
- f. From the graph or by calculation determine the half-life of meningococci in the presence of cefotaxime.
- _____

Problem 27

Carbenicillin and ticarcillin are penicillin antibiotics that decay in aqueous solutions according to the following equations:

Carbenicillin	$f = e^{-0.034t}$
Ticarcillin	$f = e^{-0.125t}$

Where f is the fraction of the antibiotic remaining **intact** after time t in hours.

a. Which antibiotic decays more rapidly?

b. What is the rate constant for **ticarcillin** degradation? Be sure to indicate the units.

c. How long does it take for 90% of the **ticarcillin** to decay?

d. What is the half-life of **ticarcillin**?

e. The shelf life of a drug is usually estimated by the time required for 10% of the drug to degrade. Estimate the shelf life of **ticarcillin**.

f. Calculate the percentage of ticarcillin remaining intact after 24 hours.

Problem 28

Xataxin and bactasome are investigational broad-spectrum antibiotics that decay in aqueous solutions according to the following equations:

$$\text{Xataxin: } f = e^{-0.05t}$$

$$\text{Bactasome: } f = e^{-0.15t}$$

Where **f** is the **fraction of non-degraded** antibiotic in solution after time *t* in hours.

- a. What is the rate constant for the degradation of bactasome in solution? **Indicate units.**

- b. Calculate the time necessary for 50% of xataxin to degrade. **Indicate units.**

- c. Calculate the fraction of **non-degraded** bactasome in solution after $t = 2$ days.

- d. Calculate the **fraction of degraded** xataxin after 24 hours.

- e. What is the percentage of bactasome degraded per hour?

Problem 29

Ertapenem is a broad spectrum antibiotic with activity against Gram-negative and Gram-positive pathogens. The serum concentration C of ertapenem over 24 hours after a single i.v. injection (dose: 1 g), can be described with the equation:

$$C = 160e^{-0.22t}$$

Where C is the serum concentration of ertapenem in $\mu\text{g/ml}$, the units of the 160 are in $\mu\text{g/ml}$ and t is time in hours.

- a. Calculate the serum concentration of ertapenem ($\mu\text{g/ml}$) after five hours.

- b. Calculate the time necessary to reach a serum concentration of 2 $\mu\text{g/ml}$.

- c. Calculate the initial concentration of ertapenem, i.e., the concentration at time $t = 0$.

- d. Calculate the time necessary to reach an ertapenem serum concentration equal to 50% of the initial drug concentration.

- e. What percentage of ertapenem remains in serum after $t = 24$ h?

- f. Assume that the exponential equation representing ertapenem serum concentration was correctly plotted on a semi-log plot. What would be the slope of the straight line on the graph?

Problem 30

The following table shows experimental data from a study evaluating the stability of a new solid preparation of ertapenem in aqueous solutions (pH: 7.4, 37°C).

Time, days	Concentration $\mu\text{g/ml}$
0	3.00×10^4
5	8.18×10^3
15	607
30	12.3
40	0.91

- a. Plot the points and draw the line that fits the data. **Label both axes, indicate units and clearly indicate data points to obtain credit.**

- b. Calculate the slope of the straight line **from the graph**.

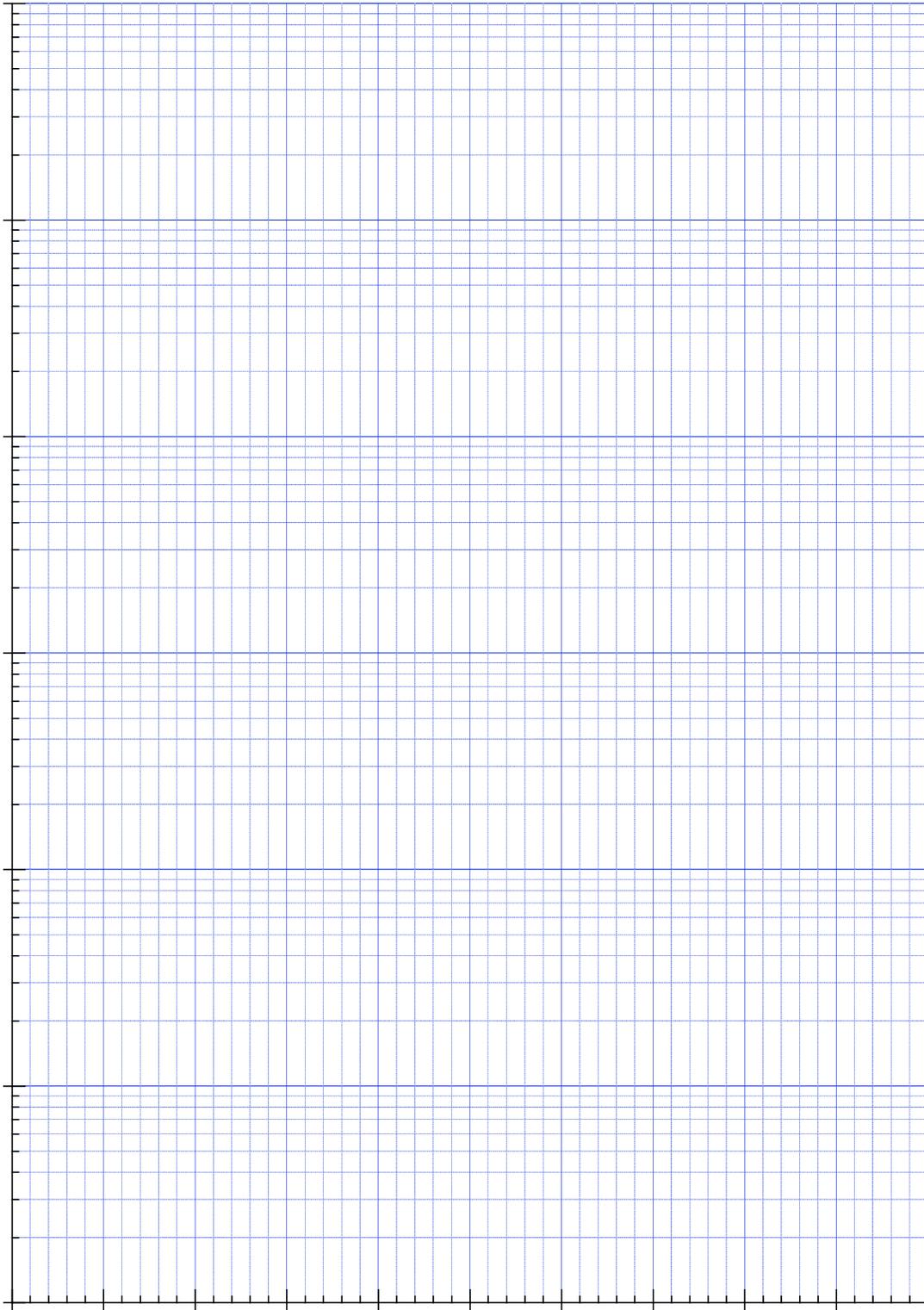
- c. Calculate ertapenem's decay constant. **Indicate units.**

- d. **From the graph**, determine the time necessary for ertapenem concentration to reach 100 $\mu\text{g/ml}$ (Indicate the extrapolated value both in the graph and below to obtain credit).

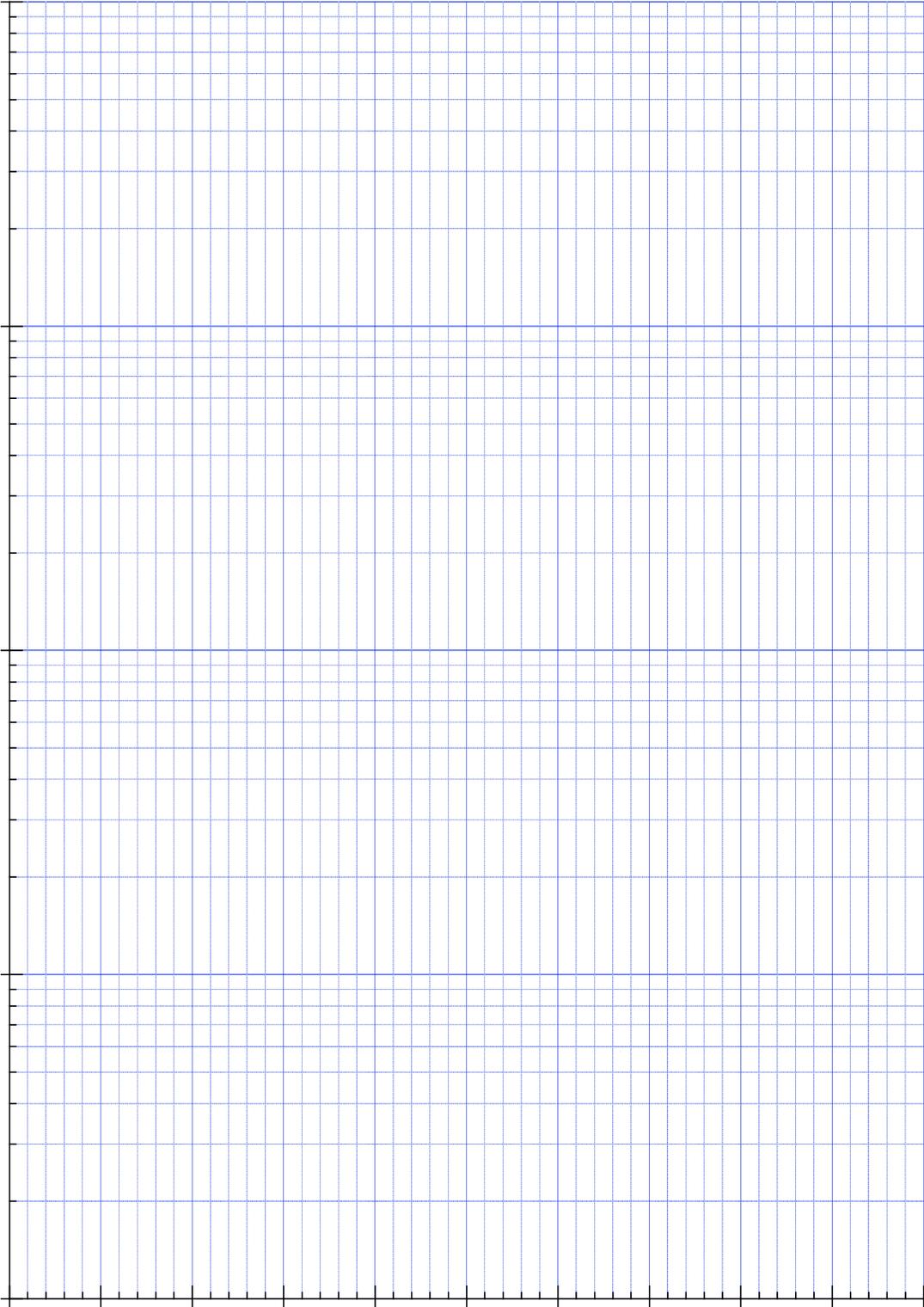
- e. **From the graph**, determine the time necessary for ertapenem concentration to reach 90% of the initial concentration (Indicate the extrapolated value both in the graph and below to obtain credit).

