

MATH 103 - MIDTERM II

- (a) You will be required to show all work. You will not receive credit for answers not accompanied by work, even on multiple choice questions.
- (b) You will not be able to use a calculator.
- (c) You are allowed one 8 1/2 x 11 inch cheat sheet.

(1) Find all of the critical values of $f(x) = x^3 - 9x^2 - 48x + 52$. and say whether they are local maxima, minima or inflection points.?

(2) Let $f(x) = x^5 + 8x^4 - 30x^3 + 30x^2 - 31x + 22$. What is the relationship between $f(x)$ and $g(x) = 5x^4 + 32x^3 - 90x^2 + 60x - 31$? Show that there is a number $c \in [-1, 1]$ such that $g(c) = -60$.

(3) The post office wants to construct a rectangular box (enclosed on all sides) whose base is square and has total surface area 8 square inches. What are the dimensions of such a box that maximizes the volume.

(4) A radio navigation system used by aircraft gives a cockpit readout of the distance, s , in miles, between a fixed ground station and the aircraft. The system also gives a readout of the instantaneous rate of change, $\frac{ds}{dt}$, of this distance in miles/hour. An aircraft on a straight flight path at a constant altitude of 4 miles has passed directly over the ground station and is now flying away from it. What is the speed of this aircraft along its constant altitude flight path when the cockpit readouts are $s = 5$ miles and $ds/dt = 210$ miles/hour?

(5) Calculate

(a)

$$\lim_{x \rightarrow 0} \frac{e^x - 1 - \ln(1+x)}{x^2}$$

(b)

$$\lim_{x \rightarrow \infty} x \ln(1 + 1/x)$$

(6) (a) What is the derivative of

$$f(x) = \sqrt{1 + \sqrt{2 + 3x^2}}$$

(b) Let $f(x) = (\cos(x))^{\sin(x)}$. Calculate f' .

(7) Graph the function

$$f(x) = \sin(x) - x$$

between -2π and 2π .

(8) Find the slope of the curve $y^3 = x^2 + xy$ at the point $(4/27, 4/9)$.