Objective

1. I can convert linear velocity to angular velocity. 2. I can convert angular velocity to linear velocity.

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Things that *turn* have both a ***linear velocity*** and an ***angular velocity***

Things that Turn - Examples

tire on a car or bike

teeth on a gear

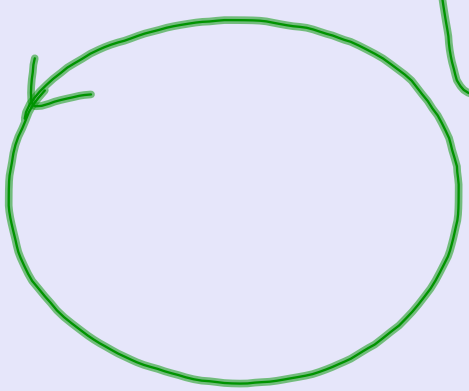
a record on an old record player

rope around a pulley

on a Ferris seat wheel

hands on a clock

horse on a Merry-Go-Round



rad → revolution
÷ 2π

revolution → rad
× 2π

1 revolution = 360°

1 revolution/rotation = 2π rad

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Definition:

Linear Velocity is distance/time:

$$v = \frac{s}{t}$$ (Arc Length)

Ex. 55 mph, 6 ft/sec, 27 cm/min, 4.5 m/sec

Definition:

Angular Velocity is turn/time:

$$\omega = \frac{\theta}{t}$$ (angle)

Ex. 6 rev/min, 360°/day, 2π rad/hour

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Deriving a formula which relates the two velocities:

Definition of Linear Velocity:

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

$s = r\theta$

Recall Arc Length Formula→

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

Recall Definition of Angular Velocity→

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

Formula for Linear and *Angular Velocity:*

$$v = r\,\omega$$

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1. A bicycle with 20-in wheels is traveling down a road at 15 mi/h. Find the angular velocity of the wheel in revolutions per minute.

$V = 15\ mi/h = 15{,}840\ in/min$

$\frac{15\ mi}{1\ h} \cdot \frac{5280\ ft}{1\ mi} \cdot \frac{12\ in}{1\ ft} \cdot \frac{1\ h}{60\ min} = \frac{15(5280)(12)}{60} = 15{,}840\ \frac{in}{min}$

$r = 10\ in$

$\omega = 0\ \frac{rot}{min}$

$15{,}840 = 10\theta$

$\theta = 1{,}584\ \frac{rad}{min} \div 2\pi = 252.1\ r/min$

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2. A wheel 4 ft in diameter is rotating at 80 r/min. Find the distance (in feet) traveled by a point on the rim in 1 second, that is, the linear speed of the point in ft/s.

$V = ?\ ft/sec$

$r = 2\ ft$

$\omega = 80\ \frac{r}{min} = \frac{8\pi}{3}\ \frac{rad}{sec}$ $\frac{80}{min} \left| \frac{2\pi\ rad}{1\ rot} \right| \frac{1\ min}{60\ sec}$ $\frac{80(2\pi)}{60} = \frac{8\pi}{3}\ \frac{rad}{sec}$

$V = 2\left(\frac{8\pi}{3}\right) = \frac{16\pi}{3} = 16.76\ ft/sec$

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1 A tire with a 9 inch radius is rotating at 30 mph. Find the angular velocity of a point on its rim. Express the result in revolutions per minute.

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5 Formulas to KNOW/MEMORIZE:

Arc Length:

$$s = r\theta$$

Linear Velocity: $v = \frac{s}{t}$

Area of a Sector:

$$A = \frac{1}{2}\theta r^2$$

Angular Velocity: $\omega = \frac{\theta}{t}$

$$v = r\ \omega$$