4.3 Rates of Change Other Than Motion

Calculus Name: ______________________________ **CA #1**

1. The tide removes sand from a beach at a rate modeled by the function R, given by
$$R(t) = 1 + 6\sin\left(\frac{2\pi x}{25}\right).$$
A pumping station adds sand to the beach at a rate modeled by the function S, given by $S(t) = \frac{18t}{1+4t}$. Both $R(t)$ and $S(t)$ have units of cubic yards per hour and t is measured in hours for $0 \le t \le 10$. Find the rate at which the total amount of sand on the beach is changing at time $t = 6$.

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2. Tourists visiting an island resort contracted a mystery illness over a 45-day period. The health authorities recorded the rate of new cases per day and some of the rates are listed in the table below.

t Day	$N(t)$ New cases per day
2	3
6	8
10	15
15	30
25	100
35	50
40	22
45	10

a. Use the table to estimate $N'(20)$. Show the computations that lead to your answer. Indicate units of measure.

b. After studying the spread of the disease, the health department authorities decided they could model the number of new cases per with the model $R(t) = \frac{80000e^{-0.2t}}{(1+200e^{-0.2t})^2}$ for $0 \le t \le 50$ days. The disease is considered eradicated when the number of new cases per day does not exceed 5. Use $R(t)$ to find on what day this will occur.

c. Find $R'(20)$. Using appropriate units, explain the meaning of your answer in terms of the decay rate of the substance.

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3. The number of gallons, $P(t)$, of a pollutant in a lake changes at the rate $P'(t) = 2 - 4e^{-0.3\sqrt{t}}$ gallons per day, where t is measured in days. There are 100 gallons of pollutant in the lake at time $t = 0$.
Is the amount of pollutant increasing at time $t = 7$? Why or why not?

4.

t (minutes)	$R(t)$ (gallons per minute)
0	15
20	25
30	45
50	60
60	70
90	75

Use the data from the table to find an approximation for $R'(40)$. Show the computations that lead to your answer. Indicate units of measure.

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5. A store is having a 10-hour sale. The total number of shoppers who have entered the store t hours after the sale begins is modeled by the function E defined by $E(t) = 0.2t^4 - 10t^3 + 50t^2$ for $0 \le t \le 10$. At what rate are shoppers entering the store 4 hours after the start of the sale?

Answers to 4.3 CA #1

1. $S(6) - R(6) = -2.668$ yd^3 per hour	2a. $\frac{N(25)-N(15)}{25-15} = 7$ new cases per day per day	
2b: $R(t) = 5$ when $t \approx 48.274$. According to the model, the disease will be eradicated on the 49th day.	2c: On the 20th day, the rate of new cases per day is increasing by 7.6966 cases per day per day.	3. $P'(7) \approx 0.191 > 0$ so the amount of pollutant is increasing at this time.
4. $\frac{R(50)-R(30)}{50-30} = 0.75$ gallons per min^2	5. $E'(4) = -28.8$ shoppers per hour	