Angular Velocity

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

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

θ = angle (radians)

v_a = angular velocity

a = arc length

t = time

r = radius

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

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

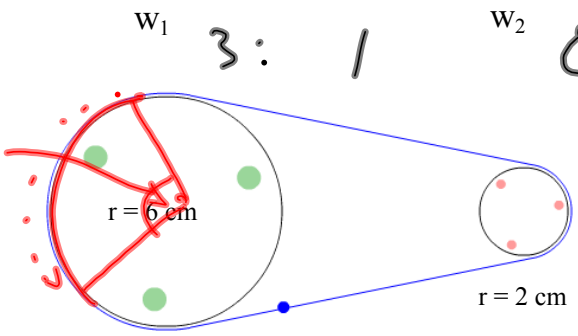
(b) Given the 40 rad rotation of wheel 1, what was the angle of rotation for wheel 2?

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

40 Rad

$a = (40\,Rad)(6\,cm)$

$a = 240\,cm$



$\theta = \frac{240\,cm}{2\,cm}$

$\theta = 120\,Rad$

Ex. A small electrical motor turns at 1500 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.

a) $1500 \frac{rev}{min} \times \frac{2\pi \, Rad}{1 \, Rev} = \underline{3000\pi \, Rad}$

$V_A = \frac{3000\pi \, Rad}{60 \, s}$

$V_A = \underline{157.1 \, Rad/sec}$

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

$\theta = V_A \cdot t$

$\theta = 157.1 \frac{Rad}{s} \cdot 0.008 s$

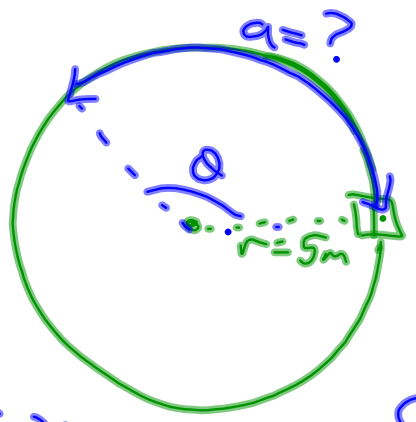
$\theta = 1.26$ Radians

$a = \theta r$

$a = (1.26 Rad)(0.8 cm)$

$a = \underline{1.01 cm}$

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?



$3 Rev = 3(2\pi) = 6\pi \, Rad$

$V_A = \frac{6\pi \, Rad}{60 \, sec} = \frac{\pi}{10} Rad/sec$

$C = 2\pi r$

$C = 10\pi m$

$C = \underline{31.4 m}$

$a = \theta r$

$a = \frac{6.5\pi}{10}(5m)$

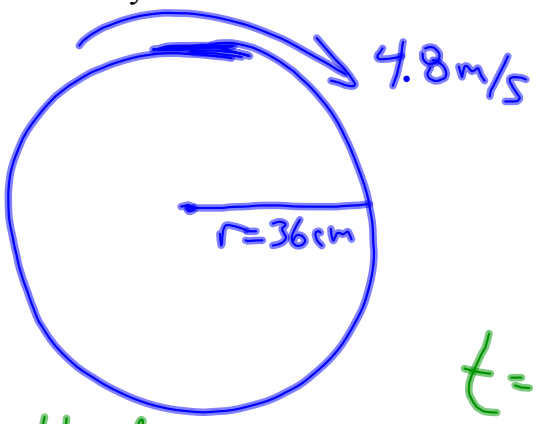
$a = \underline{10.2 m}$

$\theta = V_A \cdot t$

$\theta = \frac{\pi}{10} \cdot 6.5$

$\theta = \underline{\frac{6.5\pi}{10} Rad}$

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



Rotations & Circumference

$C = 2\pi(0.36m)$

$C = 0.72\pi\ m$

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

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

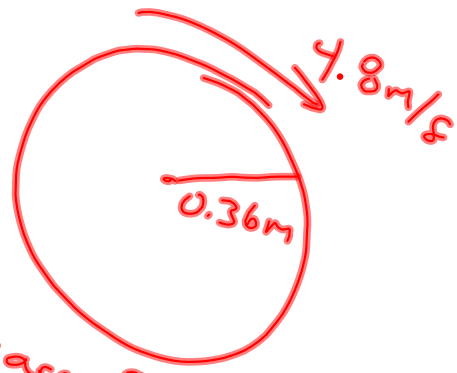
$t = \frac{0.72\pi\ m}{4.8\ m/s}$

$t = 0.47\ sec$ ← time for 1 Rev.

$V_A = \frac{2\pi\ Rad}{0.47\ sec}$

$V_A = 13.3\ Rad/sec$

Method 2



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

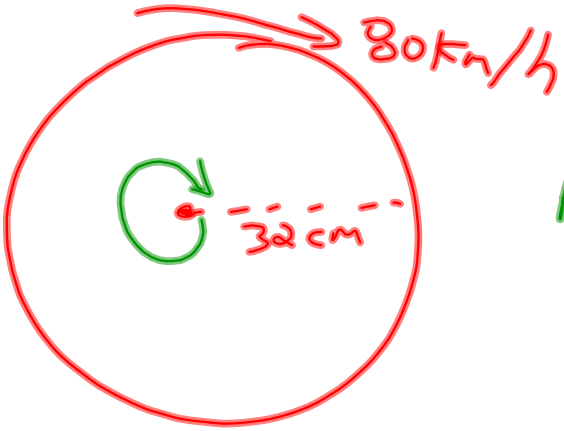
$\theta = \frac{4.8m}{0.36m}$ ← arc after 1 sec

$\theta = 13.3\bar{3}$ Radians

Angle of Rotation after 1 sec

$\Rightarrow V_A = \frac{13.3\ Rad}{1\ s}$

$V_A = 13.\bar{3}\ Rad/sec$



Angular Velocity??

$$80\frac{km}{h}\cdot\frac{10^3\ m}{1\ km}\times\frac{1\ h}{3600\ s}$$

$$=\underline{22.2\ m/s}$$

$$\theta=\frac{22.2\ m}{0.32\ m}$$

$$\theta=69.4\ Rad$$

$$V_A=\frac{69.4\ Rad}{1\ Sec}$$

$$V_A = \frac{2\pi \text{ Rad}}{15 \text{ sec}} \times 120 \text{ sec}$$

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

Practice Problems...

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#14, 15, 16, 19, 20 a, b , 21, 22, 23, 24, 25, 26, 27

Sector

$$A = \left(\frac{\theta}{360}\right)\pi r^2$$

$$A = \frac{\theta}{2\pi}\pi r^2 = \frac{\theta r^2}{2}$$