4.3 flipped math

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.

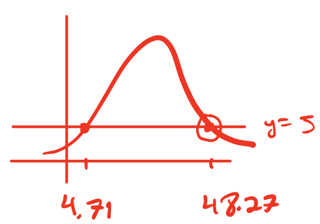
t Day	$N(t)$ New cases per day
2	3
6	8
10	15
15	30
25	100
35	50
40	22
45	10

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

$$\frac{N(25)-N(15)}{25-15} = \frac{100-30}{10} = 7$$

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.

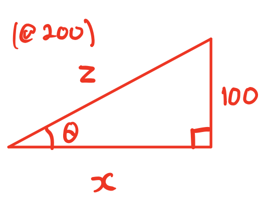
$$\left.\begin{aligned} Y_1 &= \frac{80\,000\,e^{-0.2x}}{(1+200e^{-0.2x})^2} \\ Y_2 &= 5 \end{aligned}\right\} \text{graph}$$



$\Rightarrow$ 49th day

§3.9 (small font)

28. A kite 100 ft above the ground moves horizontally at a speed of 8 ft/s. At what rate is the angle between the string and the horizontal decreasing when 200 ft of string has been let out?



$$\tan\theta = \frac{100}{x}$$

$$\sec^2\theta \cdot \frac{d\theta}{dt} = -\frac{100}{x^2}\frac{dx}{dt}$$

4.3 flipped math

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?

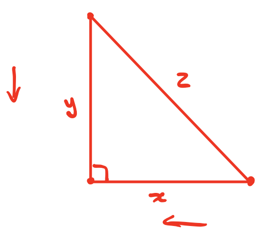
not relevant

$$P'(7) = 2 - 4e^{-0.3\sqrt{7}} \approx 0.19 > 0$$

$\Rightarrow$ amount of pollutant is increasing

4.5 flipped math

4. An air traffic controller spots two planes at the same altitude converging on a point as they fly at right angles to each other. One plane is 150 miles from the point moving at 450 miles per hour. The other plane is 200 miles from the point moving at 600 miles per hour. At what rate is the distance between the planes decreasing?

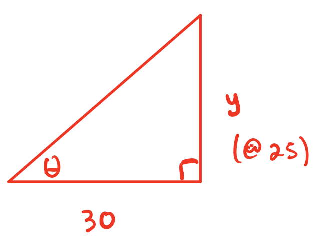


$$x^2 + y^2 = z^2$$

$$2x \cdot \frac{dx}{dt} + 2y \frac{dy}{dt} = 2z \cdot \frac{dz}{dt}$$

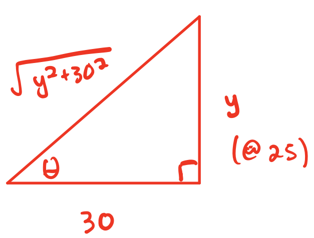
$150 \quad (-450)$

5. A balloon rises at a rate of 2 meters per second from a point on the ground 30 meters from an observer. Find the rate of change of the angle of elevation of the balloon from the observer when the balloon is 25 meters above the ground.



$$\tan\theta = \frac{y}{30}$$

$$\sec^2\theta \cdot \frac{d\theta}{dt} = \frac{1}{30} \cdot \frac{dy}{dt}$$



$$\cos\theta = \frac{30}{\sqrt{y^2+30^2}}$$

$$\cos^2\theta = \frac{30^2}{y^2+30^2}$$

$$2\cos\theta \cdot (-\sin\theta) \frac{d\theta}{dt} = \frac{-30^2}{(y^2+30^2)^2} \cdot 2y \cdot \frac{dy}{dt}$$

4.2 Position, Velocity, and Acceleration

Calculus Name: ______________________________ **CA #1**

1. A particle moves along a line so that its position at any time $t \geq 0$ is given by the function
$$s(t) = t^3 - 8t^2 + 20t - 16$$
where s is measured in meters and t is measured in seconds.

a. Find the instantaneous velocity at any time t.

$v(t) = 3t^2 - 16t + 20$

b. Find the acceleration of the particle at any time t.

c. When is the particle at rest?

$0 = v(t) = (t-2)(3t-10)$

$\Rightarrow t = 2, \frac{10}{3}$

d. What is the displacement of the particle for the first 3 seconds?