Math 162
Exam 2

Show all work in a neat and organized fashion. Clearly indicate your answers.
100 points possible.

Units, Units, Units! Your answers must include the correct units.

1. (12 pts.) The table below shows the number of Toys R Us stores from 1984 through 1994 (from Toys R Us *1995 Annual Report*).

Year	Stores
1984	213
1986	338
1988	522
1990	712
1992	918
1994	1115

(a) Find the percentage change in the number of stores from 1986 through 1990.

(b) Find the average rate of change in in the number of stores from 1986 through 1990.

2. (12 pts.) The population density of Nevada from 1950 through 1990 can be approximated by the model

$$p(t) = 0.1273(1.05136)^t \text{ people/square mile}$$

where t is the number of years since 1900 (based on data from *State Rankings 1992. A Statistical View of the United States.* Lawrence, Kansas: Morgan Quitno Corporation, 1992).

(a) Find the average rate of change in population density from 1970 through 1980.

(b) Find the percentage change in population density from 1970 through 1980.

3. (4 pts.) Let $m(x)$ be the daily mean temperature (in degrees F) at a secret location on our planet, where x is the number of months into the year (i.e., $x = 1$ for January, $x = 2$ for February, etc.).

Select the sentence that best gives an interpretation of the following:

$$m'(8) = 7$$

A. When the daily mean temperature is 8 degrees F, the month is July.

B. From the beginning of the year to July, the daily mean temperature increased at a rate of 8 degrees F per month, on average.

C. In August, the number of months into the year is increasing at a rate of 7 months per degree F.

D. In August, the daily mean temperature is 7 degrees F.

E. From the beginning of the year to August, the daily mean temperature increased at a rate of 7 degrees F per month, on average.

F. The daily mean temperature is increasing at a rate of 8 degrees F per month, in July.

G. In August, the daily mean temperature is increasing at a rate of 7 degrees F per month.

4. (12 pts.) The population of Mexico for the period from 1980 through 1994 can be modeled by the equation

$$m(x) = 68.738(1.0213)^x \text{ million people}$$

where x is the number of years since 1980 (based on data from SPP and INEGI, Mexican Censuses of Population 1921 through 1990 as reported in Pick and Butler, *The Mexico Handbook*, 1994). Use the model to investigate $m'(13)$ numerically by choosing three increasingly close points. (You only have to give the units at the end.)

5. (4 pts.) Briefly state how average rates of change and instantaneous rates of change are measured *graphically*.

6. (16 pts.) The graph below shows sales (in thousands of dollars) for a small business from 1988 through 1996.

(a) Carefully draw a tangent line at 1994.

(b) Estimate the instantaneous rate of change in 1994. (Give correct units!)

(c) Estimate the derivative in 1994. (Give correct units!)

(d) Estimate the percentage rate of change in 1994. (Give correct units!)

7. (8 pts.) (a) At each point A, B, and C in the graph below, state whether the graph is concave up, concave down, or neither (an inflection point).

(b) At each point A, B, and C in the graph below, state whether the tangent line should lie above or below the curve (or neither).

8. (8 pts.) (a) In the graph below, estimate where the output is increasing most rapidly. Mark that point on the graph.

(b) In the graph below, estimate where the output is falling most rapidly. Mark that point on the graph.

9. (12 pts.) In the left column, four graphs are given. In the right column, their slope graphs are given, but not necessarily in the correct order. Match each graph with its slope graph.

10. (12 pts.) Use the four-step method to find the derivative of $y = 8x^2 - 7x - 13$.

(a) (Step 1) Write down $f(x)$.

(b) (Step 2) Find and simplify $f(x + h)$.

(c) (Step 3) Find and simplify $\dfrac{f(x+h) - f(x)}{h}$. Show all steps of the algebra clearly and neatly.

(d) (Step 4) Find the limiting value of $\dfrac{f(x+h) - f(x)}{h}$ as h approaches 0.