- f. Indicate the exponential equation that describes the decay of ertapenem in aqueous solution. Indicate units and mathematical signs.

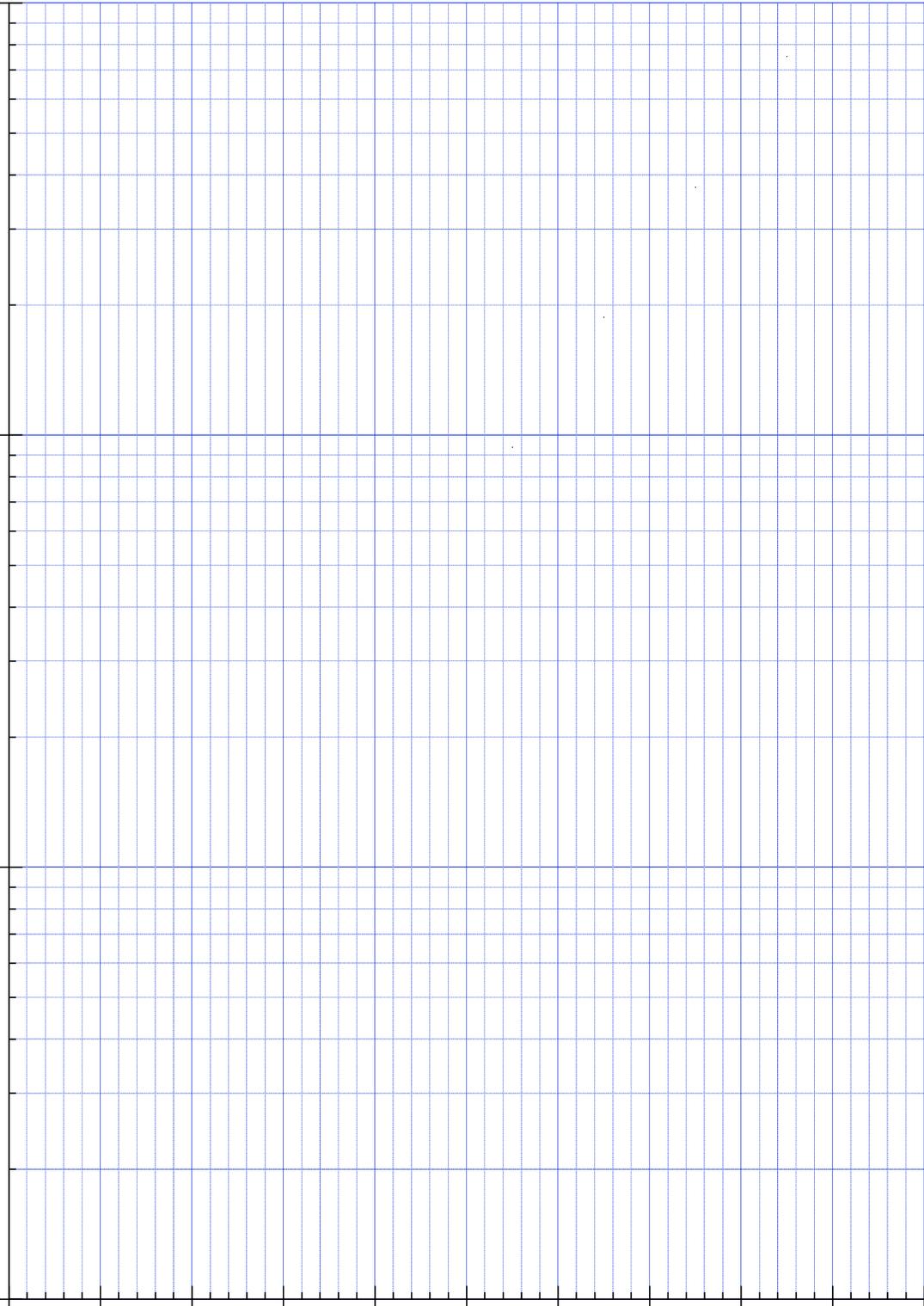
Graph Paper
Six-Cycle Semi-Log Graph Paper



