You are not responsible for Problems 7(c), 9, and 18 on Test 1.

1. Let \( f(x) = x^2 + 3x \) and \( g(x) = 4x - 1 \). Find:

   (a) \( f(g(x)) \);  
   (b) \( g(4 + f(-2)) \);  
   (c) \( f(1 + f(2)) \)

2. Evaluate the following limits:

   (a) \( \lim_{x \to 9} \frac{\sqrt{x} - 3}{x - 9} \);
   (b) \( \lim_{x \to -2} \frac{4x^2 + 7x - 2}{3x^2 + 17x + 22} \);
   (c) \( \lim_{x \to -1} \frac{2x + 1}{x - 1} \);
   (d) \( \lim_{x \to -3^+} \frac{2x + 1}{x - 1} \);
   (e) \( \lim_{x \to +\infty} \frac{3x^2 + 10}{12x^2 - 72} \);
   (f) \( \lim_{x \to -\infty} \left( 10 + \frac{1 - 6x}{3x + 12} \right) \);
   (g) \( \lim_{h \to 0} \frac{(2x + 3h)^2 - 4x^2}{7h} \);

3. Find the value of \( k \) so that the function \( f(x) = \begin{cases} 4x + 3k & \text{if } x < 2 \\ x^2 + 1 & \text{if } x \geq 2 \end{cases} \) is continuous.

4. Find the average rate of change of \( f(x) = x^2 - x \) on the interval \([-4, 3]\).

5. Find the instantaneous rate of change of \( f(x) = x^2 - x \) at \( x = 2 \).

6. Find the horizontal and vertical asymptotes for the following functions:

   (a) \( \frac{3x^2 + 10}{x^2 - 7x + 12} \)  
   (b) \( \frac{x - 6}{x(x^2 - 4)} \)  
   (c) \( \frac{x^2 - 9}{x - 3} \)  
   (d) \( \frac{x + 4}{x^2 - 16} \)

7. Find \( \frac{dy}{dx} \) for the following functions:

   (a) \( y = 4x^2 + \frac{x}{3} + \frac{3}{x} \)  
   (b) \( y = \sqrt{x} + \frac{1}{\sqrt{x}} \)  
   (c) \( y = \frac{2x + 1}{5x + 1} \)  
   (d) \( y = \frac{x^3 + 8x + 1}{x} \)

8. (a) Find an equation of the tangent line to the graph of \( y = f(x) = 4x^3 - 8x + 1 \) when \( x = 1 \).

9. If \( f'(x) = \frac{1 - 3x}{x^2 + 1} \), find an equation of the tangent line to the graph of the curve at the point \((2, 3/4)\).

10. At what points on the graph of the function \( y = f(x) = x^3 + 3x^2 - 24x + 10 \) is the slope of the tangent line equal to 9?

11. Suppose that the supply equation for a certain commodity is \( p = S(x) = 5 + .3x \) dollars and the demand equation is \( p = D(x) = 40 - .2x \) dollars. Find the equilibrium point \((x_0, y_0)\).
12. The total cost of producing $x$ units of a certain product is $C(x) = 800 + 24x - .1x^2$ dollars.

(a) Find the **marginal cost** function.
(b) At what production level $x$ does the marginal cost equal 14 dollars?
(c) Find the marginal cost when $x = 5$ units.
(d) Find the exact cost of the 6th unit.

13. A company which produces widgets has an initial investment of $10000.00. If each widget costs $21.50 to produce and can be sold at a price of $30.65, find:

(a) the equation for the total cost $C(x)$ and the total revenue $R(x)$;
(b) the break-even point (the intersection of the cost and revenue functions); (Round off to the closest integer).
(c) How many widgets must be sold to yield a profit of $8000.00 (Round off to the closest integer.)

14. A company invests $100,000.00 for equipment to produce a new product. Each unit of the product costs $11.40 and is sold for $17.98. Let $x$ be the number of units produced and sold. Find:

(a) The total cost function $C(x)$
(b) The total revenue function $R(x)$
(c) The total profit function $P(x)$.

15. The cost (in dollars) of producing $x$ units of some product is given by $C(x) = 2000+35x-.02x^2$.

(a) Find the marginal cost function.
(b) Find the marginal cost when $x = 10$.
(c) Find the exact cost of the 11th unit.

16. Let $y = f(x) = \begin{cases} 
\frac{4x^2+x-5}{x-1} & \text{if } x \neq 1 \\
8 & \text{if } x = 1 
\end{cases}$

(a) Evaluate $\lim_{x \to 1} \frac{4x^2+x-5}{x-1}$;
(b) Is $f(x)$ a continuous function at $x = 1$? Why or why not?

17. Write down an equation of a rational function (i.e., quotient of polynomials) which has vertical asymptotes at $x = 6$, $x = 0$, and $x = 21$ and a horizontal asymptote at $y = -29$.

18. Find $f'(2)$, if $f(x) = \frac{3 - 4x}{x^2 + 1}$.

19. Find the instantaneous rate of change of $g(x) = \sqrt{x}$ at $x = 4$.

20. Find $k$ so that the line segment through $(3, -2)$ and $(k, 2)$ is
(a) parallel to the line $3x + 2y = 8$.
(b) perpendicular to the line $5x - 2y = 8$. 