MATH 122 Fall, 2001 Exam #1 Name:_____

There are 100 points. **For full credit you must show your work.**

1. (15 points) EPA inspectors have taken a sample of murky lake water and placed it in a tube. They shine a light of known intensity at one end of the tube and place a light sensor at various depths down the tube. The depth D is measured in cm and the intensity I is measured as a fraction of full power; here are the results:

D	0	1	2	3	4
I	.912	.560	.344	.211	.130

   a. Demonstrate clearly that I can not be a linear function of D.

   b. Give evidence, using all the values given in the table, that I is an exponential function of D, and write a suitable formula for this relationship.

2. (10 points) In many organisms the weight W is proportional to the cube (third power) of the largest "diameter" ℓ (length for fish and birds, height for humans and bears). If an organism weighs 800 grams and has a diameter of 40 cm, determine the constant of proportionality to 4 decimal places.

3. (20 points) Until recently automobile ownership in the US was growing exponentially at 3.6% a year, based on a poll that is taken once each year. In 1940, a total of 28.7 million families owned cars.

   a. How many families owned cars in 1943?

   b. Give a formula for the number of families owning cars, $N(t)$, where t is measured in years since 1940.

   c. How long did it take car ownership to triple (to 86.1 million families)?

   d. Since 1980 the rate of growth in car ownership has slowed, although ownership is still increasing. Sketch $N(t)$ as a function of t from $t = 0$ to $t = 60$, *i.e*, the year _____ . What concavity features does this graph exhibit?

4. (15 points) a. Assuming p is a linear function of q, write the slope intercept equation of the line. Also fill in the remaining spaces in the table.

q		-1	0	1		4
p	10	6		2	-1	-4

b. Find the formula for q as a function of p.

5. (15 points) A company that makes ceiling fans has fixed costs of \$7000 and variable costs of \$40 per fan. The company plans to sell the fans for \$75 each. Let q represent the number of fans. Give formulas for the cost function $C(q)$ and the revenue function $R(q)$. What is the break-even point in terms of number of fans?

6. (10 points) Using the graph of $r = f(p)$, given below, which variable is the dependent variable? _____ ? Determine the average rate of change (to two decimal places) from $p = 0$ to $p = 4$: _____ . At which value of p is $f(p)$ the greatest? _____ , and what is this greatest value? _____ .

7. (15 points) When you buy US Treasury bonds, the face value is the amount you will get in 20 years. Assuming that the interest is compounded continuously and you pay \$400 for a bond with face value \$1000, what annual interest rate is the government paying you?