

MAT 161—Exam #3A—11/18/14

Name: _____

Calculators are NOT allowed. Show all work using correct mathematical notation.

1. (20 points) Consider the function $f(x) = 3x^5 - 20x^3$.
 - (a) Determine the intervals on which f is increasing/decreasing.
 - (b) Determine the intervals on which f is concave up/concave down.
 - (c) Sketch a graph of the function, clearly labeling the coordinates of all intercepts, local extrema, and inflection points.

2. (15 points) Evaluate each of the following limits. Show all work using correct notation!

(a) $\lim_{x \rightarrow \infty} \frac{\ln(5x + 2)}{\ln(4x + 3)}$

(b) $\lim_{x \rightarrow 0} \frac{e^{3x} - 1 - 3x}{1 - \cos 5x}$

3. (15 points) Evaluate each of the following indefinite integrals.

(a) $\int (2x^4 + e^{-2x} + 5 \sec^2 x + 7) dx$

(b) $\int \left(\sqrt{x} + \frac{3}{x^2} - \frac{6}{x} + 3 \sin 5x \right) dx$

4. (15 points) Consider the function $f(x) = \frac{1}{\sqrt{x}}$.

(a) Find the linearization $L(x)$ of $f(x)$ at $x = 4$.

(b) Use the linearization from part (a) to give an estimate for $\frac{1}{\sqrt{4.2}}$.

5. (10 points) Find the absolute maximum and minimum values of the function $f(x) = x \ln x$ on the interval $[e^{-2}, 1]$. *Hint:* Recall that $e > 2$.

6. (7 points) Find the interval(s) on which the function $f(x) = \frac{e^{2x}}{x+3}$ is increasing.

7. (18 points) You are asked to design a box of volume 500 cm^3 , with square base and no top. Find the dimensions that minimize the total amount of material used, and justify that your answer gives a minimum.