Mathematics 16A. Summer 2009 **Instructor: Ian Herbert**

Final Exam

August 13, 2009, 8:00-10:00

Your Name: _____

SID: _____

Directions: This is a *closed* book exam. No calculators, cell phones, pagers, mp3 players and other electronic devices are allowed.
Remember: Answers without explanations will not count. You should **show your work** clearly. If I can not understand the work you are trying to show, I won't be able to give you credit for it. Solve each problem on its own page. If you need extra space you can use backs of the pages and the extra page attached to your exam paper, but make a note that you did so.
Note: Some answers will involve square roots. Unless otherwise noted, you may leave your answers in terms of square roots/improper fractions/natural logs/numbers with exponents/unsimplified expressions, although it will sometimes help to to simplify in the process of solving a problem.
Attention: The questions are ordered more or less by the order in which we encountered the material, NOT in order of difficulty. If you get stuck on a hard question, there might be an easier question later, so it could be to your advantage to move on and come back later.

Problem	Score
1	
2	
3	
4	
5	
6	
7	
Total	
Grade	

(20)

Problem 1 Let $f(x) = e^x - \frac{x^3}{6} + x^2 - 8x + 12$. Let $g(x) = f''(x)$ be the second derivative of $f(x)$.
a.) Find the minimum value of $g(x)$ and show that it is the minimum.

b.) Does $f(x)$ have an inflection point? Why or why not?

(30)

Problem 2

a.) Use a Riemann Sum to approximate the area between $y = (2x + 1)^2$ and $y = -4x + 13$ from $-1 \leq x \leq 1$ using $n = 4$ and right endpoints. Your answer should be a whole number.

b.) Find all functions that satisfy $f'(x) = \frac{-2}{(x-2)^2}$, $f(4) = 0$, and $f(0) = 4$.

(30)

Problem 3

a.) Find the area enclosed by the curves $f(x) = x^3 - x^2 - 2x$ and $g(x) = x^2 + x$.

b.) Find $\int_0^6 |x^2 - 6x + 5| dx$.

(20)

Problem 4 Let $f(x) = \int_{e^x}^{e^{2x}} (\ln t)dt$. Find $f'(1)$

(20)

Problem 5

a.) Find all numbers a so that the region enclosed by the curve $y = x^3$ and the straight line through the points (a, a^3) and $(-a, -a^3)$ has area 8. Hint: the straight line also goes through $(0, 0)$.

(20)

Problem 6 Find the volume of the truncated cone (a cone whose point has been cut off) with large radius $R = 9$, small radius $r = 3$, and height $h = 2$. HINT: You'll probably have to revolve something around something else.

(20)

Problem 7

a.) Suppose a bacterial colony starts with 10000 bacteria, and doubles in size every 3 years. Find the average number of bacteria over the next 9 years.

b.) When will the colony have this many bacteria?