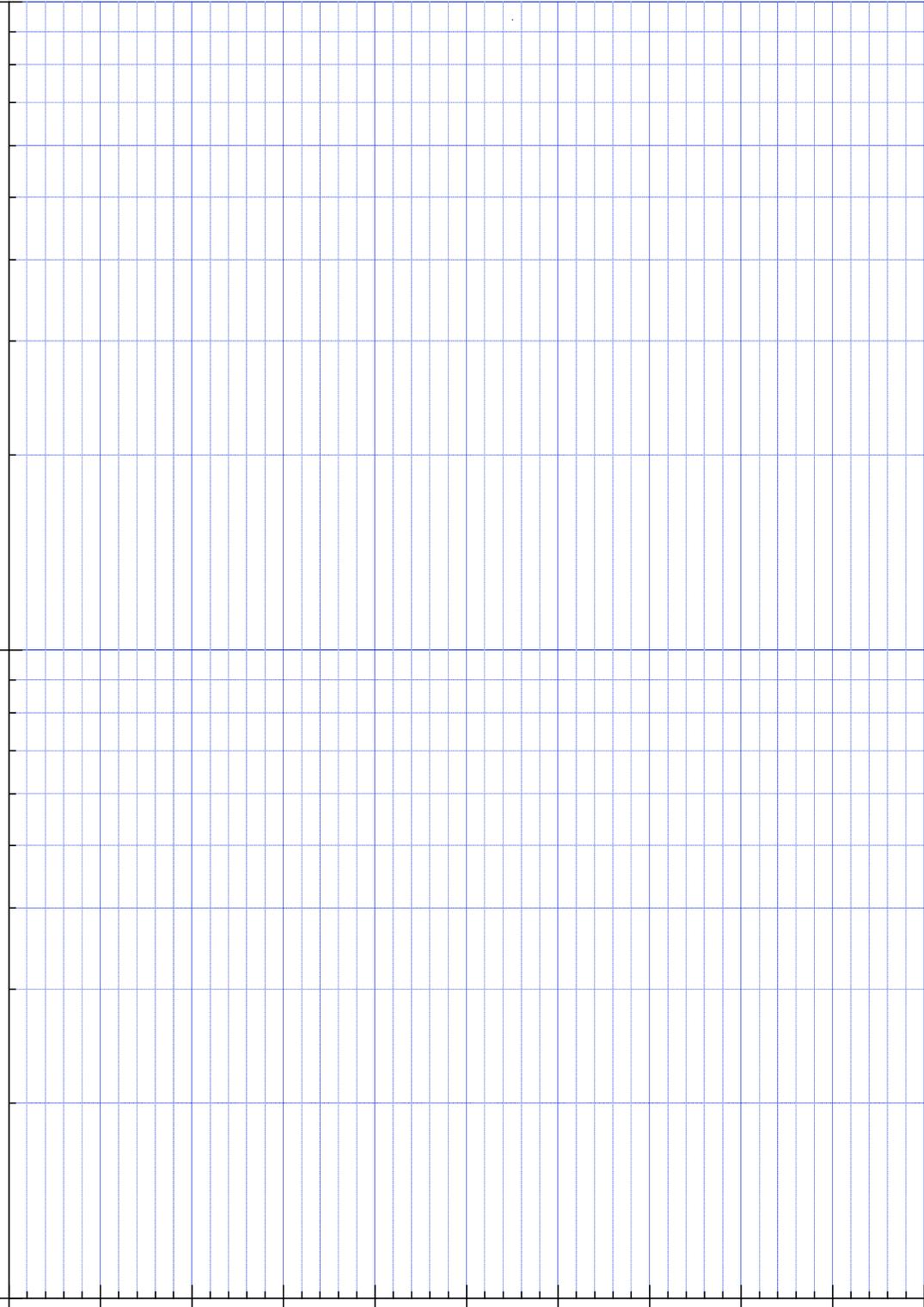
Four-Cycle Semi-Log Graph Paper



Three-Cycle Semi-Log Graph Paper



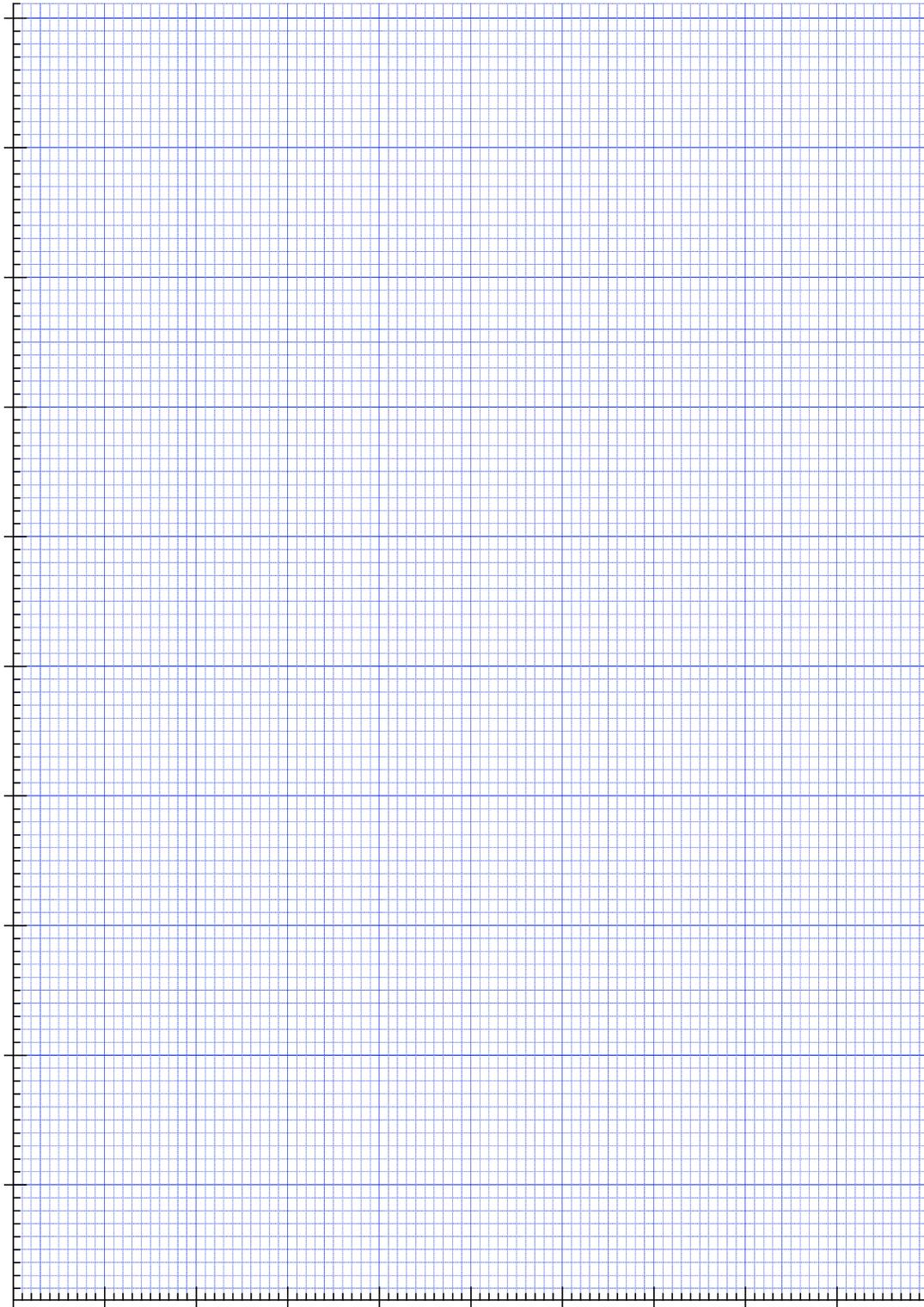
Two-Cycle Semi-Log Graph Paper



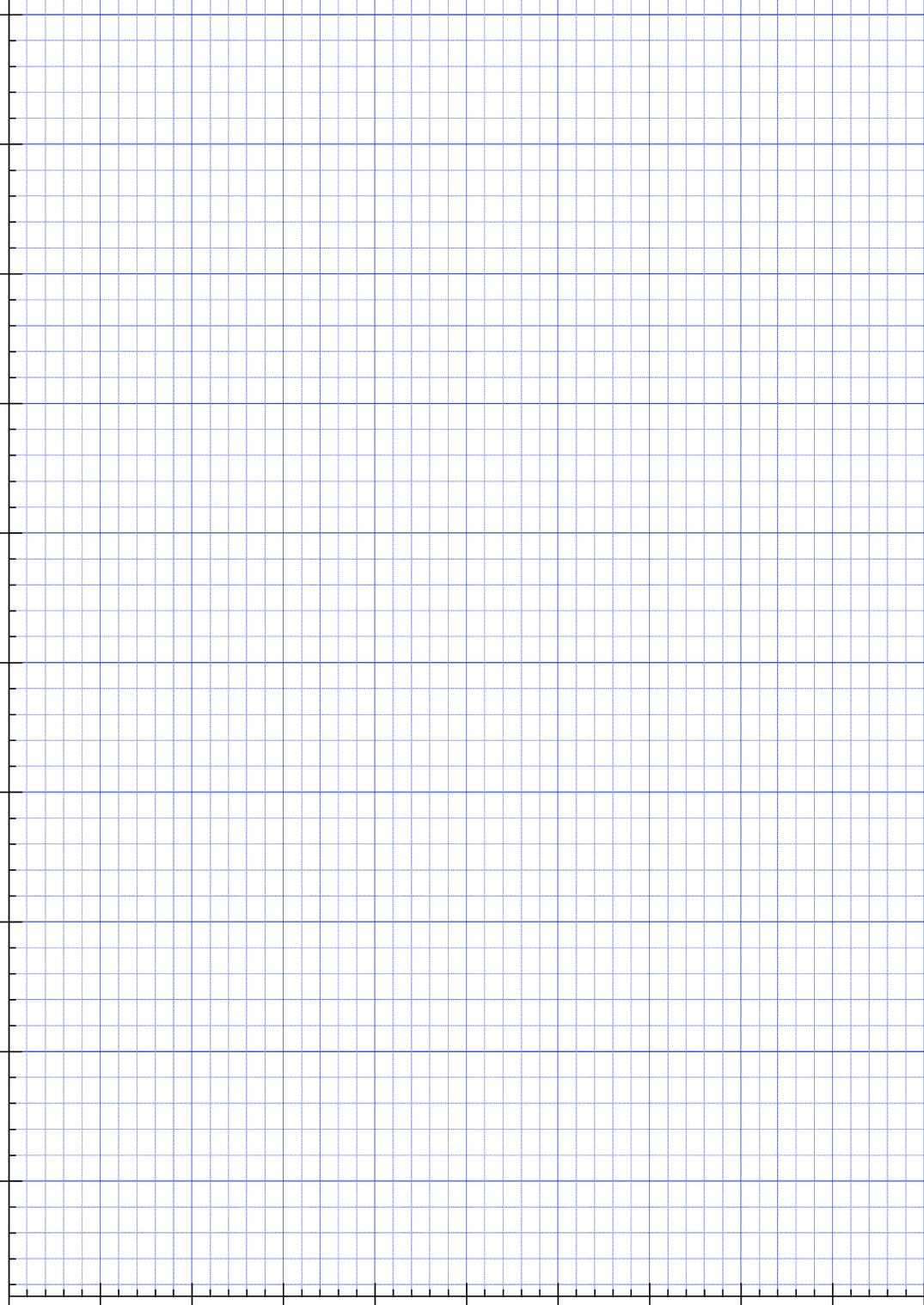
One-Cycle Semi-Log Paper



Linear Graph Paper (Fine Grid)



Linear Graph Paper (Coarse Grid)



CHAPTER 13
RADIOACTIVITY AND RADIATION

NOTES

Outline

- Rationale
- Radioactivity, Definitions of units
- Radiation, Definitions of units
- Law of radioactive decay

Rationale

- Radiochemicals used as pharmaceuticals in diagnosis.
- Radiation is used in cancer chemotherapy.
- Radiation e.g., X-rays and positron emission used in imaging.
- Radioactive materials are widely used in research.
- Of course, radioactive materials are commonly used in military applications and energy production.

Radioactivity Units

- Radioactivity is caused by the spontaneous decay of unstable nuclei.
- There are two units of activity the Curie and the SI unit, the Becquerel.
- The Curie (Ci) is based on the decay of 1 gram of radium.
- The SI unit, the Becquerel (Bq) equals 1 disintegration per second (1 dps).
- $1 \text{ Ci} = 3.7 \times 10^{10} \text{ Bq}$
- The Becquerel is a relatively small unit and terms such as megabecquerel (MBq), gigabecquerel (Gq) and terabecquerel are used to describe commonly used levels of radioactivity.
- The Curie is a relatively small unit and terms such as millicurie (mCi), and microcurie (μCi) are used to describe commonly used levels of radioactivity.
- The Becquerel will probably ultimately replace the Curie.
- The specific activity of a radioactive material or preparation is the activity per milliliter or gram. Its is used for dosing calculations and has units of Ci/ml, Ci/g , Bq/ml , Bq/g etc.

Radiation Units

- The Roentgen (R) is a measure of radiation exposure.
- 1 Roentgen (R) is defined as the amount of X or gamma rays that produces 1 electrostatic unit of charge in air at standard temperature and pressure.
- The rad or radiation absorbed dose is equal to an energy exposure of 100 ergs/gram
- The SI unit for absorbed dose is the Gray (Gy) equal to 1 Joule/kg.

