6.2: Linear and Angular Velocity

Angular Displacement

$$\boxed{1 \text{ revolution} = 2\pi \text{ radians}}$$

$$\boxed{180^\circ = \pi \text{ radians}}$$

1 **Determine the angular displacement in radians of 4.5 revolutions. Round to the nearest tenth.**

As the object travels along the circle, suppose that θ (measured in radians) is the central angle swept out in time ***t***. Then the **angular speed or velocity,** ω of this object is the angle (measured in radians) swept out divided by the elapsed time.

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

Angular and Linear Motion

- **Angular speed/velocity is measured in units like revolutions per minute (rpm) or radian per unit of time.**

If an object moves along a circle during a time of t units, then the angular velocity, ω, is given by

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

where θ is the angular displacement in radians.

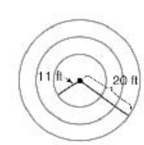
Angular and Linear Motion

2 **Determine the angular velocity if 7.3 revolutions are completed in 5 seconds. Round to the nearest tenth.**

Angular and Linear Motion

Real World Application

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.



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

STARTER 6.2

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

6. 5.8 revolutions
7. 710 revolutions

Determine each angular velocity. Round to the nearest tenth.

8. 3.2 revolutions in 7 seconds
9. 700 revolutions in 15 minutes

Suppose an object moves along a circle of radius ***r*** at a constant speed. If ***s*** is the distance traveled in time ***t*** along this circle, then the **linear speed or velocity *v*** of the object is defined as

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

Angular and Linear Motion

- **Linear speed/velocity is measured in units like miles per hour (mph).**

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

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

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

Angular and Linear Motion

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.**

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

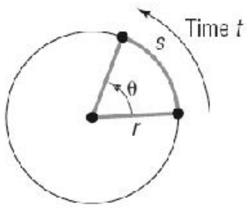
Angular and Linear Motion

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).**

$$s = r\theta$$

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

$$\boxed{v = r\omega}$$



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

Linear Speed

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

Angular Speed

$$\boxed{v = r\omega}$$