Your Name: _____

Exam II 4/7/99

Write your answers to the six problems in the spaces provided. If you must continue an answer somewhere other than immediately after the problem statement, be sure (a) to tell where to look for the answer, and (b) to label the answer wherever it winds up. In any case, be sure to circle your final answer to each problem.

If you need scratch paper, please ask for it.

You may refer to notes you have brought in on one or two sheets of paper (regular notebook or typing size) as announced in class.

If you have to evaluate a definite integral and the problem does not say otherwise, you may use symbolic techniques (finding an antiderivative and "plugging in") or numerical techniques. If you use your calculator, be sure to tell exactly what you do: Remember the notice below!

BE SURE TO SHOW YOUR WORK: YOU MAY RECEIVE REDUCED OR ZERO CREDIT FOR UNSUBSTANTIATED ANSWERS. IF YOU USE A CALCULATOR TO DO A SIGNIFICANT PART OF THE WORK ON A PROBLEM, WRITE OUT AN EXPLANATION OF JUST WHAT YOU ASKED THE CALCULATOR TO DO.

Problem	Points	Score
1	16	
2	18	
3	15	
4	18	
5	15	
6	18	
TOTAL	100	

Problem 1 (16 points) The population of a certain city is given by

$$P(t) = \frac{500,000}{1 + 8e^{-.05t}}$$

where t is time in years starting with 1920 as year zero.

- (a) What was the population in 1920?
- (b) What is the largest the population will ever be?
- (c) When is the population growing most rapidly? What is the population at that time?
- (d) Is the growth of population speeding up or slowing down at this time (1999)? (Note: this does not ask whether the population is growing or shrinking!)

Problem 2 (18 points) Evaluate the integrals:

(a)
$$\int \left(9x^3 - \frac{2}{x}\right) dx$$

(b)
$$\int_2^4 \frac{1}{x^2} dx$$

Problem 3 (15 points)

The graph at the right shows the cost Cand the revenue R for producing quantity q of a product. Label the following points on the graph: (use letter A to mark the answer to part A, etc.)

- (A) The point representing fixed costs of production.
- (B) The point where average cost is minimal.
- (C) The point where marginal cost is minimal.
- (D) The point where profit is maximal.
- (E) The point where revenues just break even with costs.



Problem 4 (18 points)

- (a) Find the largest value of the function $f(x, y) = 49 x^2 y^2$ on the line x + 3y = 10.
- (b) For what (x, y) does that maximum occur?
- (c) What would happen to that maximum if we changed the line to x + 3y = 8?

Problem 5 (15 points) Evaluate the integral:

 $\int 3x \, e^{2x} dx$

Problem 6 (18 points) The shelf life of a brand of potato chips has density function $p(t) = 4t - 4t^3$, for time measured from 0 to 1 week.

(a) What is the mean shelf life of the potato chips?

(b) What is the median shelf life of the potato chips?

(c) What fraction of the potato chips are sold within $\frac{1}{4}$ week after being put on the shelf?