

# Test 1

Name: \_\_\_\_\_

**Show your work!** Answers that do not have a justification will receive no credit.

1. (10 points) The following is a graph of temperature  $T$ , in degrees F, as a function of time  $t$ , in hours over a three day period.

(a) What is the highest temperature during the three days?

Answer: \_\_\_\_\_

(b) When did the lowest temperature occur?

Answer: \_\_\_\_\_

2. (15 points) The area  $A$  of a square with side of length  $s$  is  $A = s^2$ .

(a) If  $s$  is increased from  $s = 2$  to  $s = 3$ , then what is the change in  $A$ ?

Answer: \_\_\_\_\_

(b) If  $s$  is increased from  $s$  to  $s + \Delta s$  what is the corresponding change in  $A$ ?

Answer: \_\_\_\_\_

(c) If  $s$  is increased by 30%, then what is the % increase in  $A$ ?

Answer: \_\_\_\_\_

3. (25 points) A man starts running along a straight road at a constant speed starting from his house. At 2:30PM he is 4 miles from home and 15 minutes later he is 6 miles from home.

(a) How fast is he running?

Answer: \_\_\_\_\_

(b) At what time did he leave home?

Answer: \_\_\_\_\_

(c) Give a formula for his distance from home in terms of the time. (Be sure to label all of your variables.)

Answer: \_\_\_\_\_

4. (25 points) Consider the following S-I-R model for the spread of chicken pox.

$$\begin{aligned}S' &= -.00002SI \\I' &= .00002SI - \frac{1}{8}I \\R' &= \frac{1}{8}I\end{aligned}$$

where  $S$  is the number of susceptibles,  $I$  is the number of infecteds, and  $R$  is the number of recovered, all measured in number of persons.  $S'$ ,  $I'$  and  $R'$  are the rates of change measured in number of persons per day.

(a) According to this model how long (on the average) is a person sick with the chicken pox? Answer: \_\_\_\_\_

Why?

(b) What is the threshold for  $S$ , so that if  $S$  is less than the threshold, the number on infecteds decreases, but if  $S$  is greater than the threshold the number of infecteds increases? Answer: \_\_\_\_\_

(c) Assume we find that on Monday morning the values of  $S$ ,  $I$  and  $R$  are  $S = 100,000$ ,  $I = 8,000$ , and  $R = 2,000$ . Then estimate the values of  $S$ ,  $I$  and  $R$  on Tuesday morning.

Answer: \_\_\_\_\_

5. (25 points) The number of guppies (a type of small, but very fast breeding fish) in a pond is modeled by the rate equation

$$G' = .0002G(1000 - G)$$

where  $G$  is the number of guppies in the pond and  $G'$  is the number rate of change measured in guppies per day.

(a) If the pond has no guppies and then 200 guppies are released in it, then are there more or less guppies on the next day? (HINT: Is the rate  $G'$  positive or negative?)

Answer: \_\_\_\_\_

Why?

(b) If in the last question 2,000 guppies are released then are there more or less guppies the next day?

Answer: \_\_\_\_\_

(c) If we count and find that at some time there are 600 guppies, then approximately how many guppies are there 12 hours latter?

Answer: \_\_\_\_\_

(d) What is the number of guppies if the population is stable in the sense that the number of guppies stays same form day to day?

Answer: \_\_\_\_\_