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 \( f(a + 1) \), \( f(x + h) \) and \( f(x + h) - f(x) \);
   (4) If \( g(x) = x^2 + 1 \), find \( g(x^2 + 1) \) and \( g\left(\frac{1}{x}\right) \).

2. **Vertical line test.** Determine whether each of the curves is the graph of a function.

3. **Plotting 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) on \( xy \)-plane, and then connect the points to a curve.

4. **Piecewise functions.** Plot the following piecewise functions using sample points.

   \[
   (1) \quad f(x) = \begin{cases} 
   4 - x, & \text{for } -2 \leq x < 2 \\
   x^2 - 4x, & \text{for } 2 \leq x \leq 4 
   \end{cases} 
   \quad (2) \quad f(x) = \begin{cases} 
   2x + 4, & \text{for } -5 \leq x \leq -2 \\
   3, & \text{for } -2 < x \leq 1 \\
   6 - x^2, & \text{for } 1 < x < 3 \\
   3, & \text{for } x = 3 \\
   5 - x & \text{for } 3 < x \leq 5
   \end{cases}
   \]
5. **Domain.** Find the domain of the following functions:

(1) \( y = 4x^2 + 5 \); (2) \( y = \sqrt{4 - x} \); (3) \( f(x) = \frac{4 - t^3}{t + 1} \); (4) \( f(t) = 2t - \sqrt{7} \); (5) \( y = \sqrt{3 + x} - \sqrt{3 - x} \); (6) \( g(x) = \frac{2x}{\sqrt{x} + 3} \).

6. **Equation of straight lines.**

(1) Find the equation of line which passes through the points (1, 5) and (3, 3).

(2) Find the x-intercept and y-intercept of the line in (1).

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

7. **Slope and steepness.** Compare the slope of the lines drawn in the following graph and sort them in the order that the slope increases.

![Graph of lines](image)

8. **Simplification of fractions.** Simplify the following expressions until they are reduced, assuming \( x \) is in the domain:

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

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

(7) \( \frac{2}{x} + \frac{4}{x + 1} \); (8) \( \frac{4}{x^2} \left( \frac{x}{2} + \frac{2}{x} \right) \)

9. **Simplification of exponents.**

(1) Compute the following expressions without using calculator:

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

(2) Simplify the following expressions with exponents:

\[ (x^{1/3} \cdot x^2)^6, \quad \frac{1}{x^{-3}}, \quad \frac{x^{-1/2} \cdot 2x^2}{\sqrt{x}}, \quad x^4 \left( \frac{y^2}{\sqrt{x}} \right)^3, \quad \frac{(-27x^5)^{2/3}}{3\sqrt{x}}, \quad \frac{\sqrt{x^3 + 4x^2}}{x^3} \]
Answer to Homework 1

If you find any error in this homework or its answer, contact me at yinsu@buffalo.edu. You will get bonus points.

1. (1) 0, −22, 3; (2) 0, $\frac{15}{8}$; (3) $(a + 1)^2 - 2(a + 1)$, $(x + h)^2 - 2(x + h)$, $(x + h)^2 - 2(x + h) - x^2 + 2x$; (4) $(x^2 + 1)^2 + 1$, $\frac{1}{x} + 1$.

2. Graphs (2) (4) are functions. All the other functions fail the vertical line test.

3.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$-3$</th>
<th>$-2$</th>
<th>$-1$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$f(x)$</td>
<td>−5</td>
<td>8</td>
<td>9</td>
<td>4</td>
<td>−1</td>
<td>0</td>
<td>13</td>
</tr>
</tbody>
</table>

4.

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

6. (1) $y = -x + 6$; (2) $(6, 0), (0, 6)$; (3) $y = -x - 3$.

7. Slope: $L_3 < L_1 < L_2 < L_5 < L_4$.

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

9. (1) $27, -8, 1, 0, 8, 1, \frac{1}{2}, \frac{1}{8}, 9$; (2) $x^{14}, x^3, 2x, x^{5/2}y^6, 9x^3, \frac{\sqrt{144}}{x^2}$.