- 1 Roentgen = 0.93 rad
- 1 Gray = 100 rads
- The Rem (Roentgen equivalent man) is unit of radiation dose equivalent or exposure that takes into account the differing biological effect of different forms of radiation.
- Rems = Rads × Quality Factor
- Quality Factors

Radiation	Quality factor
X rays, gamma rays and beta particles	1
Slow neutrons	3
Fast neutrons	20
Alpha particles	20

- The SI unit of for dose equivalent is Sievert and equals 1 Joule/kg. 1 Sievert = 100 Rem

Law of Radioactive Decay

- The rate of decay is proportional to the number of atoms present.
- Mathematically,

$$\frac{dN}{dt} = -\lambda N$$

- The λ is the rate constant for decay. λ has units of time⁻¹. t is the time, N is the number of radioactive nuclei present.
- The differential equation can be integrated to give:

$$N = N_0 e^{-\lambda t}$$

- N_0 is the initial number of radioactive nuclei present.
- The differential equation can be written in terms of f , the fraction of the initial activity remaining to give:

$$f = \frac{N}{N_0} = e^{-\lambda t}$$

Half-Life And Its Relationship to the Decay Constant

- The half-life ($T_{1/2}$) of a radionuclide is time required for half of the initial radioactivity to decay.
- The half-life ($T_{1/2}$) is related to the decay constant:

$$\frac{1}{2} = e^{-\lambda T_{1/2}}$$

Taking natural logarithms on both sides:

$$\ln\left(\frac{1}{2}\right) = -\lambda T_{1/2}$$

$$T_{1/2} = \frac{\ln 2}{\lambda} = \frac{0.6931}{\lambda}$$

- The half-life ($T_{1/2}$) is characteristic of the radionuclide and can vary from years to seconds.
- The half-life ($T_{1/2}$) and the decay constant of a radionuclides is independent of temperature, pressure, concentration, and even the molecular structure inm which the radioactive atom occurs.

Ultraviolet Radiation

- Radiation from the sun consists of infrared light (wavelength > 770 nm), visible light (wavelength 400-770 nm), and ultraviolet light (wavelength 200-400 nm; principally 290-400 nm). The skin is most sensitive to a wavelength of 296 nm but majority of the stronger sunburn-causing wavelengths that reach the earth's surface have a wavelength of 310 nm.
- Responsible for many of the harmful effects of sunlight such sunburn or worse skin cancer
- UV-A, UV-B, UV-C

UV-A

- Also called long wave UV radiation
- UV-A ranges from 320-400 nm.
- Primarily results in tanning
- Weak at causing redness (erythema) of skin. About 1000 times as much UV-A needed as UV-B
- May cause more damage to underlying tissue because it penetrates deeper
- 10 times more UV-A reaches the earths surface than UV-B
- Causes immediate pigment darkening followed by delayed tanning
- UV-A also triggers new pigment formation and thickening of the stratum corneum

UV-B

- Often called sunburn radiation: causes sunburn and tanning.
- Ranges from 290-320 nm
- Very effective at casing erythema
- Needed for producing Vitamin D
- Also considered responsible for melanoma
- Effects augmented by UV-A

UV-C

- Often called germicidal radiation

- 200-290 nm
- Does not reach the earth
- Produced by lamps
- Does not cause tanning but will cause some erythema

Sunscreen Efficiency

- Highly variable human responses make it difficult to determine sunscreen efficiency
- Minimal erythemal dose is the “least exposure that will cause delayed erythema”
- 2 MED will produce a bright erythema, 4 MED will cause painful burn, 8 MED will produce a blistering burn
- MED is dependent on both energy and the responsiveness of the skin
- Sun Protection Factor (SPF) is the ratio of the MED of protected skin by the MED of unprotected skin
- Example: It 30 millijoules/cm² (25 units) of UV cause 1 MED on unprotected skin and 300 millijoules/cm² are needed after applying sunscreen. The SPF is 10.
- Sunscreens with a SPF of 2-4 provide only minimal protection against sunburn; SPF 4-6 afford moderate protection; SPF 8-15 provide maximal protection.
- The appropriate sun protection should be determined based on the individual skin type and exposure. Type I skin (always burns easily, never tans) should use highest SPF products. Type VI skin (never burn, deeply pigmented) often do not require sunscreens.
- Sunscreens work by absorbing UVB light because they contain chromophores contains loosely held electrons are raised to excited states in the presence of radiation.

PROBLEMS

Problem 1

a. Define the sun protection factor.

b. State two clinical uses of **radiation**.

c. Which form of ultraviolet radiation in sunlight is most effective at causing sunburn?

d. Which form of ultraviolet has the longest wavelength: UV-A, UV-B and UV-C?

e. What is an individual's dose exposure from 10 mRad of gamma rays, 20 mRad of beta rays and 5 mRads of fast neutrons?

Problem 2

a. What causes radioactivity?

b. State the SI unit of radioactivity.

c. State a unit that is used measure the amount of radiation absorbed.

d. State a unit that is used measure the biological effects of absorbed radiation.

Problem 3

Phone 716-555-1234	DEA# AR -12736280
<p>Dr. Marinara Pesto Piccata, NY 14002</p>	
Name <u>Alfredo Primavera</u>	Age <u>63</u>
Address <u>13 Sauce St, Piccata, NY</u>	Date <u>9/8/97</u>
Weight <u>220.5 lb</u>	Height <u>5'3"</u>
<p>Rx Take po 400 microCuries of Sodium Iodide I-123 with activitiy of 2 mCi/ml for thyroid imaging</p>	

Sodium iodide I-123 is a radiochemical. It is used for thyroid function testing because it accumulates in the thyroid and the radiation emitted can be detected with imaging devices. Because it is a radiochemical, Sodium iodide I-123 activity decays with time. The percent activity remaining as a function of time is shown in the graph on the following page.

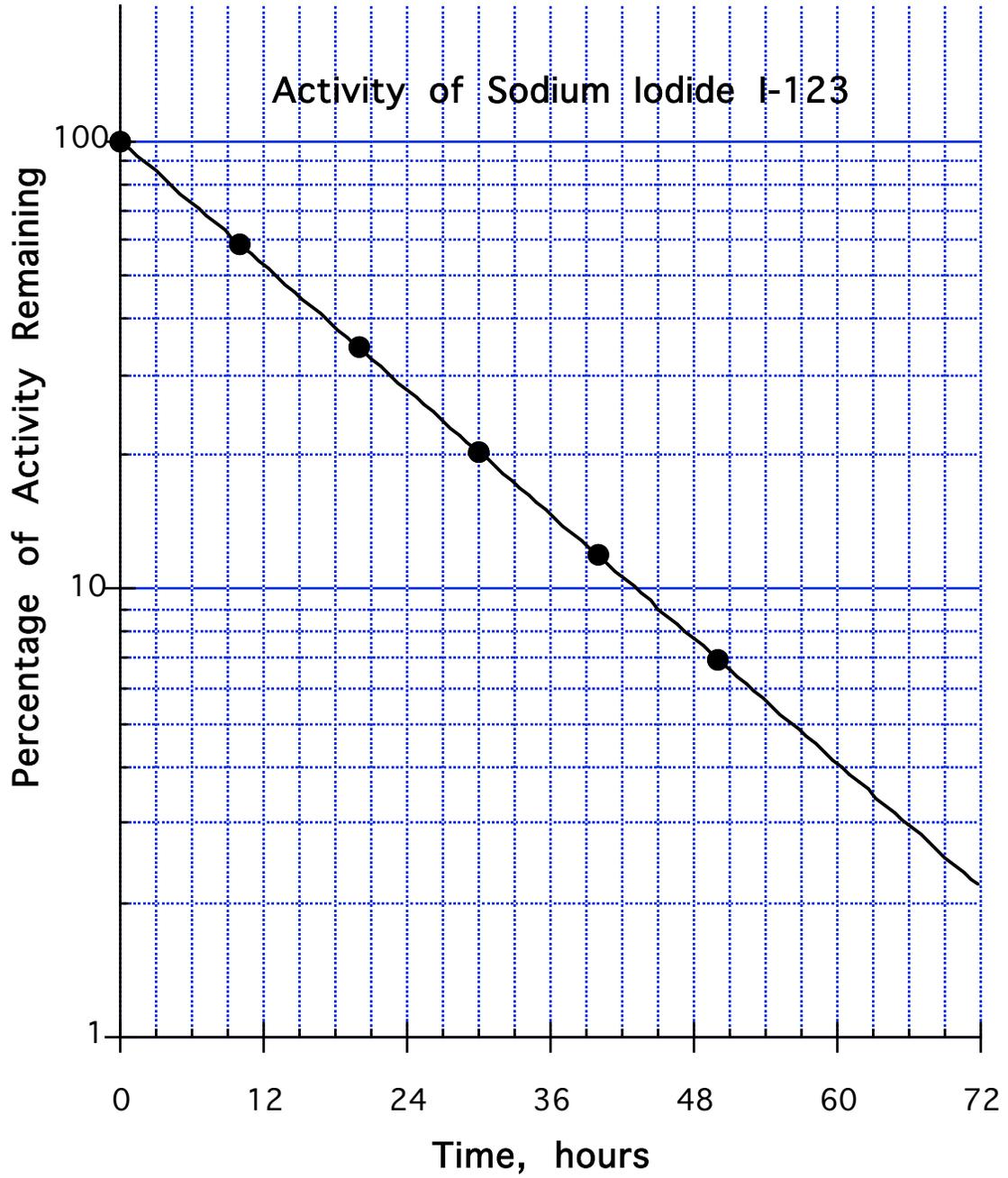
a. Calculate the volume of the solution that should be injected.

b. What is the slope of the graph.

c. From the graph, calculate the half-life for the sodium iodide I-123.

d. What is the equation of the graph shown?

e. The shipping delay between the manufacturer and your hospital is 36 hours. Calculate the specific activity that should be shipped so that you receive 2 mCuries/ml.



Problem 4

DEA# AT -12736280					
DR. HAMATO YOSHI, M.D.					
4 RAPHAEL STREET					
MANHATTAN, KS 00612					
NAME	APRIL LEONARDO-O' NEIL	AGE	55	HEIGHT	130 CM
ADDRESS	2 DONATELLO, MANHATTAN,	DATE	8/18/97	WEIGHT	71 KG
<div style="display: flex; justify-content: space-between;"> <div style="text-align: center;"> <p>R_x</p> <p>CO-57 CYANOCOBALMIN</p> <p>LACTOSE QS</p> <p>M FT SA CAP</p> </div> <div style="text-align: center;"> <p>0.8 MICROCURIE</p> <p>200 MG</p> </div> </div>					
<u>H. YOSHI, MD</u>					

Cyanocobalmin is vitamin B12 and it contains cobalt. A radioactive form of vitamin B-12, Co-57 cyanocobalamin, contains radiocative cobalt (Co-57), is used for the diagnosis of pernicious anemia

a. What is the unit of the radioactive decay rate constant?

b. Cobalt-57 has a half-life of 270 days, calculate the rate constant for decay.

c. Write the equation that describes the loss of radioactivity from a capsule of Co-57 cyanocobalamin.

d. After how many days will the radioactivity decrease to 90% of its original value?

e. How much radioactivity will remain 90 days after the capsule is prepared.

