MTH 151
Exam 3
Fall 2022

Show all work in a neat and organized fashion. Clearly indicate your answers.
100 points possible.

Formulas and unit circle are on the last page, which you may pull off.

Graphing calculator OK but not one with CAS (e.g., no TI-89, no TInspire).

These formulas may or may not be useful.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \qquad L(x) = f(a) + f'(a)(x - a)$$

0. (2 pts.) Two free points

1. (14 pts.) Find the differential dy. Then evaluate dy for the given values of x and dx.

(a) $y = \cos x, \quad x = \pi/6, \quad dx = 0.3$

(b) $y = \sqrt{5 + x^2}, \quad x = 2, \quad dx = 0.06$

2. (14 pts.) The altitude of a triangle is increasing at a rate of 2 ft/min while the area of the triangle is increasing at a rate of 6 ft^2/min. At what rate is the base of the triangle changing when the altitude is 30 ft and the area is 750 ft^2?

3. (14 pts.) Use the Candidates Test (i.e., Closed Interval Method), showing all work, to find the absolute maximum and absolute minimum values of f on the given interval.

$$f(x) = 2x + \frac{128}{x}, \quad [2, 16]$$

4. (14 pts.) 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 $5x + 4y = 400$. 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.

5. (14 pts.) 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.

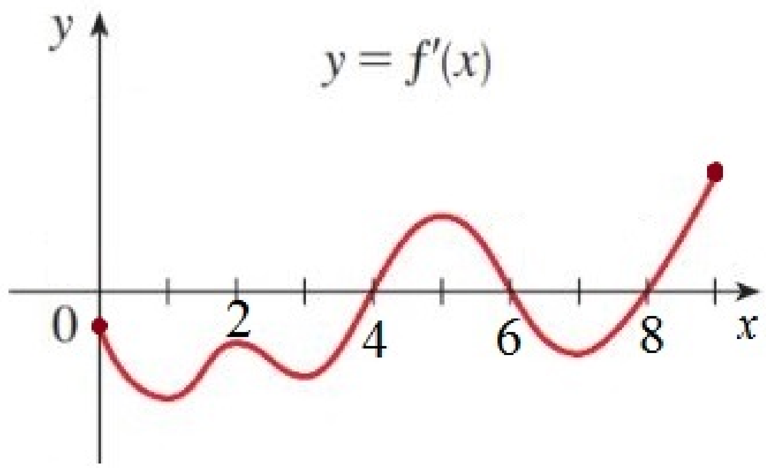
$$f(x) = 2x^2 - 10x + 15, \qquad [-1, 6]$$

6. (14 pts.) Researchers measured the average blood alcohol concentration $C(t)$ of eight men starting one hour after consumption of 30 mL of ethanol (corresponding to two alcoholic drinks). Selected values of $C(t)$ are shown in the table. The function C is known to be twice-differentiable.

t (hours)	1	3	5	7	9
$C(t)$ (mg/dL)	44	24	14	6	3

Explain why there must be at least one time t, for $1 < t < 9$, such that $C'(t) = -5$.

7. (14 pts.) The graph of the *derivative* f' of a function f is shown.



(a) On what intervals is f increasing? Decreasing?

(b) At what values of x does f have a local maximum? Local minimum?