**Information**

Problems to hand in: Problem 1, 2, 5, 6, 7, 9(2)

Due: Week 2 09/07 in recitation or in lecture

Please staple your homework

**Problems**

1. **Evaluation of functions.** (1) Given $f(x) = x^3 - 3x^2 + x$, find $f(0), f(-2)$ and $f(3)$.
   
   (2) Given $g(x) = \frac{x^2 + 2x}{x^2 - 1}$, find $g(0)$ and $g(3)$.
   
   (3) If $f(x) = x^2 - 2x$, find $f(a + 2), f(x + h)$ and $f(x + h) - f(x)$.
   
   (4) If $g(x) = x^2 + 1$, find $g(x^2 + 1)$ and $g\left(\frac{1}{x^2}\right)$.
   
   (5) If $f(x) = x^3$ and $g(x) = 3 - 2x$, find $f(g(x))$ and $g(f(x))$.

2. **Plot the graph of a function.** (1) Suppose $f(x) = x^3 - 6x + 4$. Find the value of this function at $x = -3, -2, -1, 0, 1, 2, 3$.
   
   (2) Plot the sample points in (1) in the $xy$-plane, and then connect the points to a curve.

3. **Slope and steepness.** (1) Compare the slope of the lines drawn in the figure (3.1) and sort them in the order where the slope increases.
   
   (2) Match the lines in the figure (3.2) with the following expressions:
      
      (A) $y = 2x - 1$;  
      (B) $y = 2x + 3$;  
      (C) $y = -x + 3$;  
      (D) $y = 2$;  
      (E) $y = -\frac{1}{2}x$.

   ![Figure 3.1](image1)
   
   ![Figure 3.2](image2)

4. **Equation of straight lines.** Consider the straight line $L$ that passes through the points $(1, 7)$ and $(3, 3)$.
   
   (1) Find the equation of this straight line $L$.
   
   (2) Find the $x$-intercept and $y$-intercept of the line $L$.
   
   (3) Does the point $(2, 5)$ lie in the line $L$? Why?
   
   (4) Find the equation of the straight line which is parallel to the line in part (1), but passes through point $(-2, -1)$. 

![Image 3.1](image1)

![Image 3.2](image2)
5 **Equation of straight lines.** Consider the straight line $L$ that passes through the points $(-2, 3)$ and $(1, 2)$.

(1) Find the equation of this straight line $L$.

(2) Find the $x$-intercept and $y$-intercept of the line $L$.

(3) Does the point $(3, 1)$ lie in the line $L$? Why?

(4) Find the equation of the straight line which is parallel to the line in part (1), but passes through point $(2, 0)$.

6 **Demand function.** At ticket price $50$, the average attendance of a concert at the opera house was 4000. For each $1$ in excess of the ticket price, the attendance will decline by 100.

(1) Suppose $x$ is the ticket price and the $y$ is the concert attendance. Express $y$ as a linear function of $x$.

(2) If the price is $65$, how many tickets can be sold?

(3) Find the price of the ticket such that 5000 tickets can be sold.

7 **Domain.** Find the domain of the following functions:

(1) $y = 4x^2 + 5$; (2) $y = \sqrt{4 - x}$; (3) $f(t) = \frac{4 - t^3}{t + 1}$; (4) $f(t) = 2t - \sqrt[3]{t}$; (5) $y = \sqrt[3]{3 + x} - \sqrt[3]{3 - x}$; (6) $g(x) = \frac{2x}{\sqrt{x} + 3}$.

8 **Simplification of fractions.**

Simplify the following fractions until they are reduced:

(1) $\frac{2}{10}$; (2) $\frac{2/3}{4}$; (3) $\frac{10}{4/5}$; (4) $\frac{3/4}{5/6}$; (5) $\frac{x^3}{x^2}$; (6) $\frac{x+1}{2x+7}$;

Simplify the following expressions into a single fractional function, using common denominator:

(7) $\frac{2}{x} + \frac{4}{x+1}$; (8) $\frac{4}{x} \cdot \frac{x}{2} + \frac{2}{x}$; (9) $x + 1 + \frac{2}{x - 1}$; (10) $\frac{3x}{x - 2}$.

9 **Simplification of exponents.** (1) Compute the following expressions without using calculator:

$$3^3, \quad (-2)^3, \quad 1^{100}, \quad 0^{25}, \quad \sqrt{64}, \quad 49^{2}, \quad 5^{-1}, \quad 4^{-1/2}, \quad \left(\frac{1}{8}\right)^{-2/3}, \quad \sqrt[3]{3} \cdot \sqrt[3]{27}$$

(2) Simplify the following expressions with exponents (assuming $x$ is positive):

$$(x^{1/3} \cdot x^2)^6, \quad \frac{1}{x^3}, \quad \frac{x^{-1/2} \cdot 2x^2}{\sqrt{x}}, \quad x^4 \left(\frac{\sqrt{x}}{\sqrt{x}}\right)^3, \quad \frac{(-27x^3)^{2/3}}{\sqrt{x}}, \quad \frac{\sqrt{x^3 + 4x^2}}{x^3}$$

10 **Basic computation rules.** Determine if each of the following expressions is correct.

