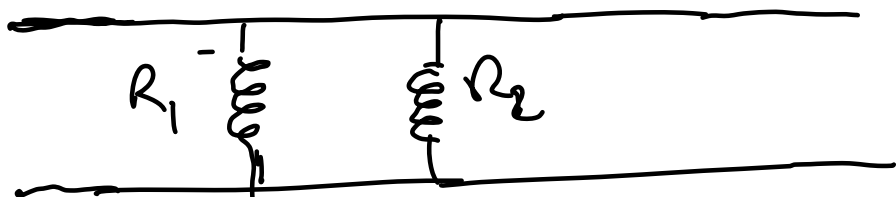


11/4/16 RELATED RATES

p 249 #35



$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

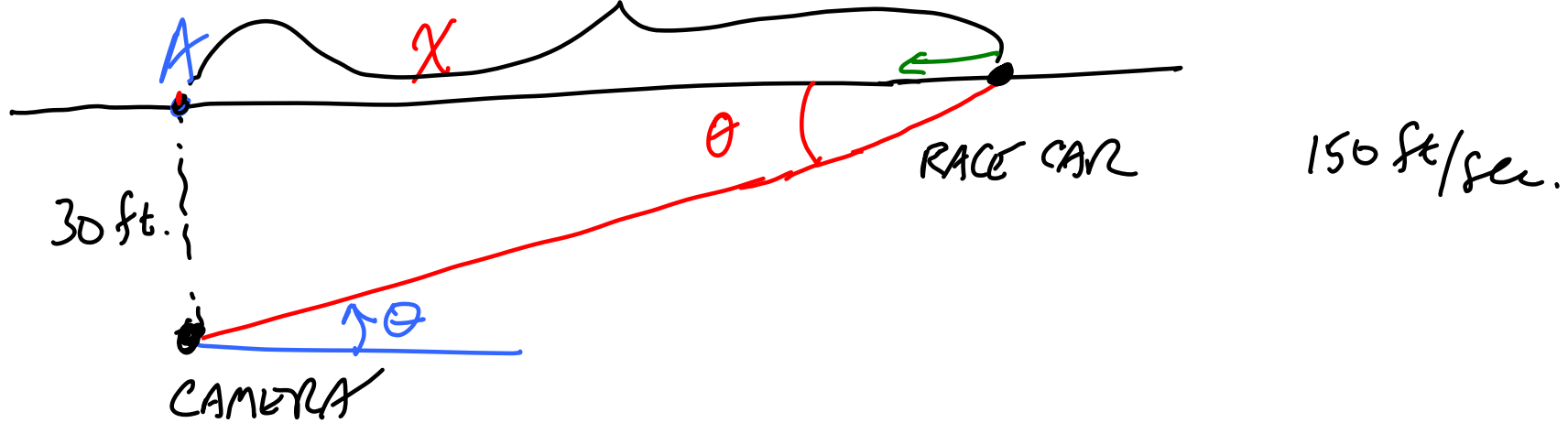
$$\frac{dR_1}{dt} = 0.3 \quad \frac{dR_2}{dt} = 0.2$$

What is $\frac{dR}{dt}$ when $R_1 = 80$ $R_2 = 100$?

DON'T NEED TO SOLVE FOR R — JUST DIFFERENTIATE IMPLICITLY.

$$-\frac{1}{R^2} \frac{dR}{dt} = -\frac{1}{R_1^2} \frac{dR_1}{dt} - \frac{1}{R_2^2} \frac{dR_2}{dt}$$

$$-\left[\frac{1}{80} + \frac{1}{100} \right] \frac{dR}{dt} = -\frac{1}{80^2} (0.3) - \frac{1}{100^2} (0.2)$$



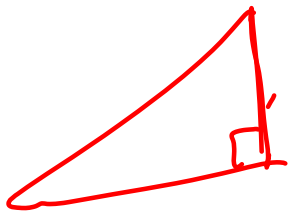
HOW FAST IS THE CAMERA ROTATING WHEN THE RACE CAR IS 100 ft FROM A? WANT $\frac{d\theta}{dt}$

$$\frac{dx}{dt} = -150$$

$$\frac{x}{30} = \cot \theta$$

$$\frac{1}{30} \frac{dx}{dt} = -\csc^2 \theta \frac{d\theta}{dt}$$

$$x = 100 \quad \left(\frac{100}{30} = \cot \theta \right)$$



$$\begin{aligned} \sin^2 \theta + \cos^2 \theta &= 1 \\ 1 + \cot^2 \theta &= \csc^2 \theta \end{aligned}$$

$$\frac{1}{30} (-150) = - \left[1 + \left(\frac{100}{30} \right)^2 \right] \frac{d\theta}{dt}$$

SAME QUESTION WHEN CAR IS DIRECTLY OPPOSITE THE CAMERA?

$$\theta = \frac{\pi}{2} \quad -5 = -1 \frac{d\theta}{dt} \quad \frac{d\theta}{dt} = 5 \frac{\text{rad}}{\text{sec}}$$

