

Test 1

Name: _____

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

1. (20 points) Our favorite jogger has hurt her foot and is riding a bike for exercise. She is riding at a constant speed along a straight road starting from her house. At 3:30PM she is 4 miles from home and 15 minutes later she is 8 miles from home.

(a) How fast is she going?

(b) At what time did she leave home?

(c) Give a formula for her distance from home in terms of the time. (Be sure to label all of your variables, you will lose points if you do not.)

(d) At what time will she be 24 miles from home.

2. (20 points) A student is driving from Columbia to Miami. He gets on the interstate and for the first hour does 70mph. Then it starts to rain and he slows down to 50mph.

(a) Graph his speed as a function of the time he has been driving

(b) Graph his distance as a function of the time he has been driving.

(c) What is the total distance he has covered in the first 3 hours of his drive. **Explain how you get your answer in complete sentences.**

(d) Give a formula for the distance he has travel as a function of the time t he has been driving for $0 \leq t \leq 3$. (REMARK: This function may have different expressions on different intervals.)

3. (20 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: _____

4. (15 points) At the beginning of the year 300 guppies (a type of small, but very fast breeding fish) are released in a pond. It is known that the *per capita* growth rate of guppies is 1.3 guppies per month.

(a) What is the rate equation for the growth of the population of guppies in the pond. Label all variables you use.

(b) Give an estimate for the number of guppies a month after the first two hundred were released.

(c) Use your answer to part (b) to give an estimate for the net rate of change of the guppy population a month after the first 300 were released and use this to estimate the number of guppies two months after the first 300 were released.

(d) Write a short paragraph explaining how you could be a more accurate estimate for the number of guppies two months after the first 300 were released.

5. (15 points) The area A of a square with side of length s is $A = s^2$.

(a) If s is increased from $s = 4$ to $s = 5$, then what is the change in A ?

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

(c) If s is increased by 20%, then what is the % increase in A ?

6.(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?

(b) When did the lowest temperature occur?