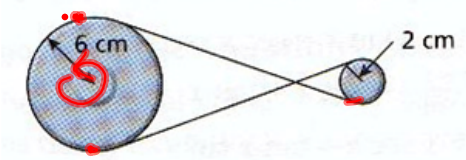
Practice Problems...

Pages 175 - 178
#3, 4, 5, 6, 7, 9, 11, 12, 13

Two flywheels are connected by a belt, as shown in the diagram below. The larger one has a radius of 6 cm and the smaller one has a radius of 2 cm.

Ratio: 3 : 1



(a) If the small wheel rotates –300°, then through how many radians does the large wheel rotate?

(b) If the large wheel rotates $\frac{7\pi}{6}$ radians, what distance would a point on the circumference of the small wheel rotate?

(a) Larger wheel:

$\theta = \frac{300^\circ}{3} \times \frac{(\pi)}{180^\circ}$

$\theta = \frac{100\pi}{180}$

$\theta = \frac{5\pi}{9}$

(b) $\theta = \frac{a}{r}$ Radians

$\frac{7\pi}{6} = \frac{a}{6\text{ cm}}$

$a = 7\pi$ cm

Arcs are equal on both wheels

Angular Velocity

Angular velocity - amount of rotation around a central point per unit of time

$V = \frac{d}{t}$

$$v_a = \frac{\theta}{t} \qquad \theta = \frac{a}{r}$$

θ = angle (radians)

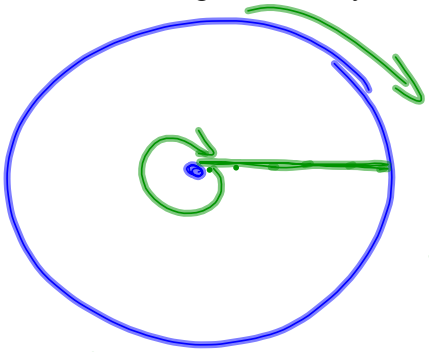
v_a = angular velocity

t = time

a = arc length

r = radius

Ex. The roller on a computer printer makes 2200 rpm (revolution per minute). Find the roller's angular velocity.



2200 RPM's ⇒

$V_A = \frac{\theta}{t}$

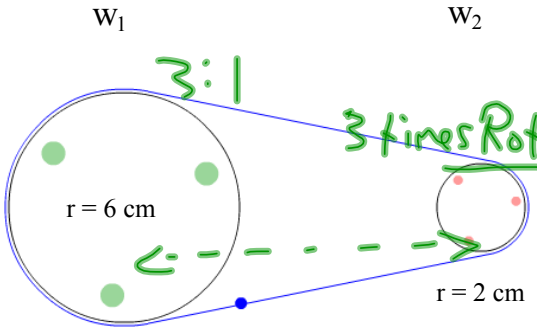
1 Rev = 360°

= 2π Rad

$2200 \frac{Rev}{min} \times \frac{2\pi Rad}{1 Rev} = 4400\pi \frac{Rad}{minute} \times \frac{1 min}{60s} = 73.3\pi$ Rad/sec

Ex. (a) If wheel 1 rotates 40 radians, how far has the belt traveled?

(b) Given the 40 rad rotation of wheel 1, what was the angle of rotation for wheel 2?



$\theta = \frac{a}{r}$

$40 Rad = \frac{a}{6 cm}$

$a = 240 cm$

3:1

3 times Rotation:

θ = 120 Rad

Ex. A small electrical motor turns at 2200 rpm.

