You have 50 minutes to complete this test. You must *show all work* to receive full credit. Work any 7 of the following 8 problems. Clearly **CROSS OUT** the problem you do not wish me to grade. Each problem is worth 14 points, and you get 2 points for free, for a total of 100 points. The answers will be posted on the electronic reserves later today.

1. Solve $\dfrac{dy}{dx} = \sqrt{xy}$ for y.

2. Evaluate $\displaystyle\int \dfrac{(\ln 2x)^3}{5x}\,dx$.

3. Find all maxima, minima and inflection points of $f(x) = 5 - 2e^{-x}$. Also give the intervals where f is increasing, decreasing, concave up, and concave down. Find all vertical and horizontal asymptotes, or state that none exist. Then carefully sketch the graph of f.

4. Find $f'(x)$ for the following functions. DO NOT simplify!

   (a) $f(x) = x^3 \ln(x^2 + 3)$

   (b) $f(x) = \dfrac{\ln \sqrt{x}}{e^{-2x} + 1}$

5.   Suppose you win a sweepstakes, and you get to choose how your prize money will be distributed to you. You can either take a lump sum payment of $10,000 now, or you can receive your prize as three payments: $4000 now, $4000 in one year, and $4000 in two years. The prevailing annual interest rate is 8% compounded continuously. Which method of payment will you choose, and why?

6.   Suppose 30 grams of a radioactive substance is sitting in a lab. Two years later, there are only 22 grams of radioactive material left. How long will it take until there are just 20 grams left?

7. a) If $\ln x = \dfrac{1}{3}(\ln 16 + 2\ln 2)$, solve for x. Your answer should be an integer, and be sure to show all your steps (i.e., don't just use your calculator).

   b) If $\log_3 a = 3$, $\log_3 b = 2$, and $\log_3 c = -4$, find $\log_3 \dfrac{a^3 \sqrt{b}}{c^2}$.

8. Evaluate $\displaystyle\int x\ln(x^2)\,dx$.