Problem 5

DEA# BE 12736280					
Dr. Scripta Elegans, M.D. 33 Terrapin Street Turtle Lake, ND 58575					
Name	Atlas Testudo	Age	55	Height	130 cm
Address	989 Chelonian St, TL	Date	8/18/97	Weight	71 kg
<div style="display: flex; align-items: center;"> <div style="font-size: 2em; margin-right: 10px;">R_x</div> <div> <p>Tc 99 Lidofenin</p> <p>m ft sa. Inject 5 milliCuries iv. Obtain image at 10 min</p> </div> </div>					

Tc 99 lidofenin contains radioactive technetium (Tc 99) and is used imaging the liver in patients with hepatobiliary disease.

The radioactive compound is prepared by adding Tc99 sodium pertechnetate to 10 mg of lidofenin complexed with stannous chloride. The lidofenin complexed with stannous chloride is not radioactive; All the radioactivity is provided by Tc99 sodium pertechnetate. After adding the Tc99 sodium pertechnetate the preparation is qs-ed to a total volume 10 ml.

a. Express the dose in Becquerels

b. The rate constant for the decay of Technetium is 0.1151 hr^{-1} . Determine the half-life.

c. The specific activity of the Tc99 sodium pertechnetate you have is 20 mCi/ml. What volume of Tc99 sodium pertechnetate should you add to lidofenin complexed with stannous chloride?

d. What is the concentration of Tc-99 radioactivity in the final preparation? Give your answer in mCi/ml

e. What volume of preparation should be injected?

Problem 6

DEA# AT -12736280					
<p>Dr. Chad Jordan, M.D. 30 Cyprus Street Malta, GA</p>					
Name	Cameron Israel	Age	55	Height	130 cm
Address	900 Syria St, Malta, GA	Date	8/18/97	Weight	71 kg
<p>R_x Tc 99 Sodium pertechnetate m ft sa. Inject 5 milliCuries iv. Obtain image at 10 min</p>					

Tc 99 Sodium pertechnetate contains radioactive technetium and is used in angiography. The decay rate constant for Tc99 sodium pertechnetate is 0.1151 hr^{-1} . You will be plotting the percentage of Tc99 radioactivity remaining as a function of time for a 24 hour time period.

a. Assuming you have 100% of the activity at time $t = 0$, write the equation of the curve describing the decay of Tc99 sodium pertechnetate

b. Do you expect the slope of the graph on semi-log graph paper to be positive or negative? Briefly explain why.

c. Calculate the percent radioactivity remaining after 24 hours.

d. Which graph paper is better for plotting the graph, 2-cycle or 3-cycle?

e. Label the graph axis.

f. Plot the graph. Use at least 4 points.

g. Calculate the slope.

Problem 7

Phone 716-555-1234	DEA# BP -12736280
<p>Dr. Aurora Stefan Diablo Ravine, CA 94518</p>	
Name <u>Flora Merryweather</u> Address <u>289 Maleficent St, Briar Rose</u>	Age <u>63</u> Date <u>9/28/97</u>
Weight <u>150 lb</u> Height <u>5'3"</u>	
<p>R Take po 3.7 megaBecquerels of Sodium Iodide I-123 with activity of 7.4 megaBecquerels/ml for thyroid imaging. Image at 4 hours and 24 hours</p>	
<p><u>Aurora Stefan M.D</u></p>	

Sodium iodide I-123 is a radiochemical. It is used for thyroid function testing because it accumulates in the thyroid and the radiation emitted can be detected with imaging devices.

- a. Calculate the volume of the solution that should be injected.

- b. The half-life of I-123 is 13.2 days. Calculate the rate constant.

- c. The shipping delay between the vendor and the hospital is 72 hours. How much radioactivity in MBq should be ordered?

- d. What dose would the patient receive if the administration of the same volume of drug were to be delayed by 2 days?

Problem 8

DEA# BP -12736280					
Dr. Dimple Punchcard, M.D. 3 Recount Street Tallyhashee, FL					
Name	Chad Ballot	Age	55	Height	130 cm
Address	9 Certify St, FL	Date	11/1/00	Weight	71 kg
<i>Rx</i>	Inj iv 0.37 Mbq of either I-131 radioiodinated human albumin or I-125 radioiodinated human albumin				

Iodine-131 has a half-life of 8.08 days. Iodine-125 has a decay constant of $0.00048 \text{ hour}^{-1}$.

a. Calculate the radioactive decay rate constant for iodine-131.

b. Calculate the half-life of iodine-125.

c. Write the equation that describes the loss of radioactivity from a single dose of I-125 radioiodinated albumin. Indicate the units for activity and the time variables

d. Which of the two radionuclides, I-125 or I-131, decays faster?

e. What percent of the initial radioactivity will remain if the **I-125** radioiodinated albumin dosage form is unused for 14 days.

f. Convert the dose to curies

Problem 9

DEA# AG -12736280					
<p>Dr. Hunter Gatherer, M.D. 5 Fisherman's Wharf Bakersfield, CA</p>					
Name	Ed Ucator	Age	55	Height	130 cm
Address	25 University Av, Bakersfield	Date	8/18/97	Weight	71 kg
<p>R_x Inject 0.2 mCi of 0.1 mCi/ml Cr-51 sodium chromate iv for diagnosis of GI blood loss.</p> <p style="text-align: center;"><u>H. Gatherer, MD</u></p>					

Chromium-51 sodium chromate has a half-life of 27.7 days.

a. Express the dose in Becquerels

b. Calculate the volume of sodium chromate solution to be injected.

c. The specific activity of the Cr-51 sodium chromate is 10 mCi/mg. What is the concentration of sodium chromate in **percent strength**?

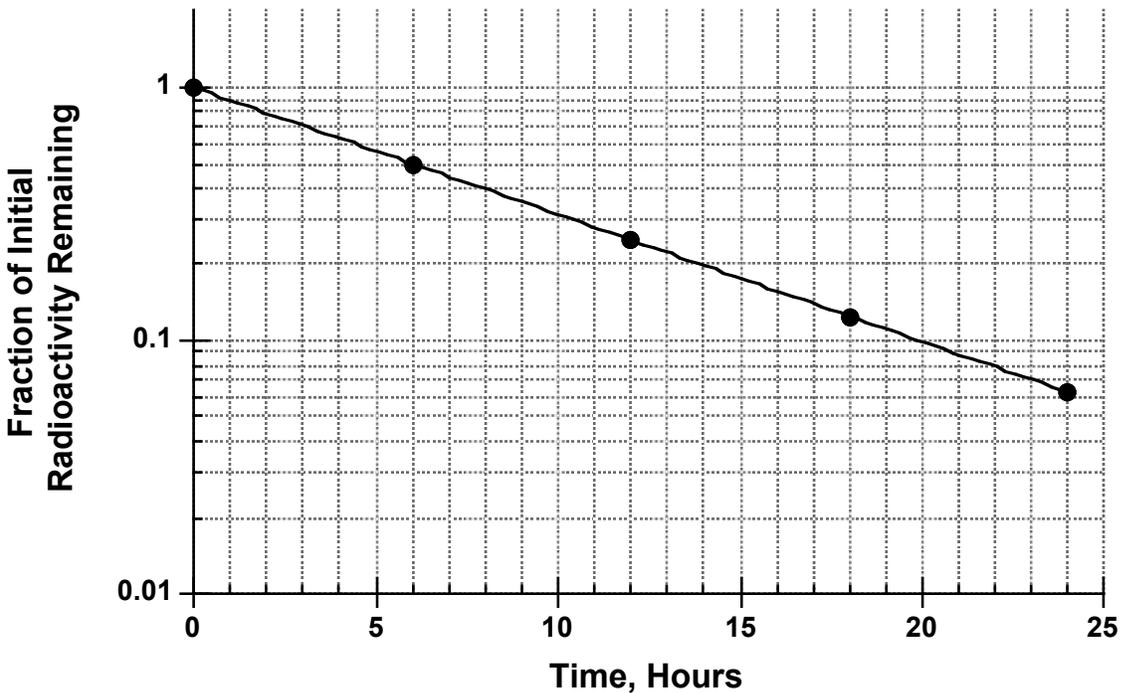
d. Calculate the decay constant for Cr-51 sodium chromate.

e. If the shipping delay is 10 days, calculate the activity in mCi/ml of Cr-51 sodium chromate that should be shipped to provide 0.1 mCi/ml at the time of injection.

Problem 10

Phone 716-555-1234	DEA# AR -12736280	
Dr. Nick Otine Tarrytown, NY 14002		
Name <u>Carci Nogen</u>	Age <u>63</u>	Weight <u>220.5 lb</u>
Address <u>21 Butt St, Tarrytown, NC</u>	Date <u>9/28/97</u>	Height <u>5'3"</u>
R_x Sodium pertechnetate Tc99 8 MBq/kg		
<u>N Otine M.D</u>		

Sodium pertechnetate Tc99 is a radiochemical used as a diagnostic agent for brain disorders. The following curve describes the decay of sodium pertechnetate radioactivity.



a. What is the prescribed dose of radioactivity in MBq?

b. What is the slope of the sodium pertechnetate Tc99 decay curve?

c. What is the rate constant for sodium pertechnetate Tc99 decay?

d. What is the time constant for sodium pertechnetate Tc99 decay?

e. What is the half-life of sodium pertechnetate Tc99?

f. Based on your calculations, provide an equation that describes the decay of sodium pertechnetate Tc99.

