PRINT Your Name:_____   Section:_____

There are 8 problems on 3 pages.   Problems 1 and 2 and are worth 20 points
each. The other problems are worth 10 points each. In problem 3 you MUST use
the definition of the derivative; in the other problems you may use any legitimate
derivative rule. SHOW your work. $\boxed{CIRCLE}$ your answer.

NO CALCULATORS!

1. **(The penalty for each mistake is five points.)** Let

$$f(x) = \begin{cases} 4 - x^2 & \text{if } x < 0, \\ x & \text{if } 0 \leq x \leq 1, \text{ and} \\ 2 - x & \text{if } 1 < x. \end{cases}$$

   (a) Graph $y = f(x)$.
   (b) Fill in the blanks:

   $f(0) =$ ___ $\lim\limits_{x \to 0^+} f(x) =$ ___ $\lim\limits_{x \to 0^-} f(x) =$ ___ $\lim\limits_{x \to 0} f(x) =$ ___

   $f(1) =$ ___ $\lim\limits_{x \to 1^+} f(x) =$ ___ $\lim\limits_{x \to 1^-} f(x) =$ ___ $\lim\limits_{x \to 1} f(x) =$ ___

   $f(2) =$ ___ $\lim\limits_{x \to 2^+} f(x) =$ ___ $\lim\limits_{x \to 2^-} f(x) =$ ___ $\lim\limits_{x \to 2} f(x) =$ ___

   (c) Where is $f(x)$ continuous?
   (d) Where is $f(x)$ differentiable?

2. Compute the following limits:
   (a) $\lim\limits_{x \to 3^+} \dfrac{x^2 - 9}{x - 3}$
   (c) $\lim\limits_{x \to 3^+} \dfrac{x - 3}{x^2 - 9}$
   (c) $\lim\limits_{x \to 3^+} \dfrac{x^2 - 9}{x + 3}$
   (d) $\lim\limits_{x \to 3^+} \dfrac{x + 3}{x^2 - 9}$

3. Use the DEFINITION of the DERIVATIVE to find the derivative of
   $f(x) = 4\sqrt{x - 3}$.

4. Graph $y = 3 + \sin x$.

5. Find the equation of the line tangent to $f(x) = 9x^{10} + 8x$ at $x = -1$.

6. Let $f(x) = x^2 \cos x$. Find $f'(x)$.

7. Let $f(x) = \dfrac{x^3 + 9x}{\sin x}$. Find $f'(x)$.

8. Let $f(x) = 9x^3 + \dfrac{9}{x} + 4\sqrt{x} + 16$. Find $f'(x)$.