

PRINT Your Name: _____ Recitation Time _____

There are 9 problems on 4 pages. Each problem, unless otherwise noted, is worth 10 points. In one problem you are instructed to use the definition of the derivative; you **MUST** use the definition of the derivative in that problem. In the other problems you may use any legitimate derivative rule. **SHOW** your work. *CIRCLE* your answer. **NO CALCULATORS!**

- Graph $y = \cos x - 2$.
- Let $f(x) = 9x^4 + \frac{8}{x} + 3\sqrt{x} + 6$. Find $f'(x)$.
- (14 points) (**The penalty for each mistake is four points.**) The picture represents the graph of $y = f(x)$.

(a) Fill in the blanks:

$$\begin{array}{cccc} f(1) = \underline{\quad} & \lim_{x \rightarrow 1^+} f(x) = \underline{\quad} & \lim_{x \rightarrow 1^-} f(x) = \underline{\quad} & \lim_{x \rightarrow 1} f(x) = \underline{\quad} \\ f(2) = \underline{\quad} & \lim_{x \rightarrow 2^+} f(x) = \underline{\quad} & \lim_{x \rightarrow 2^-} f(x) = \underline{\quad} & \lim_{x \rightarrow 2} f(x) = \underline{\quad} \\ f(3) = \underline{\quad} & \lim_{x \rightarrow 3^+} f(x) = \underline{\quad} & \lim_{x \rightarrow 3^-} f(x) = \underline{\quad} & \lim_{x \rightarrow 3} f(x) = \underline{\quad} \end{array}$$

- Where is f continuous?
- Where is f differentiable?

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

- Let $f(x) = (x + 6)\sqrt{x}$. Find $f'(x)$.

- Find the equation of the line tangent to $f(x) = 10x^{11} + 12x$ at $x = -1$.

- Find $\lim_{x \rightarrow 0} \frac{1 - \cos x}{x^2}$.

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

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

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

$$\begin{array}{cccc} f(0) = \underline{\quad} & \lim_{x \rightarrow 0^+} f(x) = \underline{\quad} & \lim_{x \rightarrow 0^-} f(x) = \underline{\quad} & \lim_{x \rightarrow 0} f(x) = \underline{\quad} \\ f(1) = \underline{\quad} & \lim_{x \rightarrow 1^+} f(x) = \underline{\quad} & \lim_{x \rightarrow 1^-} f(x) = \underline{\quad} & \lim_{x \rightarrow 1} f(x) = \underline{\quad} \\ f(2) = \underline{\quad} & \lim_{x \rightarrow 2^+} f(x) = \underline{\quad} & \lim_{x \rightarrow 2^-} f(x) = \underline{\quad} & \lim_{x \rightarrow 2} f(x) = \underline{\quad} \end{array}$$

- Where is $f(x)$ continuous?
- Where is $f(x)$ differentiable?

9. (12 points – 3 points for each part) Compute the following limits:

(a) $\lim_{x \rightarrow 3^+} \frac{x^2 - x - 6}{x - 3}$

(c) $\lim_{x \rightarrow 3^+} \frac{x - 3}{x^2 - x - 6}$

(c) $\lim_{x \rightarrow 3^+} \frac{x^2 - x - 6}{x + 3}$

(d) $\lim_{x \rightarrow 3^+} \frac{x + 3}{x^2 - x - 6}$