Problem 11

Phone 716-555-1234	DEA# BC -12736280
<p>Dr. Charlotte Cavatica 441 Orbweaver Street Wilbur, NE 68465</p>	
Name <u>Fern Arable</u>	Age <u>49</u>
Address <u>21 Zuckerman St, Wilbur, NE</u>	Date <u>9/2/07</u>
	Weight <u>200 lb</u>
	Height <u>5'3"</u>
<p>Rx Technetium Tc99m sestamibi 1000 MBq Inject iv</p>	

Technetium Tc99m sestamibi is a radiochemical that is used for cardiac imaging to identify myocardial infarcts. It has a decay rate constant of 0.1151 hour^{-1} .

- a. What is the dose of Technetium Tc99m sestamibi in **millicuries**?

- b. What is the half-life of technetium Tc99m sestamibi?

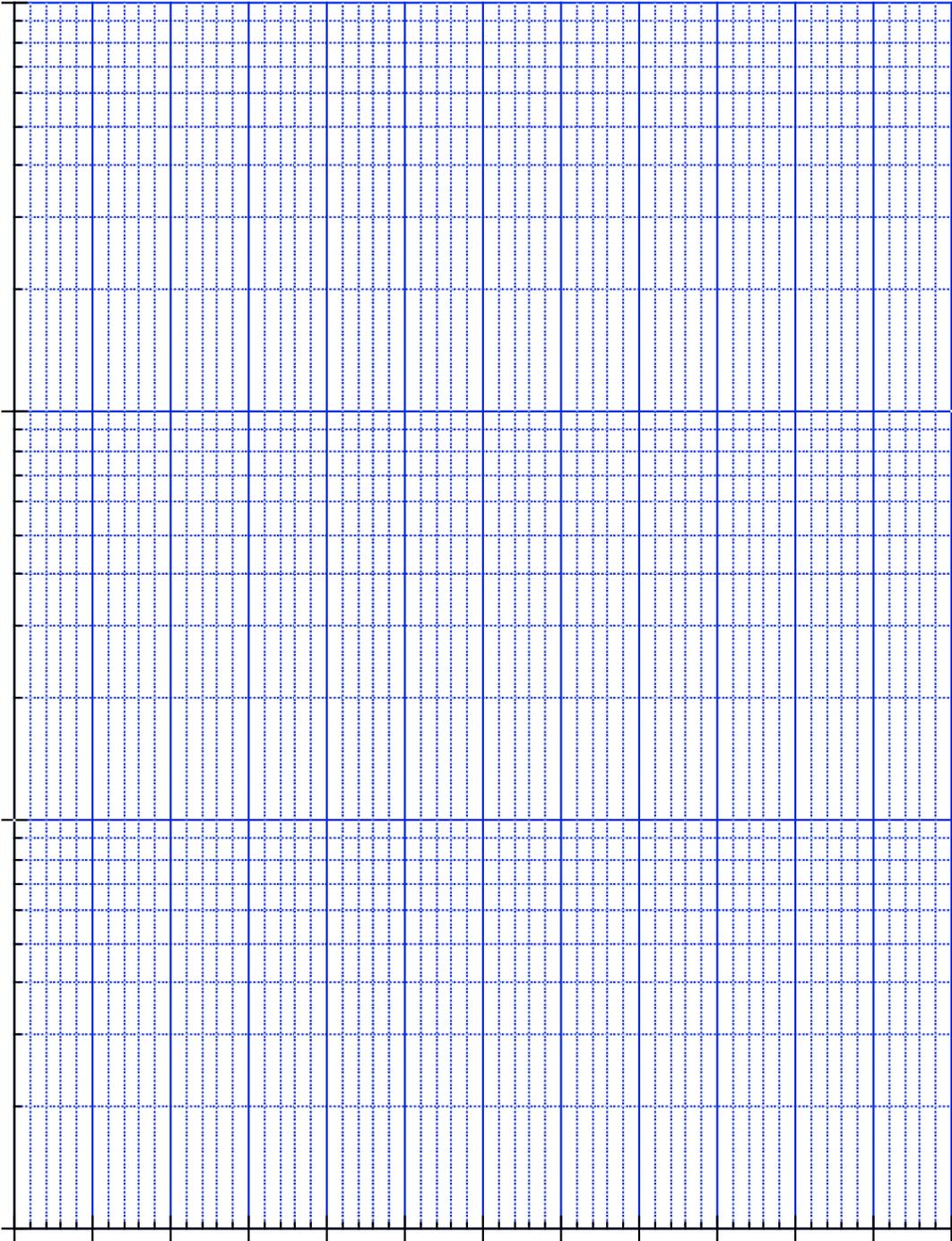
- c. What is the time constant for technetium Tc99m sestamibi decay?

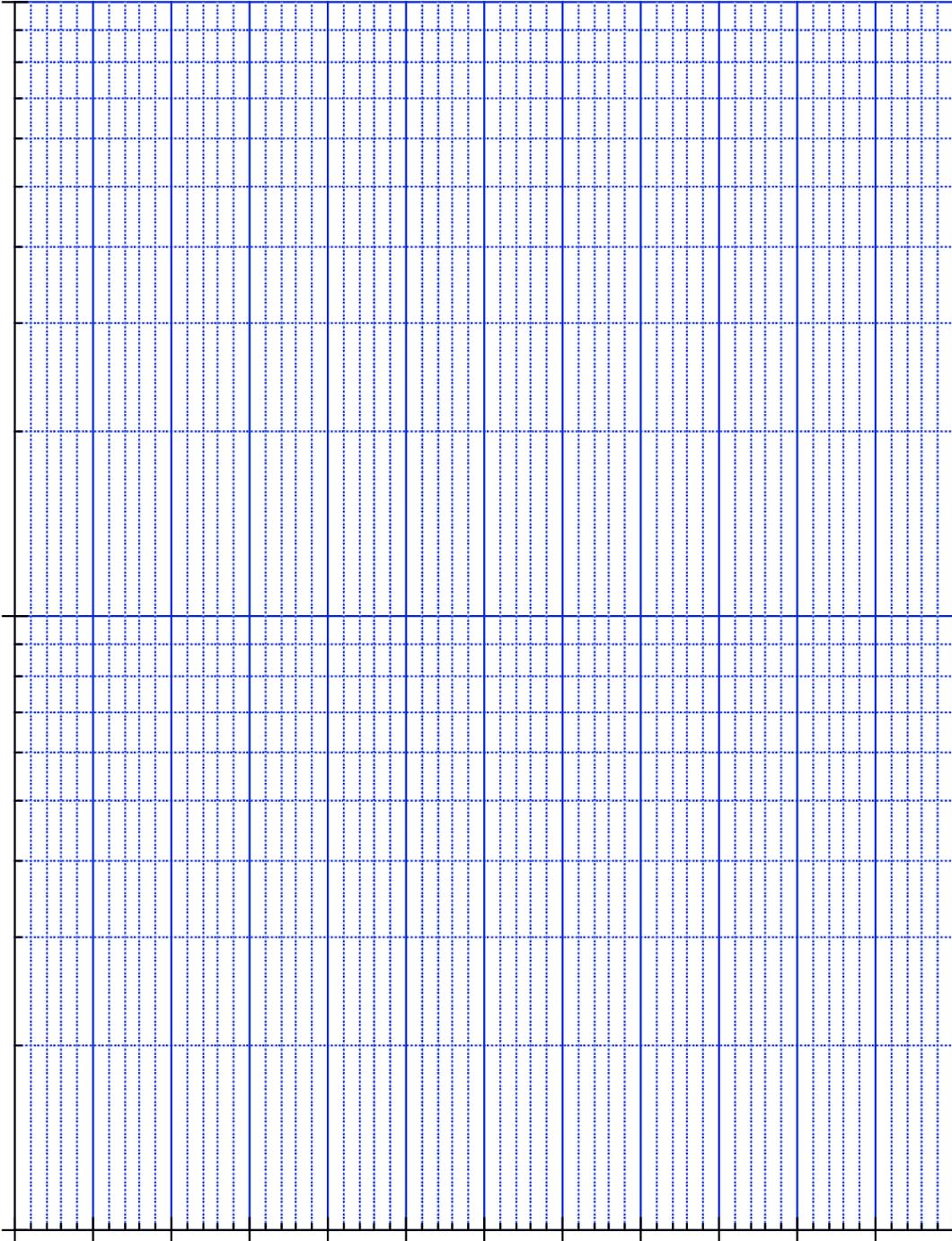
- d. Based on the information provided, write a equation for that describes the decay of the technetium Tc99m sestamibi.

- e. How much radioactivity (in MBq) will remain in the patient 1 day after the injection?

- f. The shipping delay on Technetium Tc99m sestamibi is 2 days. How much radioactivity should be shipped?

