

Name: _____

Section: _____

IMPORTANT: All answers must include either supporting work or an explanation of your reasoning. These elements are considered part of the answer and will be graded.

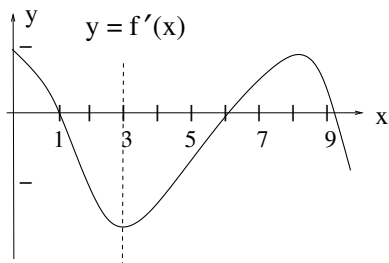
1. (15 pts) Let $f(x) = x^{1/3}$.

(a) Find the linear approximation to $f(x)$ at $x = 1$.

(b) Use the linear approximation in part (a) to estimate $(1.1)^{1/3}$. Round your answer to two decimal places. **Show supporting work.**

2. (15 pts) Use L'Hopital's rule to evaluate $\lim_{x \rightarrow 1} \frac{3x^2 - 2x - 1}{3x^2 + 8x - 11}$.

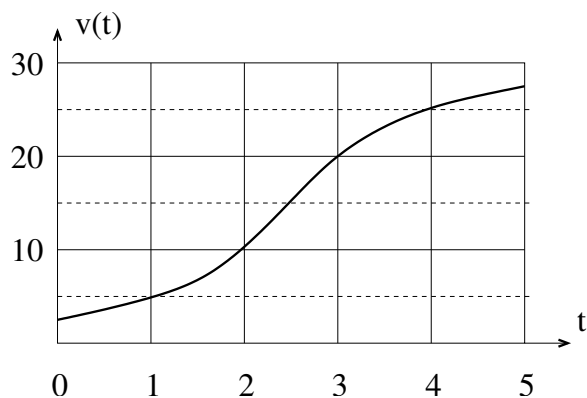
3. (10 pts) True or false (circle the correct answer): The graph of the **derivative** $y = f'(x)$ of $f(x)$ is shown below. The domain of $f(x)$ is the closed interval $[0,9]$. (**Caution:** This is **NOT** the graph of $y = f(x)$.)
- (a) The function $f(x)$ has a local minimum at $x = 6$. TRUE or FALSE
- (b) The function $f(x)$ is increasing on the interval $(3, 5)$. TRUE or FALSE
- (c) The graph of $f(x)$ is concave up on the interval $(5, 7)$. TRUE or FALSE



4. (15 pts) Let $f(x) = xe^{-3x} + 6$.
- (a) Find all critical points of $f(x)$.
- (b) Use calculus to find the point where $f(x)$ has a global maximum value and the point where $f(x)$ has a global minimum value, or indicate if one of these points does not exist.

5. (15 pts) A rectangular sheet of paper is to contain 72 square inches of printed matter with 2 inch margins at the top and bottom and 1 inch margins on the sides. No printed matter appears in the margins. What dimensions for the sheet will use the least paper? Draw a sketch with appropriate labels, find the derivative and critical points algebraically, and use your calculator to check your solution. Show all work.

6. (15 pts) The graph shown below is that of the velocity of an object (in feet/second). Approximate the total distance travelled from $t = 0$ to $t = 5$ seconds by using a left-hand sum and a right-hand sum with $n = 5$ subdivisions.



7. (15 pts) Suppose the revenue from selling q items is given by $R(q) = 0.25q^2 + 10q - 5$. The graph of $MC(q)$, the marginal cost, is given in the figure below.

(a) Determine a formula for the marginal revenue $MR(q)$ and sketch its graph on the same coordinate system below on which the graph of $MC(q)$ is drawn.

(b) Use the graphs of $MC(q)$ and $MR(q)$ to estimate the quantity q that maximizes profit.

