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 
$$\frac{dy}{dx} = y^2 \sqrt{4-x}$$
 if  $y = 2$  when  $x = 4$ .

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

(a) 
$$f(x) = \frac{4e^{3x}}{x^2 + 1}$$

(b) 
$$f(x) = \ln \sqrt{3x^2 + 4x - 1}$$

3. If you invest \$100,000 at 12% annual interest compounded continuously, how long will it take for you to become a millionaire?

4. Suppose that the undergraduate enrollment at S&T grows exponentially. According to the enrollment count on the registrar's webpages, in the fall of 2005, our total enrollment was 5602. It grew to 8889 by the fall of 2015. In what year will our enrollment top 10000?

5. a) If 
$$\log_2 x = 2(\log_2 3 - \log_2 5)$$
, find x.

b) If 
$$\ln a = -1$$
,  $\ln b = 2$ , and  $\ln c = 4$ , calculate  $\ln \frac{a^3}{\sqrt{bc}}$ .

6. Evaluate the following integrals:

a) 
$$\int (x^2 - 1)(x^3 - 3x)^4 dx$$

b) 
$$\int \frac{2x+3}{x^2} dx$$

c) 
$$\int x^2 \ln x \, dx$$

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