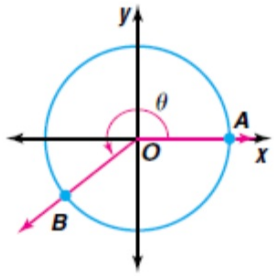
Trig 6.2

Find linear and angular velocity



revolution

central angle

radians

angular displacement θ

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

linear velocity $v = r \cdot \omega$

dimensional analysis

activity: bicycle wheel
rope and circle @ parking lot

Determine each angular displacement in radians. Round to the nearest tenth.

6. 5.8 revolutions

7. 710 revolutions

$$5.8 \text{ rev} \cdot \frac{2\pi}{1 \text{ rev}}$$

$$= 476.3$$

Determine each angular velocity. Round to the nearest tenth.

8. 3.2 revolutions in 7 seconds

9. 700 revolutions in 15 minutes

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

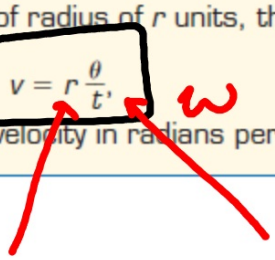
$$\frac{3.2 \text{ rev}}{7 \text{ s}} \cdot \frac{2\pi}{1 \text{ rev}} = 2.9 \frac{\text{rad}}{\text{s}} = 2.9 \frac{}{\text{s}}$$

Linear Velocity

If an object moves along a circle of radius of r units, then its linear velocity, v is given by

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

where $\frac{\theta}{t}$ represents the angular velocity in radians per unit of time.



how big is the circle?
how fast is it rotating?
radius*angular velocity
Must use RADIANS

4 Determine the linear velocity of a point rotating at an angular velocity of 17π radians per second at a distance of 5 centimeters from the center of the rotating object. Round to the nearest tenth.

how big is the circle?
how fast is it rotating?
radius*angular velocity

$v = r \cdot \omega$

$v = 5\,cm \cdot \frac{17\pi}{s} \approx 267 \frac{cm}{s}$

* 267.0

$$\frac{267.0\,cm}{s} \cdot \frac{60\,s}{1\,min} \cdot \frac{60\,min}{1\,hr} \cdot \frac{1\,in}{2.54\,cm} \cdot \frac{1\,ft}{12\,in} \cdot \frac{1\,mi}{5280\,ft} = \frac{961200}{1609344} \approx 0.6 \frac{mi}{hr}$

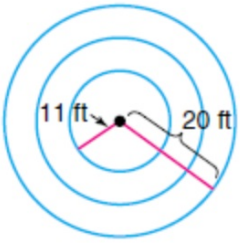
Determine the linear velocity of a point rotating at the given angular velocity at a distance r from the center of the rotating object. Round to the nearest tenth.

10. $\omega = 36$ radians per second, $r = 12$ inches

how big is the circle?
how fast is it rotating?
radius*angular velocity

Remember the rope?

ENTERTAINMENT The Children's Museum in Indianapolis, Indiana, houses an antique carousel. The carousel contains three concentric circles of animals. The inner circle of animals is approximately 11 feet from the center, and the outer circle of animals is approximately 20 feet from the center. The carousel makes $2\frac{5}{8}$ rotations per minute. Determine the angular and linear velocities of someone riding an animal in the inner circle and of someone riding an animal in the same row in the outer circle. *This problem will be solved in Examples 3 and 5.*



rev

w =

v =

3 ENTERTAINMENT Refer to the application at the beginning of the lesson. Determine the angular velocity for each rider in radians per second.

$$w = \frac{2\frac{5}{8}\ \text{rev}}{\text{min}} \cdot \frac{2\pi\ \text{rad}}{1\ \text{rev}} \cdot \frac{1\ \text{min}}{60\ \text{s}} = 0.3\ \frac{\text{rad}}{\text{s}}$$

inner

$v = 11\text{ft}\left(0.3\ \frac{\text{rad}}{\text{s}}\right) \quad 3.3\ \frac{\text{ft}}{\text{s}}$

out

$v = 20\text{ft} \cdot 0.3\ \frac{\text{rad}}{\text{s}} \quad 6\ \frac{\text{ft}}{\text{s}}$

5 **ENTERTAINMENT** **Refer to the application at the beginning of the lesson. Determine the linear velocity for each rider.**

how big is the circle?
how fast is it rotating?
radius*angular velocity

$r = 15 in$

6 CAR RACING The tires on a race car have a diameter of 30 inches. If the tires are turning at a rate of 2000 revolutions per minute, determine the race car's speed in miles per hour (mph).

how big is the circle?
how fast is it rotating?
radius*angular velocity
dimensional analysis

$$V = \frac{2000 \text{ rev}}{\text{min}} \cdot \frac{2\pi \text{ rad}}{1 \text{ rev}} \cdot 15 \text{ in}$$

$$V = 188495.56 \frac{\text{in}}{\text{min}} \left| \frac{60 \text{ min}}{1 \text{ hr}} \right| \frac{1 \text{ ft}}{12 \text{ in}} \left| \frac{1 \text{ mi}}{5280 \text{ ft}} \right| = 178.5 \frac{\text{mi}}{\text{hr}}$$

$V = 65 \frac{mi}{hr}$ $\omega = ?$ tires $d = 20$ in

$$\frac{V}{r} = \frac{r \cdot \omega}{r}$$

$$\omega = \frac{V}{r} \cdot \frac{65 \text{ mi}}{\text{hr}} \cdot \frac{5280 \text{ ft}}{1 \text{ mi}} \cdot \frac{12 \text{ in}}{1 \text{ ft}}$$

$411{,}840 \frac{rad}{hr}$

$$411{,}840 \frac{\text{rad}}{\text{hr}} \cdot \frac{1 \text{ hr}}{60 \text{ min}} \cdot \frac{1 \text{ rev}}{2\pi \text{ rad}} = 1092.4 \frac{rev}{min} \text{ rpm}$$

WB
6.2
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