(1) $2x(x^2 + 1) = 2x^3 + 2x$

(2) $x^2 \cdot (3x) = (x^2 \cdot 3) \cdot (x^2 \cdot x) = 3x^2 \cdot x^3 = 3x^5$

(3) $\frac{2}{x^2 + x} = \frac{2}{x^2} + \frac{2}{x}$

(4) $\frac{x^2 + 2x}{x} = x + 2$;

(5) $(2x^3)^3 = 2^3 \cdot (x^3)^3 = 8x^6$;

(6) $\frac{a^3}{b^3} = \left(\frac{a}{b}\right)^3$

(7) $(x + a)^3 = x^3 + a^3$;

(8) $\sqrt[3]{2} + \sqrt[3]{3} = \sqrt[3]{2 + 3} = \sqrt[3]{5}$;

(9) $\sqrt[3]{2} \cdot \sqrt[3]{3} = \sqrt[3]{2 \cdot 3} = \sqrt[3]{6}$;

(10) $\frac{x^2}{x^2 + 2} = \frac{1}{x} = \frac{1}{1+2} = \frac{1}{3}$

(11) $\frac{3x^2}{4} = \frac{3}{4} x^2$;

(12) $\frac{2}{x^2} = \frac{2}{x^2}$;

(13) $(-2)^4 = -2^4$;

(14) $3 \cdot (-2)^3 = (-6)^2 = 36$
Answer to Homework 1

If you find any error, please tell me: yinsu@buffalo.edu. Bonus points will be rewarded.

1. (1) \( f(0) = 0, f(-2) = -22, f(3) = 3 \); (2) \( g(0) = 0, g(3) = \frac{15}{8} \);
   (3) \( f(a+2) = (a+2)^2 - 2(a+2) = a^2 + 2a, f(x+h) = (x+h)^2 - 2(x+h) = x^2 + 2xh + h^2 - 2x - 2h, f(x+h) - f(x) = (x+h)^2 - 2(x+h) - x^2 + 2x = 2xh + h^2 - 2h \);
   (4) \( g(x^2+1) = (x^2+1)^2 + 1 = x^4 + 2x^2 + 2, g(\frac{1}{x^2}) = \frac{1}{x^4} + 1 \);
   (5) \( f(g(x)) = (3-2x)^2 = 9 - 12x + 4x^2 \); \( g(f(x)) = 3 - 2x^2 \).

2. (1) \[
\begin{array}{c|cccc}
 x & -3 & -2 & 0 & 1 \\
 f(x) & -5 & 8 & 9 & -1 \\
\end{array}
\]
   (2) See the figure.

3. (1) \( L_3 < L_1 < L_2 < L_5 < L_4 \);
   (2) \( A) - L_5; \ (B) - L_4; \ (C) - L_3; \ (D) - L_1; \ (E) - L_2 \).

4. (1) \( y = -2x + 9 \); (2) \( (\frac{9}{2}, 0), (0, 9) \); (3) Yes; (4) \( y + 1 = -2(x + 2) \).

5. (1) \( y = -\frac{1}{3}x + \frac{7}{3} \); (2) \( (7, 0), (0, \frac{7}{3}) \); (3) No; (4) \( y - 0 = -\frac{1}{3}(x - 2) \).

6. (1) \( y = -100x + 9000 \); (2) 2500 tickets; (3) $40 per ticket.

7. (1) All real numbers; (2) \( x \leq 4 \); (3) \( t \neq -1 \); (4) All real numbers; (5) \( -3 \leq x \leq 3 \); (6) \( x > -3 \).

8. (1) \( \frac{5}{6} \); (2) \( -\frac{1}{6} \); (3) \( \frac{25}{2} \); (4) \( \frac{9}{10} \); (5) \( \frac{x^2}{x + 2} \); (6) \( \frac{(x + 1)^2}{2x(x + 2)} \); (7) \( \frac{6x + 2}{x(x + 1)} \); (8) \( \frac{2x^2 + 8}{x^3} \); (9) \( \frac{x^2 + 1}{x - 1} \); (10) \( \frac{3x^2}{x^2 - 2} \).

9. (1) \( 27, -8, 1, 0, 8, 7, \frac{1}{2}, 4, 9 \); (2) \( x^{14}, x^3, 2x, x^{3/2}, y^6, 9x^3, \frac{\sqrt{x} + 4}{x^2} \).

10. (1) \( T \); (2) \( F \); (3) \( T \); (4) \( T \); (5) \( T \); (6) \( T \);
    (7) \( F \); (8) \( F \); (9) \( T \); (10) \( F \); (11) \( T \); (12) \( F \); (13) \( F \); (14) \( F \).