MAT 161—Exam #3—6/18/15

Name: ____

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

1. (20 points) Consider the function $f(x) = x^4 + 4x^3 + 1$.

   (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) $\lim_{x \to \infty} \dfrac{\ln(5x+2)}{\ln(4x+3)}$

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

3. (10 points) Find the absolute maximum and minimum values of $f(x) = x + \dfrac{1}{x}$ on the interval $[\frac{1}{2}, 3]$.

4. (15 points) Consider the function $f(x) = \ln x$.

   (a) Find the linearization $L(x)$ of $f(x)$ at $a = 1$.

   (b) Use the linearization from part (a) to give an estimate for $\ln(0.93)$.

5. (15 points) Evaluate each of the following indefinite integrals.

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

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

6. (10 points) Find the interval(s) on which the function $f(x) = \dfrac{e^{2x}}{x+3}$ is increasing.

7. (15 points) A rectangular storage bin with no top is to have volume 10 cubic meters. The length of its base is twice its width. Material for the base costs \$10 per square meter, and material for the sides costs \$6 per square meter. Find the dimensions of the cheapest such container.