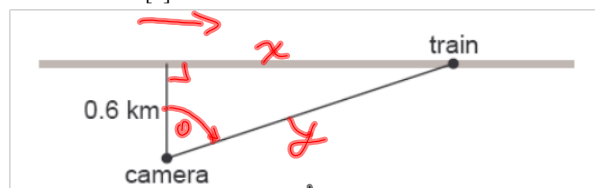


A high speed train is traveling at 2 km/min along a straight track. The train is moving away from a movie camera which is located 0.6 km from the track. The camera keeps turning so as to always point at the front of the train.

(a) How fast (in degrees per minute) is the camera rotating 15 seconds after the train passes by the camera? [4]

(b) How fast is the train moving away from the camera when the front of the train is 0.8 km from the camera? [4]

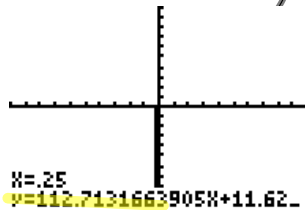


(a) $\tan \theta = \frac{x}{0.6}$ Let "t" Rep. time in minutes
 $x = 2t$

$$\tan \theta = \frac{2t}{0.6}$$

$$\theta = \tan^{-1} \left(\frac{2t}{0.6} \right)$$

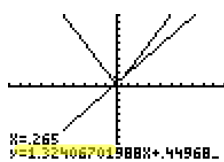
At 15 sec $\Rightarrow \frac{15}{60} = \frac{1}{4}$ min



IRC @ 0.25 minute = 112.7° /minute

(b) $x^2 + (0.6)^2 = y^2$
 $(2t)^2 + (0.6)^2 = y^2$

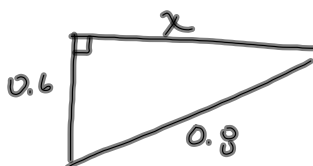
$$y = \sqrt{4t^2 + 0.36}$$



IRC = 1.32 km/minute

Let "t" Rep. time in minutes

$$x = 2t$$



$$x = \sqrt{(0.8)^2 - (0.6)^2}$$

$$x = 0.53$$

$$x = 2t$$

$$\therefore 2t = 0.53$$

$$t = \underline{0.265 \text{ minutes}}$$

A large spherical balloon is being inflated by an electric pump in such a manner that its radius is increasing at a rate of 0.08 m/s. Determine the rate at which the surface area of the balloon is increasing when the balloon has a volume of $36\pi \text{ m}^3$. [3]

(Volume of a sphere: $V = \frac{4}{3}\pi r^3$, Surface area of a sphere: $SA = 4\pi r^2$)

$$SA = 4\pi r^2$$

Let "t" Rep. time in seconds

$$6.03 \text{ m}^2/\text{sec}$$

$$SA = 4\pi(0.08t)^2$$

$$r = 0.08t$$

$$36\pi = \frac{4}{3}\pi r^3$$

IRC @ 37.5 seconds

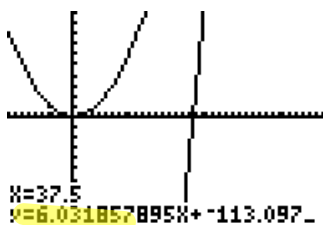
$$\frac{108\pi}{4\pi} = r^3$$

$$27 = r^3$$

$$r = 3$$

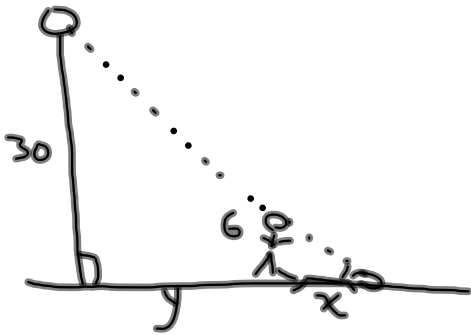
$$3 = 0.08t$$

$$t = 37.5 \text{ sec}$$



$$IRC = 6.03 \text{ m}^2/\text{sec}$$

A street light is mounted on a pole 30 feet above the ground. A young man 6 feet tall walks away from the street light at a rate of 3 ft./s. How fast is the length of his shadow increasing at the moment when he is 10 feet from the pole? [4]
 (TI-83 permitted to determine final solution)



$$\frac{30}{6} = \frac{x+y}{x}$$

$$30x = 6x + 6y$$

$$24x = 6y$$

$$y = 3t$$

$$x = \frac{6}{24}y$$

$$x = \frac{6}{24}(3t)$$

$$x = \frac{3}{4}t$$