1.) Differentiate each of the following functions. DO NOT SIMPLIFY ANSWERS.

a.) $y = x^{3/4} + \sqrt{123} - 2x^{-7}$

b.) $f(x) = \dfrac{2^x}{6 + e^{3x}}$

d.) $f(x) = (\ln x)^x$

2.) Let $f(x) = x(5 - x)^4$.

a.) Solve $f'(x) = 0$ for x .

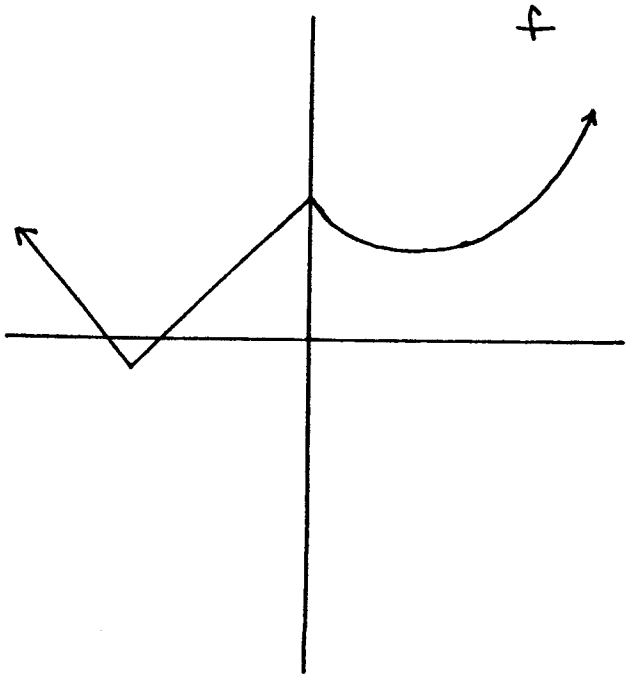
b.) Solve $f''(x) = 0$ for x .

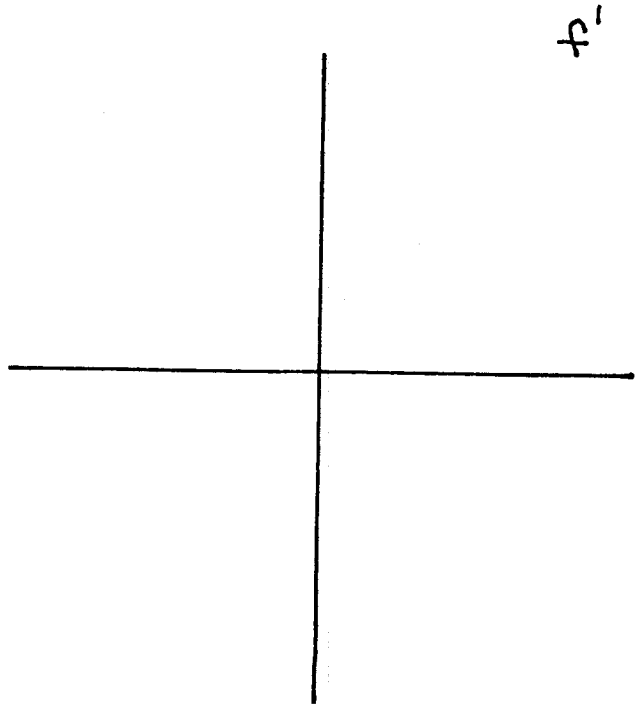
3.) Use the Intermediate Value Theorem to prove that the equation $x^3 = 4 - x$ is solvable. This is a writing exercise. You will be scored on proper style and mathematical correctness.

5. Use linearization to estimate the value of $\sqrt{8}$. DO NOT SIMPLIFY THE ANSWER.

5.) Assume that y is a function of x and $xy^2 + y = x + 3$. Determine an equation of the line perpendicular to this graph at $x = 0$.

6.) Sketch a graph of the derivative f' using the given graph of f.





6.

(a) State the definition of the derivative.

(b) Use the definition of the derivative to differentiate the function

$$f(x) = \frac{x}{x+7}$$

9.) **Find all points (x, y) on the graph of $f(x) = x^2$ with tangent lines to the graph of f passing through the point $(0, -1)$.**

8.) A 15-foot ladder is leaning against a wall. If the base of the ladder is pushed toward the wall at the rate of 2 ft./sec., at what rate is the top of the ladder moving up the wall when the base of the ladder is 6 ft. from the wall ?

3.) You are standing on the top edge of a building which is 96 ft. high. You throw an apple straight UP at 80 ft./sec. and watch as it falls back to the ground.

a.) Assume that the acceleration due to gravity is $s''(t) = -32$ ft./sec.^{2} . Derive velocity, $s'(t)$, and height (above ground), $s(t)$, formulas for this apple.

b.) In how many seconds will the apple strike the ground ?

c.) How high does the apple go ?

The following EXTRA CREDIT PROBLEM is worth . This problem is OPTIONAL.

1.) Evaluate the following limit : $\lim_{x \to 0} \dfrac{\sin x^2 \cdot \sin^2(\sin x^2)}{\cos^2 x^2 - 1}$