Graph Paper





CHAPTER 14
DENSITY

NOTES**Outline**

- Rationale
- Definitions of density, specific gravity and specific volume
- Measuring density and specific gravity
- Archimedes principle and density and specific gravity measurements
- Powders and bulk density
- Problems

Definitions And Concepts

- Density (ρ) is the **mass per unit volume** of substance.
- Density has dimensions of mass/volume and units such as **g/cm³**, **g/ml**, kg/m³, lbs/ft³, grains/fluid ounce.
- **Specific gravity (SG)** is density of the substance **relative** to the density of a reference substance, water. Equivalently, specific gravity is the ratio of the weight of the substance to weight of an equal volume of water.
- Specific gravity is a pure number and is **nondimensional**.
- **Specific volume (SV)** is the ratio of the volume of a given mass of the substance to volume of an equal mass of water.

$$SV = 1/SG$$

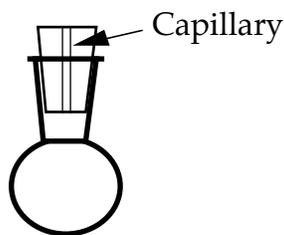
- Specific volume, like specific gravity, is **nondimensional**.
- The **density of water** at 4°C is **1.000 g/ml**.
- Therefore, the numerical value of volume of water (in ml or cm³) is the same as the weight in grams.
- Also, in units of **g/ml** or **g/cm³**, the **numerical value of the specific gravity is the same as that of density**.
- Density is **temperature dependent**. Therefore, the temperature of measurement must accompany any density measurement.
- **Calculation Example:** 30 ml of glycerin weigh 37.471 g. Calculate ρ , SG and SV.

$$\text{Density} = \rho = \frac{37.471 \text{ g}}{30 \text{ ml}} = 1.250 \text{ g/ml}$$

$$\text{Specific Gravity} = SG = 1.250$$

$$\text{Specific Volume} = SV = \frac{1}{1.250} = 0.8006$$

- **Pycnometer or Specific Gravity Bottle** is useful for measuring specific gravity of liquids. It is a simple device with known volume that is filled to capacity and weighed. The masses of equal volumes of the liquid of interest and water are measured. It is shown in the Figure below



- **Calculation Example:** A 50 g pycnometer, when completely filled with an oil of unknown density weighs 94.000 g. The pycnometer when filled with water weighs 100.000 g. Calculate the specific gravity of the oil.

$$\text{Specific Gravity} = SG = \frac{\text{Weight of Oil}}{\text{Weight of Water}} = \frac{94 - 50}{100 - 50} = 0.880$$

Archimedes' Principle

- A body immersed in a fluid experiences an apparent loss of weight.
- The apparent loss of weight is equal to weight of fluid displaced.
- Archimedes' principle is widely used to determine specific gravities.
- Archimedes' principle-based specific gravity measurements are convenient and accurate because they ingeniously eliminate volume measurements, which can introduce error. The volume measurements are substituted by weight measurements, which are more accurate. These approaches can be used to measure the density of solid objects and liquids.

Estimating Density

- You may occasionally have to estimate the density of a solution or suspension.
- The following common sense approach may come in handy in such estimation.
- Remember, these are estimates only. There may be situations when you more accurate results or need actual measurements.
- **Case 1: Dilute solutions of solids in liquids:** For dilute solutions of a solid dissolved in a liquid, we can often assume that the addition of the solid does not cause a change in total volume. Thus:

$$\text{Total mass} = \text{Mass of solvent} + \text{Mass of solute}$$

$$\text{Total volume} = \text{Volume of solvent}$$

From this, density of the solution can be easily calculated.

- **Case 2: Dilute suspensions of solids in liquids:** For dilute suspensions of **undissolved** solid in a liquid, we can often assume that the addition of the solid causes a full change in total volume. Thus:

$$\text{Total mass} = \text{Mass of solvent} + \text{Mass of solid}$$

$$\text{Total volume} = \text{Volume of solvent} + \text{Volume of solid}$$

- From these equations, the apparent density of the suspension can be estimated, provided the volume of the solid is known or calculated.

- **Case 3: Dilute solutions, suspensions or emulsions of liquids in liquids.** The equations of Case 2 can be used for liquid in liquid solutions, emulsions and suspensions. For some liquid-in-liquid-solutions, notably alcohol in water, there can be a substantial volume change upon dissolution and it is important to realize the limitations of the approach in these situations. Which assumption are violated?
- **Case 4: Mixtures of dissolved and undissolved solids and liquids:** When a preparation contains both dissolved and undissolved materials, a combination approach can be used to estimate apparent density.

Total mass = Mass of all the components

Total volume = Volume of solvent + Volume of liquids + Volume of undissolved solids

The apparent density can be calculated from the total volume and total mass.

Powder Density

Porosity of a Powder

- A powder is porous because it has pores or void volumes in its structure. There are two kinds of voids, voids between particles and void within particles. Let V_b be the **bulk or apparent volume** and V_p is the true volume of the particles in the powder. The **void volume** v , is given by:

$$v = V_b - V_p$$

- The void fraction is also called the **porosity** ε . It represents the fraction of the powder volume that is occupied by voids. The porosity is related to the

$$\varepsilon = \frac{V_b - V_p}{V_b} = \frac{\rho_p - \rho_b}{\rho_p}$$

- You have to be very specific when making references to powder density.
- The **True density**, ρ_p , is the density of the solid material constituting the powder. The volume measurement takes into account only the volume occupied by the powder. It does not consider the volume of the voids.
- The **bulk density**, ρ_b , is the density of the powder determined by dividing the powder mass by powder volume. The powder volume contains contributions from both the solids and from the voids between and inside granules.
- The **granule density**, ρ_g , is the density of each granule. The granule volume contains contributions from the solids and the intra-particle voids. Therefore,

$$\rho_p > \rho_g > \rho_b$$

- The bulk density is important in determining the packaging requirements of powders. The bulk density is often 2 – 20% of the true density. Thus, if the package size of say, a foot powder, were determined based on true density you might be wrong by an order of magnitude.
- Bulk density is easy to determine. Just measure the volume of the powder in a measuring cylinder and determine its weight. Industrially it is important to control bulk density because if it too high the package will seem less full to customers and if it is too low the package cannot be filled with the powder.

- The granule density is ideally determined by measuring the volume of mercury displaced. The mercury does not enter the small intra-particle pores (Why?) and is restricted to the surface of the particle. The granule density can be a determinant of dissolution because the intra-particle voids can enable fluids in the digestive tract to permeate the solid dosage form and this can hasten dissolution. The granule porosity or intra-particle porosity can be obtained from:

$$\epsilon_{\text{intraparticle}} = \frac{\rho_p - \rho_g}{\rho_p}$$

- The true density is ideally measured by using a helium displacement method. Helium enters every nook and cranny of the powder (Why is helium used?). This measurement provides an estimate for the true volume occupied by the solid part of the powder.
- True density and bulk density can be very different! Table 13.1 provides a comparison.

Table 13.1. Comparison of bulk density and true density for some pharmaceutical ingredients.

Ingredient	Bulk density g/cm³	True Density g/cm³	Ratio
Bismuth Subcarbonate	0.22	6.9	0.032
Magnesium Carbonate	0.07	3.0	0.023
Phenobarbital	0.34	1.3	0.26
Sulfathiazole	0.33	1.5	0.22
Talc	0.48	2.7	0.18

PROBLEMS

Problem 1

a. What are the units of density?

b. Why does specific gravity not have any units?

c. Why is the density in g/cm^3 numerically equal to the specific gravity?

d. How much does a **liter** of water weigh in **kilograms**?

f. How many kilograms does 1 cubic meter of water weigh?

Problem 2

- a. Define porosity. You can either give a formula or a definition. If you give a formula you must define the symbols.

- b. Is the bulk density usually greater than, less than or equal to the true density?

- c. What is the density of water in units of grains/fluidounce? Show how the value is derived from a specific gravity of 1.000. Give your answer to **FOUR significant figures**.

- d. Is density in grains/fluid ounce numerically equal to the specific gravity? Justify your answer.

- e. Ethanol has a density of 0.7939 g/cm^3 . Calculate its specific gravity. Be sure to indicate units of specific gravity if appropriate.

Problem 3

a. State Archimedes principle.

b. Why is Archimedes principle more useful for determining the density of irregular solids than determining the density by measuring the mass and volume?

c. Championship athletes and their coaches, supermodels, and princesses are particularly concerned about body composition measurements such as muscle mass and body fat content. One of the more accurate ways of determining body fat content in humans involves weighing the subject in water and (surprisingly) the use of Archimedes principle. **Outline** the physical principle/s or steps you think might be involved in this measurement. Be very brief. Use 6 sentences or less.

Problem 4

Phone 555-3784					
Dr. Stoma Guardcell 156 Xylem Road Palisade, CA					
Name	Phloem Mesophyll	Age	39	Weight	221 lb
Address	14 Cuticle St, Palisade, CA	Date	9/6/96	Height	5 ft 3"
R_x 2 liters of D5W over 16 hours.					
<u>S Guardcell M.D.</u>					

a. Calculate the density of D5W.

b. Determine the D5W flow rate prescribed in **ml/min**.

c. Determine the D5W **mass** flow rate in **g/min**.

Problem 5

Phone 555-3784			
Barbie Turate			
101 Sedate St.			
Lake Placid, NY			
Name	<u>Sally C. Late</u>	Age	<u>12</u>
		Weight	<u>60 lb</u>
Address	<u>Payne Ave, Hartburne, NY</u>	Date	<u>9/6/96</u>
		Height	<u>4 ft 4"</u>
<p><i>Rx</i> 30 g of activated charcoal stat for poisoning.</p> <p style="text-align: right;"><u>Barbie Turate</u> <u>M.D.</u></p>			

You have available an aqueous suspension (e.g., Actidose-Aqua) containing 200 mg activated charcoal per ml of **suspension**. Charcoal is completely **insoluble** in water and has specific gravity of 0.4000.

a. How much suspension (in ml) is required?

b. If you took 1 ml of the suspension, what volume would be occupied by charcoal?

c. If you took 1 ml of the suspension, what volume would be occupied by water?

d. Calculate the density of the suspension.

Problem 6

Phone 555-3784	DEA# AM0365420		
Dr. Virginia Washington, M.D. 101 State St. Union, NC 14003			
Name	Caroline Montana	Age	26
Address	Starr St., Stripes, NC 14004	Date	1/10/95
R Tolnaftate 1% Talc qs ad 50 g Sig: Apply powder to affected area bid for 3 weeks Refill			
<u>V Washington M.D.</u>			

This is a prescription for a foot powder similar to Tinactin[®]. The bulk density of the powder is 0.48 g/cm³ and the true density of the preparation is 2.88 g/cm³.

a. Calculate the minimum size of the container required for the prescription.

b. Calculate the porosity.

c. Calculate the volume of the voids in the powder.

