You have 50 minutes to complete this test. You must *show all work* to receive full credit. Work any 6 of the following 7 problems. Clearly **CROSS OUT** the problem you do not wish me to grade. Each problem is worth 16 points, and you get 4 points for free, for a total of 100 points. The answers will be posted on the electronic reserves later today.

1.   Solve $e^{2y}y' - x^2 = 0$ if $y = 0$ when $x = 0$.

2.   The aerobic rating of a person x years old is given by $A(x) = 110\dfrac{(\ln x - 2)}{x}$ if $x \geq 10$. Find the age when a person's aerobic rating is a maximum.

3. Suppose you have $5000 to invest as a single lump sum. You have a choice of investing it either in (a) an account that has an 8.5% annual interest rate compounded quarterly, or (b) an account that has an 8.2% annual interest rate compounded continuously. At the end of your investment, you want to have an ending balance of $10000. Which account will achieve your goal faster?

4. Objects that are heating up or cooling down follow Newton's Law of Cooling. One specific example of this law you can use for this problem is

$T(t) = 70 - Ae^{-kt}$, where T is the temperature of the hot liquid, the outside air is $70°F$, A and k are constants, and t is the length of time in minutes. Over the upcoming cold weekend, you plan to have a nice hot cup of cocoa. When you first make the cocoa, it's $212°F$ (from the boiling water), and it is far too hot to drink. After 5 minutes, the cocoa has cooled to $160°F$, but it is still a little too hot. If the ideal drinking temperature is $140°F$, how long will you have to wait after you make the cocoa to drink it?

5.   a)   Solve for x: $-1 = 2\ln x - \dfrac{1}{3}\ln x$.

   b)   Solve for x (simplify): $x = \log_8 \dfrac{1}{32}$.

6.   Evaluate $\displaystyle\int x^2 \ln x \, dx$.

7. For the function $f(x) = xe^{-2x}$, list all intervals of increase and decrease, all maximum and minimum *points*, intervals where the function is concave up and concave down, all inflection *points*, and all asymptotes (or say there are none). Then sketch the graph of the function.