1. [6] TRUE/FALSE: Circle T in each of the following cases if the statement is *always* true. Otherwise, circle F. Let f be a function and x and y be positive numbers.

   T   F $(x+y)^{-2} = \sqrt{x+y}$

   T   F $\lim_{x \to a}[3f(x)] = 3 \lim_{x \to a} f(x)$

   T   F $\lim_{x \to a} f(x) = f(\lim_{x \to a} x)$

   T   F   If $f'(a)$ exists, then $\lim_{x \to a} f(x) = f(a)$.

   T   F   The absolute value function is a differentiable function.

   T   F $\frac{d}{dx}(e^x) = xe^{x-1}$

   Show your work for the following problems. The correct answer with no supporting work will receive NO credit (this includes multiple choice questions).
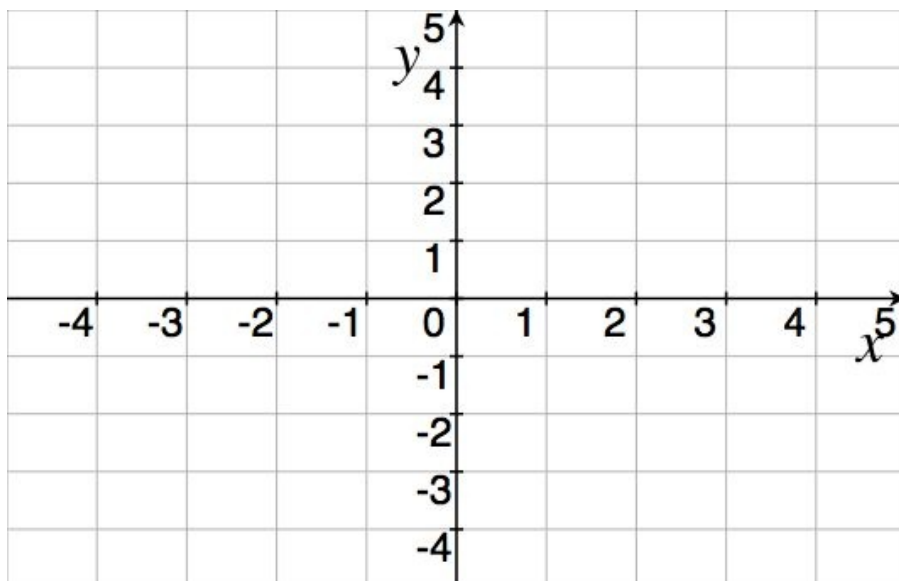
2. [4] (Quiz 2 #2) Sketch the graph of an example function f that satisfies the following conditions:

   (a) f is continuous everywhere but when $x = 3$

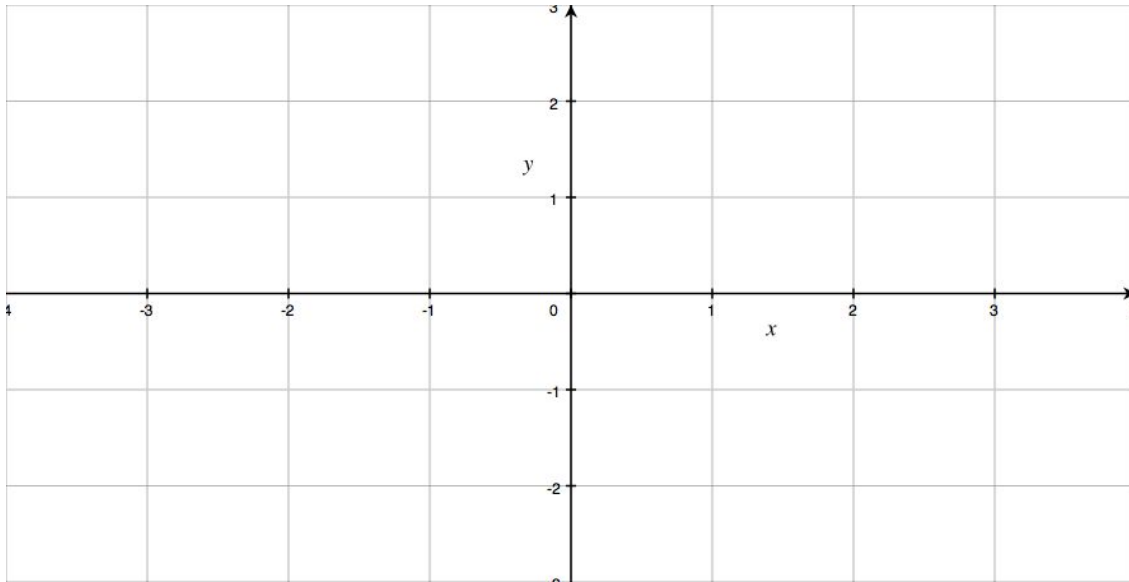   (b) $\lim_{x \to 3^-} f(x) = \infty$

   (c) $f(-1) = 2$

   (d) $f'(-1) = 0$

3. Let

$$g(x) = \begin{cases} \cos\left(\frac{\pi}{2}\right) & \text{if } x \leq 0, \\ -\frac{1}{2}x + 2 & \text{if } 0 < x < 3. \end{cases}$$

[3] *Carefully* graph g below.

[3 each] Use the graph above to find the following (if they exist!):

$\lim\limits_{x \to 0^+} g(x)$

$\lim\limits_{x \to -\infty} g(x)$

$g'(2)$

$\lim\limits_{x \to -2} [6g(x) - 5]$

[3] (§2.8 #9) Make a rough sketch of the graph of $g'(x)$:

4. [3 each] (§2.3 #3 & CalcWebW5 #4) Find the limit or explain why it does not exist.

$$\lim_{x \to -1} (3x^4 + 2x^2 - x + 1)$$

$$\lim_{x \to \infty} \frac{4 - 7x^2}{8x^2 + 3x}$$

$$\lim_{h \to 0} \frac{(2+h)^2 - (2+h) - 2}{h}$$

$$\lim_{x \to \infty} \frac{\sin x}{x^2}$$

5. [3] (CalcWebHW5 #13) If the tangent line to $y = f(x)$ at $(4, 3)$ passes through the point $(0, 2)$ find the following.

    (a) $f(4)$

    (b) $f'(4)$

6. Let $f(x) = x^2 - e$, where e is approximately 2.718.

    (a) [4] (Nice Derivative Wks #3) Find the equation for the line tangent to the graph of f, when $x = 1$.

    (b) [3] (Nice Derivative Wks #4) Find the point on the graph of f whose tangent line is parallel to the line defined by $3y = x + 3$.