PART 1: MULTIPLE-CHOICE PROBLEMS

Each problem is worth 4 points: NO partial credit will be given. Calculators may NOT be used on this part. ScanTron forms will be collected after 1 hour.

1. Find the derivative of $g(x) = 2 + 3x + 4x^2 + x^3$.

   (a) $2x + \frac{3}{2}x^2 + \frac{4}{3}x^3 + \frac{1}{4}x^4$

   (b) $3 + 8x + 3x^2$

   (c) $5 + 8x + 3x^2$

   (d) $3 + 7x^2$

   (e) $2 + 8x + 3x^2$

2. If $\lim_{x \to a} f(x) = 9$ and $\lim_{x \to a} g(x) = 2$, then $\lim_{x \to a} \left[4\sqrt{f(x)} + 5g(x) \right] =$

   (a) $45 + 4\sqrt{2}$

   (b) 57

   (c) 22

   (d) 1

   (e) Can't be determined unless a is known.

3. Evaluate $\lim_{x \to \infty} \dfrac{3x^3 + 2x^2 + 5}{2x^3 + 7x}$.

   (a) 1

   (b) ∞

   (c) 0

   (d) $\frac{2}{3}$

   (e) $\frac{3}{2}$

4. Find the equation of the tangent line to the curve $y = f(x) = x^4 + 2x + 1$ at the point $x = 1$.

(a) $y - 4 = 6(x + 1)$

(b) $y - 6 = 4(x - 1)$

(c) $y - 4 = -6(x - 1)$

(d) $y - 4 = 6(x - 1)$

(e) $y - 6 = 6(x - 1)$

5. A line is given by the parametric equations $x = 2 + 3t$, $y = 4 + 12t$. Find the slope of this line.

(a) $-\dfrac{1}{4}$

(b) $\dfrac{1}{4}$

(c) -4

(d) 4

(e) 36

6. Consider the function $f(x) = \begin{cases} 3x - 1 & \text{if } x \leq 2 \\ x^2 + 2 & \text{if } x > 2 \end{cases}$. Which statement is true?

(a) $f(2) = 6$.

(b) $f(2)$ is not defined.

(c) $f(x)$ is continuous at $x = 2$.

(d) $\lim\limits_{x \to 2^-} f(x) = 6$.

(e) $\lim\limits_{x \to 2^+} f(x) = 6$.

7. The displacement of a particle moving in a straight line is given by $s = \frac{t^4}{4} - 8t + 3$. When is the velocity of the particle equal to zero?

   (a) $t = 0$

   (b) $t = 1$

   (c) $t = 2$

   (d) $t = 4$

   (e) $t = 8$

8. If $h(x) = f(x)g(x)$ and $f(3) = 4$, $g(3) = 2$, $f'(3) = -6$ and $g'(3) = 5$, then $h'(3) =$

   (a) -30

   (b) 8

   (c) 4

   (d) -14

   (e) -4

9. Only one of the following intervals contains a solution of the equation $2x^3 + x^2 + 2 = 0$. Which one?

   (a) $(-2, -1)$

   (b) $(-3, -2)$

   (c) $(-51, -50)$

   (d) $(0, 1)$

   (e) $(3, 8)$

10. Evaluate $\lim_{t \to 2} \dfrac{2t^2 + 6t}{5t - 5}$.

(a) $\dfrac{14}{5}$

(b) $\dfrac{2}{5}$

(c) $\dfrac{6}{5}$

(d) 4

(e) 1

11. Find the value of x that makes the vectors $\langle 1, x \rangle$ and $\langle 3 - 4x, 5 \rangle$ orthogonal.

(a) $x = -3$

(b) $x = -1$

(c) $x = 0$

(d) $x = 1$

(e) $x = 3$

PART 2: WORK-OUT PROBLEMS

Each problem is worth 8 points; partial credit is possible. Calculators are permitted ONLY AFTER the ScanTrons are collected. **SHOW ALL WORK!** *If you use a calculator, explain how.*

12. Find the derivative of $f(x) = \dfrac{1}{x}$ using **only** the **definition** of the **derivative** as a **limit**.

13. Find the **vector** projection of $5\mathbf{i}+12\mathbf{j}$ onto $3\mathbf{i}-4\mathbf{j}$.

14. Differentiate $f(x) = \dfrac{x^2 - 1}{2x^2 + 1}$.

15. Differentiate $g(x) = (1 + x + 2x^2)(2 + x^2 + x^3)$.

16. Evaluate $\lim_{x \to -\infty} (x + \sqrt{x^2 + 6x})$.

17. Find the value of the constant c that makes the function $f(x) = \begin{cases} cx+1, & \text{if } x \leq 2 \\ \frac{1}{4}cx^2 - 2 & \text{if } x > 2 \end{cases}$ continuous on $(-\infty, \infty)$. **Clearly EXPLAIN your answer!**

18. A triangle has vertices at the points $P(0,1)$, $Q(2,1)$ and $R(3,3)$. **Using vector methods:**
(a) Find the distances from R to P and R to Q.

(b) Find the cosine of the angle of the triangle at the vertex R.