Problem 7

Phone 555-3784			
Dr. Mark Pound, M.D. 1225 Lira Street, Peseto, NY 14226			
Name	<u>Penny Shilling</u>	Age	<u>70</u>
		Weight	<u>50 kg</u>
Address	<u>35 Guilder Ave, Peseto, NY</u>	Date	<u>9/6/06</u>
		Height	<u>5 ft 3"</u>
R_x	Epinephrine hydrochloride, 1: 1000		
	M ft 25 ml isotonic solution in NS		
	Sig: ii gtt ou during surgery		
	Mark Pound, MD		

a. What is the concentration of epinephrine hydrochloride in mg/ml?

b. How many mg of epinephrine hydrochloride are needed according to the prescription?

c. How much epinephrine hydrochloride would you weigh out? What volume of NS would you dissolve the amount weighed?

d. Epinephrine hydrochloride is completely soluble in NS at the concentration used. Calculate the density of the solution. Do not ignore the solute/s in NS.

Problem 8

Phone 555-3784			
Dr. Elaine Peterman, M.D. 1225 Newman Street, New York, NY 10226			
Name	Susan Castanza-Ross	Age	70
		Weight	90 kg
Address	35 Central Park West, NY	Date	9/6/06
		Height	5 ft 3"
Rx	Calcium carbonate	500 mg/5 ml	
	Magnesium carbonate	400 mg/5 ml	
	Water	qs	
	Mft	100 ml suspension	
	Sig:	15 ml bid	

This is a recipe for an antacid suspension. Both calcium carbonate and magnesium carbonate are **insoluble** in water. Calcium carbonate has a density of 2.5 g/ml and Magnesium carbonate has a density of 3 g/ml.

a. What instructions would you give the patient?

b. How many grams of calcium carbonate are required for the total preparation?

c. If you took 100 ml of the product, what volume would be occupied by the calcium carbonate?

d. If you took 100 ml of the product, what volume would be occupied by the magnesium carbonate?

e. Calculate the density of the preparation.

Problem 9

Phone 555-3784			
Dr. Barbie Ninja-Turtle, M.D. 49 Sesame Street, Barney, ND 58008			
Name	G.I Joseph	Age	40
		Weight	100 kg
Address	2401 Bratz Parkway, Barney, ND	Date	1/16/07
		Height	5 ft 8"
Rx	Sodium bicarbonate parenteral solution 8.4% w/v Administer iv 2 mEq/kg over 4 hours		

Sodium bicarbonate, NaHCO_3 or $\text{Na}^+(\text{HCO}_3)^-$, has a molecular weight of 84. It is an alkalinizing agent used to treat metabolic acidosis.

a. What is the valence of sodium bicarbonate?

b. What is the concentration in mEq/ml?

c. How many mEq of acid will 1 ml of this solution neutralize?

d. What is estimated density of the solution? Sodium bicarbonate is completely soluble in water.

Problem 10

Phone 555-3784		Dr. R. Enema, M.D. 49 Emetic Avenue, Mydriatic	
Name	Ann Algesia	Age	30
Weight	80 kg	Date	1/6/07
Address	2401 Anastasia Parkway, Mydriatic	Height	5 ft 8"
<div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px; font-size: 2em; font-weight: bold;">RX</div> <div> <p>Castor oil 60 % w/v</p> <p>Water qs</p> <p>m ft SA suspension</p> <p>Sig: ss $\bar{3}$ for total colonic evacuation prior to surgery</p> </div> </div>			

Castor oil is a laxative and its concentration is expressed as a % weight in volume because it is a viscous liquid and is more readily weighed. The density of castor oil is 0.96 g/ml

a. What is the specific gravity of castor oil? Be sure to specify the right units.

b. What is density of castor oil in kg/m³?

c. What is the volume of castor oil in 100 ml of preparation?

d. What is the density of preparation in g/cm³?

e. What is the weight of a single dose of preparation (total preparation, not the dose of castor oil)?

Problem 11

Phone (617) 267-6731			
Dr. Samantha Sabrina			
Broom Street, Salem, MA 01970			
Name	Tabitha Hall-O'Ween	Age	35
		Weight	60 kg
Address	Spell Road, Salem	Date	1/16/07
		Height	5 ft 7"
Rx		Infuse 250 ml Intralipid iv over 5 hours	

Intralipid is an emulsion containing 20% w/v soybean oil and 2.5% w/v glycerol in water. Both soybean oil and glycerol are liquids but note that in this case, their concentrations are expressed as % w/v. Soybean oil has a specific gravity of 0.8 and glycerol has a specific gravity of 1.4.

- a. What is the infusion flow rate **per minute**? What is lipid dose, i.e., the dose of soybean oil?

- b. What volume does the soybean oil contribute to 100 ml of the preparation?

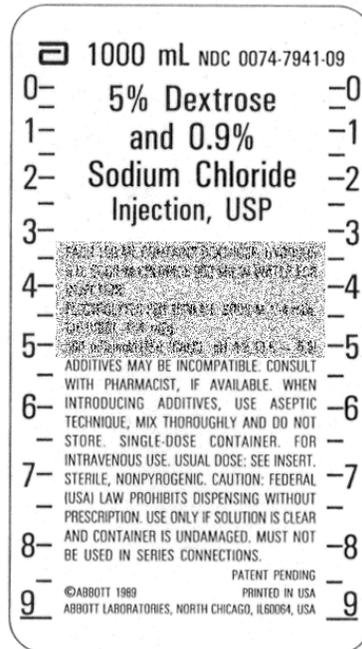
- c. What is the concentration of soybean oil in %v/v?

- d. What is the volume of water in 100 ml of the preparation?

- e. What is the density of the preparation?

- f. The maximum recommended daily dose of **emulsion** is 3 g/kg. Is this regimen safe?

Problem 12



Dr. Polly Andry, M.D.			
Phone 716-555-1234			
Name	Mona Gamous	Age	66
Address	15 Patriarch St	Date	8/18/97
Rx	Administer 1000 ml D5W/NS over 8 hours IV infusion		

The label for D5W/NS is provided. Use the prescription and the label to answer the following questions.

a. What is the **infusion** flow rate? What is the **dextrose** concentration in mg/ml?

b. What is the density of the preparation?

c. What is the mass of the preparation in the label?

Problem 13

Phone (617) 267-6731		DEA# BL -12736280	
Dr. Anne Lida, M.D. 3 Porifera Street Mollusca, GA			
Name	Nema Toda	Age	55
		Weight	71 kg
Address	Rotifera St, Mollusca, GA	Date	8/6/99
		Height	160 cm
Rx	Infuse iv fat emulsion containing 10 g/100 ml of soybean oil at 1 ml/min for 30 min		

Fat emulsions are used to prevent essential fatty acid depletion during total parenteral nutrition. Soyabean oil has a density of 0.9 g/ml and is insoluble in water. Fat emulsions are carefully formulated but treat this as an emulsion containing only oil and water.

a. Express the concentration of soybean oil as percentage % w/v.

b. What is the specific gravity of soybean oil?

c. If you had 100 ml of fat emulsion, what volume would be occupied by soybean oil?

d. What is the concentration of soybean oil in the preparation in % v/v?

e. Estimate the density of the preparation.

Problem 14

Phone (970) 728-6206		DEA# AC -12736280	
Dr. Goldie Copper, M.D. 3 Argon Ave Telluride, CO 81435			
Name	Radon Silver	Age	25
		Weight	65 kg
Address	Nickel Ave, Telluride	Date	7/2/02
		Height	170 cm
Rx	Reconstitute Kefzol in NS according to manufacturer instructions. Administer 500 mg q12h by slow iv injection over 3 min		

The manufacturers instructions read:

Add 2 ml of diluent to 500 mg Kefzol vial to give 225 mg/ml solution.

a. What is the volume of the preparation after dilution?

b. What volume is occupied by the Kefzol?

c. If you wanted to prepare a 250 mg/ml solution from the same vial, how much diluent would you add?

d. Estimate the density of the Kefzol solution in NS. Assume the sodium chloride does not contribute any volume on dissolution

Problem 15

Phone (970) 728-6206		DEA# AC -12736280	
Dr. Anther Sepal, M.D. 3 Pistil Ave, Carpel			
Name	Stamen Calyx	Age	33
		Weight	78 kg
Address	Corolla Ave, Carpel	Date	6/21/98
		Height	172 cm
Rx Sulfathiazole powder 25 g			

Unfortunately, sulfathiazole is still used in topical powders in some countries despite the risks for hypersensitivity reactions. Sulfathiazole has true density of 1.5 g/cm^3 and a bulk density of 0.333 g/ml .

- Estimate the minimum size of the container required for the powder.

- Calculate the true volume occupied by the particles of drug. Do not include the volume of the voids.

- Calculate the volume occupied by the voids.

- Calculate the porosity.

- Is the bulk density greater than of less than the granule density? Why?

Problem 16

Phone (970) 728-6206		DEA# AP -12736280	
Dr. Nectary Pedicel, M.D. 6 Articulation Ave, Flora, NJ			
Name	Perianth Bract	Age	55
		Weight	71 kg
Address	36 Filament Ave, Flora, NJ	Date	6/21/98
		Height	5ft 9 in
Rx	Sodium bicarbonate tablets USP		520 mg
	i tab tid		

Sodium bicarbonate has a true density of 2.033 g/ml and granule density of 1.45 g/ml.

a. Calculate the volume occupied by the solids in each tablet.

b. Calculate the apparent total volume of each tablet.

c. Calculate the volume of the voids in the tablets.

d. Calculate the porosity.

e. An intern claims to have measured the bulk density of the sodium bicarbonate powder used for making these tablets and has arrived at an answer of 1.55 g/ml. Is his measurement correct? Explain your reasoning

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