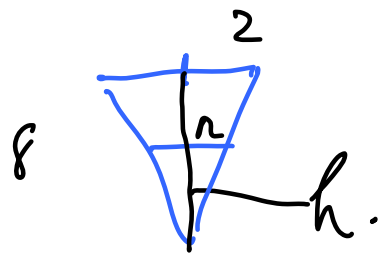
Find W 2016 #5

When $h = 5$

$$\frac{dh}{dt} = -0.15 \text{ m/min}$$

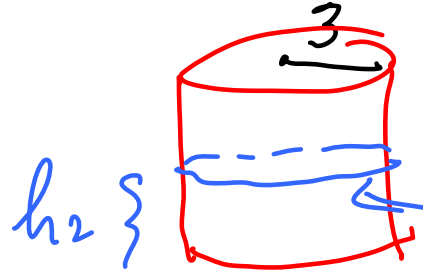


$$V_1 = \frac{\pi r_1^2 h_1}{3}$$



$$\frac{r}{h} = \frac{2}{8}$$

$$r = h/4$$



$$V_2 = \pi R_2^2 h_2 = 9\pi h_2$$

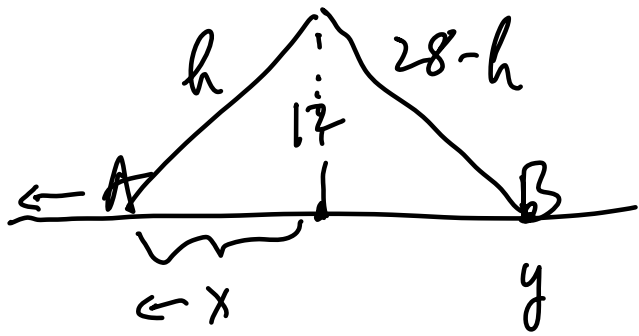
$$\text{So } V_1 = \frac{\pi \left(\frac{h_1}{4}\right)^2 h_1}{3} = \frac{\pi h_1^3}{48}$$

$$\frac{dV_1}{dt} = \frac{\pi h_1^2}{16} \frac{dh_1}{dt} = \frac{\pi}{16} 25 \cdot (-0.15)$$

$$\frac{dV_2}{dt} = \frac{\pi \cdot 25}{16} (0.15)$$

$$\ll 9\pi \frac{dh_2}{dt}$$

$$\frac{dh_2}{dt} = \frac{\frac{\pi \cdot 25}{16} (0.15)}{9\pi}$$



$$\frac{dx}{dt} = 7 \text{ ft/sec.}$$

what is $\frac{dy}{dt}$ when $x = 5$?

$$x^2 + 12^2 = h^2$$

$$y^2 + 12^2 = (28-h)^2$$

$$2x \frac{dx}{dt} = 2h \frac{dh}{dt}$$

$$2y \frac{dy}{dt} = 2(28-h) \left[-\frac{dh}{dt} \right]$$

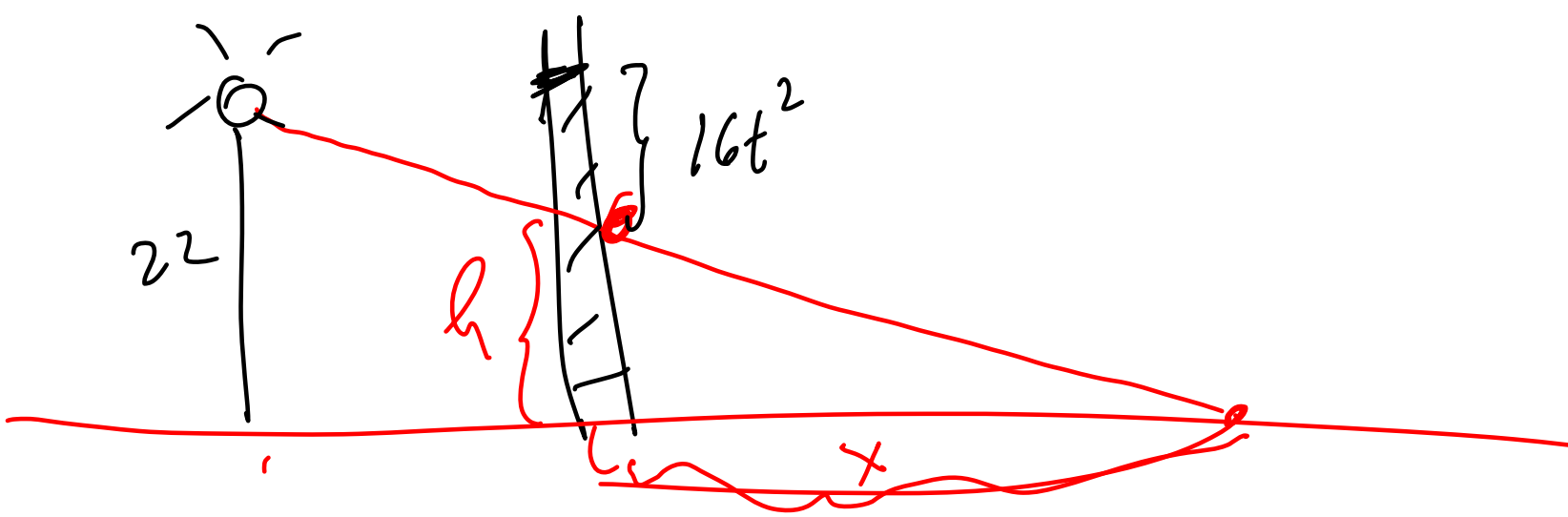
$$\text{if } x=5 \quad h = \sqrt{12^2 + 5^2} = \sqrt{169} = 13$$

$$2(5) \cdot 7 = 2 \cdot 13 \frac{dh}{dt}$$

$$y^2 + 144 = (15)^2$$

$$y = \sqrt{225 - 144} = \sqrt{81} = 9$$

$$\rightarrow 2 \cdot 9 \cdot \frac{dy}{dt} = 2(28-13) \left[-\frac{70}{26} \right]$$



Find $\frac{dx}{dt}$ when $t = \frac{1}{2}$.

$$h = 22 - 16t^2$$