(a) Express the angular velocity in rad/s.
(b) Find the distance a point 0.8cm from the center of rotation travels in 0.008 s.

radians

a) $2200 \frac{Rev}{min} \times \frac{2\pi Rad}{1 Rev} = 4400\pi \frac{Rad}{minute} \times \frac{1 min.}{60 sec}$

$= 73.3\pi Rad/sec$

b) $\theta = \frac{a}{r}$

$a = \theta r$

$a = (1.842)(0.8cm)$

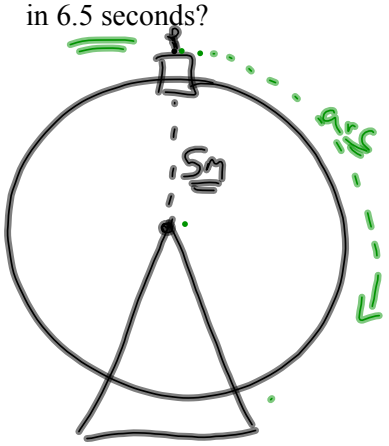
$a = 1.47cm$

$\theta = 73.3\pi \frac{Rad}{sec} \times 0.008 sec$

$\theta = 0.586\pi Rad$

$\theta = 1.842$

Ex. A Ferris Wheel rotates 3 times each minute. The passengers sit in seats that are 5 m from the center of the wheel. What is the angular velocity of the wheel in radians per second? What distance do the passengers travel in 6.5 seconds?



$V_A = \frac{\theta}{t}$

$= \frac{6\pi Rad}{60 sec}$

$= 0.314 Rad/sec$

$\theta = 3 Rev (2\pi) Rad$

$= 6\pi Rad$

took 1 minute (60 sec)

