MATH 122 Fall, 2000 Exam #1 Name:____________________

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

1. (33 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. What is the average rate of change of I from $D = 1$ to $D = 4$?

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

c. Assume that I is a discrete exponential function of D (due to different sediments at different depths). Give a formula for I as a function of D. You must use, in one way or another, all the values given in the table.

d. Predict the value of I for $D = 3.5$ cm to three decimal places.

2. (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 $p = 3$ ______ and from $p = 4$ to $p = 6$ ______ . At which value of p is $f(p)$ the greatest? ______ ?

3. (15 points) The amount of caffeine in a cup of coffee at time t is $A(t) = A_0 e^{rt}$, where A_0 is the initial amount. The half-life of caffeine in the body is about 4 hours. What is the "decay rate" r of the caffeine in the body? How long will it take for the level to fall by 75% of the original amount (hint: what per cent will remain)?

4. (8 points) The carrying capacity M is the maximum number of squirrels that can live on the Horseshoe successfully. The growth rate G of the population of squirrels on the Horseshoe is proportional to the product of the number of squirrels N and the difference between N and the carrying capacity M. Write the formula that gives G in terms of M and the present population N.

5. (12 points) Assume s is a linear function of t, with the following values.

s	10	6		0	-6	-7
t		-2	0	1	4	

a. Which is the **independent** variable? _______

b. The slope is $m =$ _______

c. Fill in the missing values, and find the formula for s as a function of t.

d. Write t as a linear function of s.

6. (15 points) A company that makes ceiling fans has fixed costs of \$9000 for a certain product line and variable costs of \$50 per fan. The company plans to sell these fans for \$80 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?

7. (7 points) The table below gives the concentration $C(t)$ of carbon dioxide (CO_2) in parts per million (ppm) in the atmosphere since 1960. Determine and fill in an appropriate scale for t. Use your calculator's curve-fitting or regression package to find the best exponential fit for this data, and give the formula. Then use the formula or your graph to estimate the amount of CO_2 in the atmosphere the year 2000.

year	1960	1965	1970	1975	1980	1985
t						
$C(t)$	316.8	319.9	325.3	331.0	338.5	345.7