Your car's speedometer is geared to accurately give your speed using a certain tire size: 13.5" diameter wheels (the metal part) and 4.15" tires (the rubber part).

(a) If your car's instruments are properly calibrated, how many times should your tire rotate per second if you are travelling at 40 mi/hr?

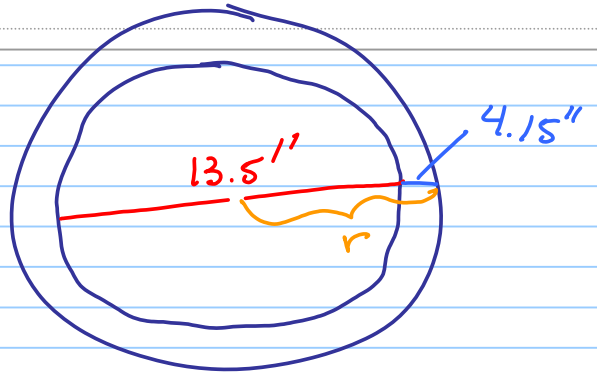
rotations = [ ]

Report answer accurate to 3 decimal places.

(b) You buy new 5.25" wheels and drive at a constant speed of 55 mph (according to your car's instrument). However, a cop stops you and claims that you were speeding. How fast did the radar gun clock you moving?

actual speed = [ ] mph

Report answer accurate to the nearest whole number.



$r = \frac{13.5}{2} + 4.15 = 10.9''$

a) Determine the distance the car travel with 1 tire revolution

$s = r\theta = (10.9\,in)(2\pi) = 21.8\pi\,in$

Now convert 40mph to inches per second

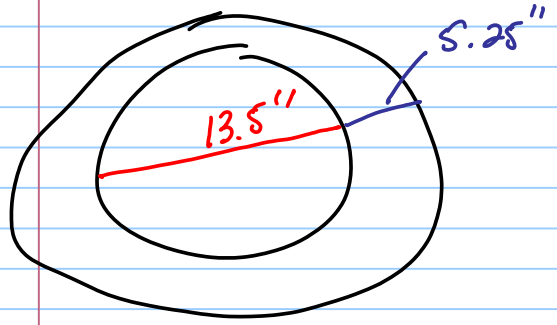
$$\frac{40\,mi}{1\,h} \cdot \frac{5280\,ft}{1\,mi} \cdot \frac{12\,in}{1\,ft} \cdot \frac{1\,h}{60\,min} \cdot \frac{1\,min}{60\,sec} = \frac{704\,in}{sec}$$

Since each revolution = 21.8π in

the number of revolutions is $\frac{704\,in}{21.8\pi\,in}$ per sec $\approx$ 10.279 rev/sec

b) new tire

Note Title 9/15/2011



$r_{new} = \frac{13.5}{2} + 5.25 = 12\text{in}$

$r_{old} = 10.9\text{in}$

Your speedometer uses the old radius

At 55mph, we need to determine the revolutions per second. Then use this with the new radius to determine the true speed.

$$\frac{55\text{mi}}{1\text{h}} \cdot \frac{5280\text{ft}}{1\text{mi}} \cdot \frac{12\text{in}}{1\text{ft}} \cdot \frac{1\text{h}}{60\text{min}} \cdot \frac{1\text{min}}{60\text{sec}} = \frac{968\text{ in}}{\text{sec}}$$

1 revolution $= 21.8\pi$ in using r_{old}

At 55 mph, revolutions/sec $= \frac{968\text{in}}{21.8\pi\text{ in}}$ per sec

≈ 14.134 rev/sec

Now determine the speed of 14.134 rev/sec using the new radius.

Note Title 9/15/2011

$$v = \frac{r\theta}{t}$$

1 rotation $= 2\pi$

$$v = \frac{12\text{in}\,(14.134 \cdot 2\pi)}{1\text{ sec}} \approx 1065.678\ \text{in/sec}$$

Now convert to mph

$$\frac{1065.678\text{ in}}{1\text{ sec}} \cdot \frac{60\text{ sec}}{1\text{ min}} \cdot \frac{60\text{ min}}{1\text{ h}} \cdot \frac{1\text{ ft}}{12\text{ in}} \cdot \frac{1\text{ mi}}{5280\text{ ft}} \approx 60.55\ \text{mph}$$

Wow! Is this physics class?