MTH 151
Exam 3
Spring 2025

Formula pages are at the end. You may pull them off.

Calculators are allowed. You may use a scientific calculator or a graphing calculator (e.g., TI-84) but not one with CAS (e.g., no TI-89, no TI-Nspire CAS). You may not use a phone app.

Show all work. Be neat and organized. Clearly indicate your answers.

100 points possible. 7 problems at 14 points each, plus 2 free points.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

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1. Find the differential dy of the given function.

(a) $y = \sqrt{25 - x^8}$

(b) $y = x^5 \cos(3x)$

2. Find the critical numbers of the function.

$$y = 3x^{2/3} - 8x$$

3. A rectangle with horizontal and vertical sides has one vertex at the origin, one on the positive x-axis, one on the positive y-axis, and one on the line $8x + 3y = 1800$. What is the maximum possible area of this rectangle?

You must set up the problem on a closed interval and use the Candidates Test (i.e., Closed Interval Method), showing all work, to justify your solution.

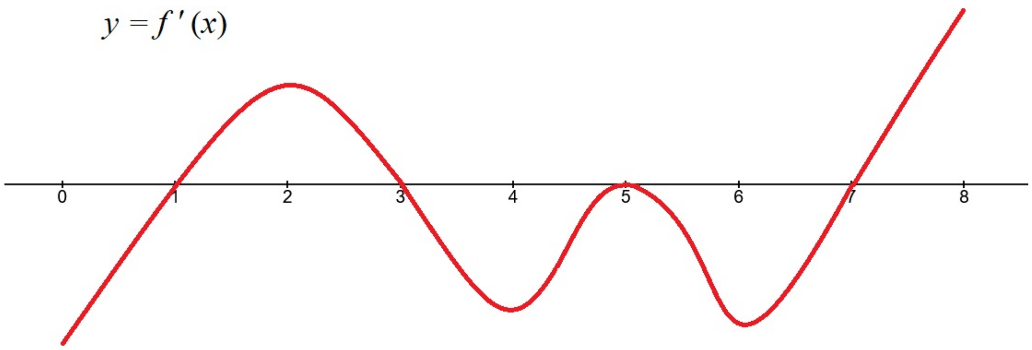
4. Verify that the function satisfies the three hypotheses of Rolle's Theorem on the given interval. Then find all numbers c that satisfy the conclusion of Rolle's Theorem.

$$f(x) = x^3 - 4x^2 - 11x, \qquad [-1, 6]$$

5. Verify that the function satisfies the hypotheses of the Mean Value Theorem on the given interval $[a, b]$. Then find all numbers c that satisfy the conclusion of the Mean Value Theorem.

$$f(x) = x^3 + 2x, \qquad [-1, 1]$$

6. The graph of the first derivative f' of a function f is shown. (Assume the function f is defined only for $0 \leq x \leq 8$.)



(a) (i) On what interval(s) is f increasing?

(ii) On what interval(s) is f decreasing?

(b) (i) At what value(s) of x does f have a local maximum?

(ii) At what value(s) of x does f have a local minimum?

(c) (i) On what interval(s) is f concave upward?

(ii) On what interval(s) is f concave downward?

(d) What are the x-coordinate(s) of the inflection point(s) of f?

7. For the following function, use the Second Derivative Test to identify local extrema. Just find the x-coordinates. If the Second Derivative Test is inconclusive, say so.

$$f(x) = x^4 - 12x^3$$