(b) $\theta = \frac{a}{r}$

$a = \theta r$

$a = (2.04 Rad)(5m)$

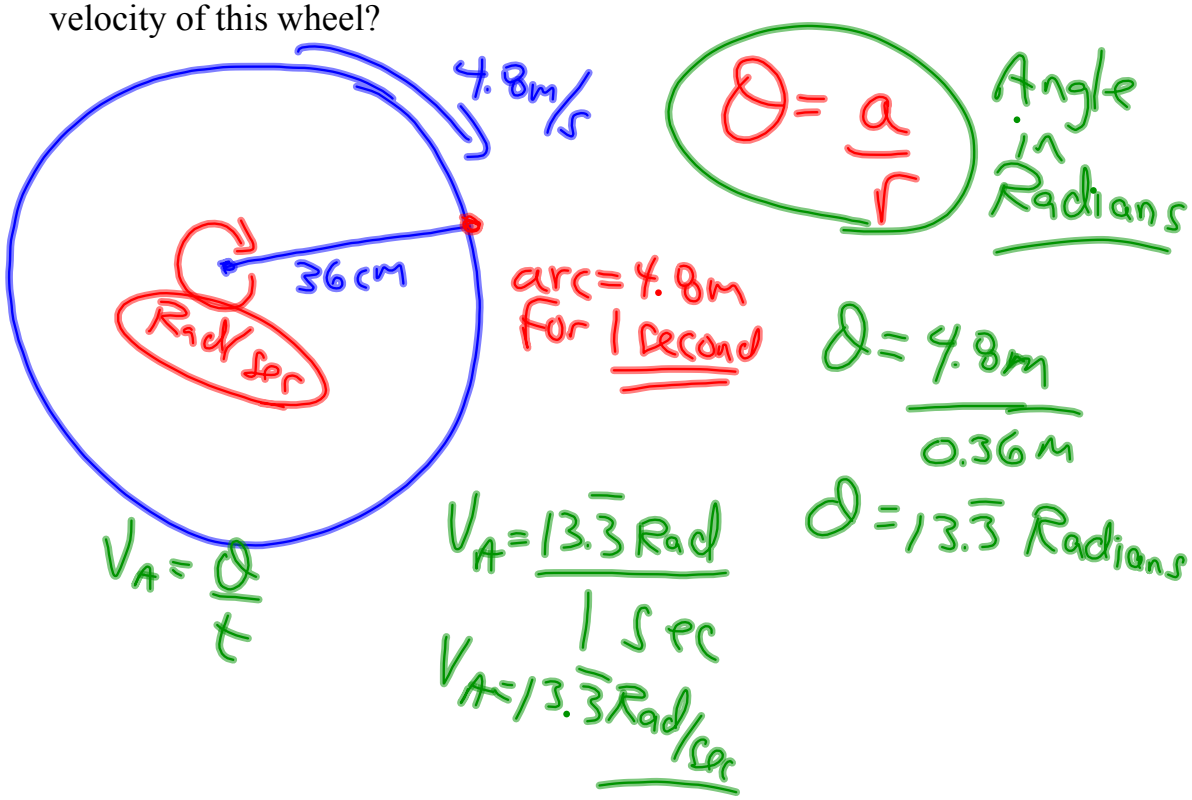
$a = 10.2m$

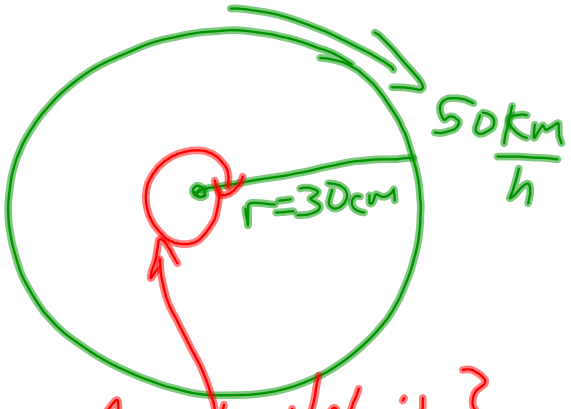
Calculate θ:

$0.314 \frac{Rad}{s} \times 6.5 sec$

$\theta = 2.04 Rad$

Ex. A bicycle wheel has a radius of 36 cm and is turning at 4.8m/s. Determine the angula velocity of this wheel?





Angular Velocity?

$50\frac{Km}{h} \times \frac{1h}{3600\,sec} \times \frac{1000m}{1Km} = 13.\overline{8}\,m/s$

Arc after 1 sec

$\theta = \frac{13.8m}{0.3m}$

$\theta = 46.296\,Rad$

$V_A = \frac{46.296\,Rad}{1\,sec}$

Practice Problems...

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Warm Up

A basketball rolling across the floor completes 75 revolutions per minute. The linear velocity of the basketball is 2.5 m/s. Find the radius of the basketball and its angular velocity.

(7.9 Rad/sec) (32 cm)

$V_A = \frac{\theta}{t}$ $\theta = \frac{a}{r}$ Angle in Radians

75 Revolutions = 75(2π) Rad

= 150π Radians

$V_A = \frac{150\pi}{60 sec} = 7.9$ Rad/sec

$\theta = \frac{a}{r}$

$7.9 Rad = \frac{2.5 m}{r}$

$r = \frac{2.5}{7.9} m$

$r = 0.316 m$

$r \doteq 32 cm$

Rotates 7.9 Radians in 1 second

Travels 2.5 m in one sec

1/

42 Rev/minute

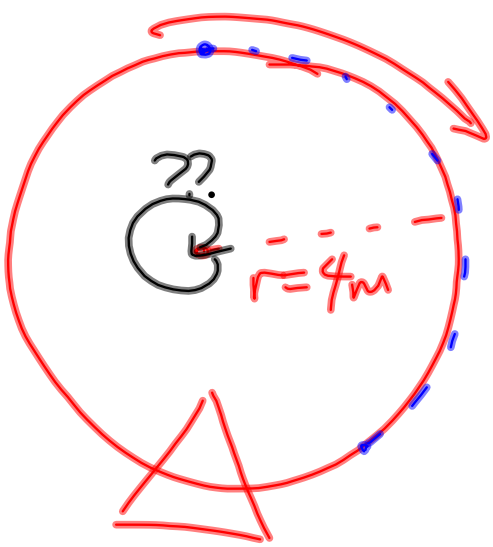
Angular Velocity??

$42\,\text{Rev} \Rightarrow 42(2\pi)\,\text{Rad}$

$= 84\pi\,\text{Rad}$

$V_A = \frac{84\pi\,\text{Rad}}{60\,\text{Sec}} = 4.4\,\text{Rad/Sec}$

2/



18m/s

"θ" after 1 second

$\theta = \frac{a}{r}$

$\theta = \frac{18m}{4m}$

$\theta = 4.5$ Radians

$V_A = \frac{4.5 Rad}{1 Sec}$

$= 4.5 Rad/Sec$