You have 50 minutes to complete this test. You must *show all work* to receive full credit. Work any 8 of the following 9 problems. Clearly **CROSS OUT** the problem you do not wish me to grade. Each problem is worth 12 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 $\dfrac{dy}{dx} = \dfrac{xy}{\sqrt{1-x^2}}$ if $y = 2$ when $x = 0$.

2.   Evaluate the following.

   (a) $\int 5e^{3x}\,dx$

   (b) $\int \dfrac{3x+6}{2x^2+8x+3}\,dx$

3. Find all maxima, minima and inflection points of $f(x) = xe^{-2x}$. Also give the intervals where f is increasing, decreasing, concave up, and concave down. Find all asymptotes. Then carefully sketch the graph of f.

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

(a) $f(x) = x^2 e^{-x}$

(b) $f(x) = \ln \sqrt{x^2 + 4x + 1}$

5. How long will it take for a $2000 investment to be worth $5000 if it grows at an annual rate of 8% compounded continuously?

6. A large turkey is placed in a 350°F oven at noon on Thanksgiving Day. The original temperature of the turkey is 70°F. Newton's Law of Cooling states that the temperature of the turkey t minutes later is given by a function of the form $f(t) = 350 - Ae^{kt}$. Suppose that after 1 hour, the temperature of the turkey is 100°F. A turkey is done when its temperature is 165°F. What time is dinner?

7. a)   Evaluate $e^{3\ln 4-\ln 2}$. Your answer should be an integer.

    b)   Find $\dfrac{1}{a}\ln\left(\dfrac{\sqrt{b}}{c}\right)^{a}$ if $\ln b = 6$ and $\ln c = 2$.

8.   A manufacturer estimates marginal revenue to be $200q^{-\frac{1}{2}}$ dollars per unit when the level of production is q units. The corresponding marginal cost has been found to be $0.4q$ dollars per unit. If the manufacturer's profit is \$2000 when the level of production is 25 units, what is the profit when the level of production is 36 units?

9. Evaluate $\int x \ln 3x \, dx$.