PRINT Your Name:_____   Section:_____

There are 8 problems on 4 pages. Problems 1 and 5 and are worth 15 points each. Problem 8 is worth 20 points. The other problems are worth 10 points each. In problem 3 you MUST use the definition of the derivative. SHOW your work. $\boxed{CIRCLE}$ your answer.

NO CALCULATORS!

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

$$f(x) = \begin{cases} x^2 + 2 & \text{if } x < 0, \\ 3 - x & \text{if } 0 \le x \le 1, \text{ and} \\ x + 1 & \text{if } 1 < x. \end{cases}$$

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

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

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

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

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

2. Let $f(x) = 3x - 1$ and $g(x) = 2x^2 + 1$.
   (a) Find $(f \circ g)(x)$.
   (b) Find $(g \circ f)(x)$.

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

4. Graph $y = \sin 3x$. Mark a few points on each axis.

5. **(The penalty for each mistake is four points.)** The picture represents the graph of $y = f(x)$.
   (a) Fill in the blanks:

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

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

   $f(3) =$ ___ $\lim_{x \to 3^+} f(x) =$ ___ $\lim_{x \to 3^-} f(x) =$ ___ $\lim_{x \to 3} f(x) =$ ___

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

6. Find $\lim\limits_{x \to 0} \dfrac{1 - \cos x}{2x^2}$.

7. Express $\cos(x - y)$ in terms of $\sin x$, $\sin y$, $\cos x$, and $\cos y$.

8. Compute the following limits:

   (a) $\lim\limits_{x \to 4^+} \dfrac{x + 4}{x^2 - 16}$

   (b) $\lim\limits_{x \to 4^+} \dfrac{x^2 - 16}{x + 4}$

   (c) $\lim\limits_{x \to 4^+} \dfrac{x^2 - 16}{x - 4}$

   (d) $\lim\limits_{x \to 4^+} \dfrac{x - 4}{x^2 - 16}$