Rotational Speeds:

- There are three types of speeds that we will discuss regarding the rotation around an axis (central point).
- Think about the different ways we might measure speeds while you are riding a carousel.

1. Think of linear speed as ***how far*** you travel around in a circle as you go around in a certain amount of time.

2. Think of angular speed as ***how many degrees or radians*** you rotate around the center of the circle as you go around in a certain amount of time.

3. Think of rotational or revolutionary speed as ***how many times you go around*** in a specific amount of time.

Angular Speed: $\omega = \frac{\theta}{t}$ θ in degrees or radians

Linear Speed: $V = \frac{s}{t} \Rightarrow V = \frac{r\theta}{t}$ ← angular speed

1 Revolution:

Angular ⟹ $\frac{360^\circ}{1\text{ rev}}$ OR $\frac{2\pi \text{ rad}}{1 \text{ rev}}$

Linear ⟹ $\frac{2\pi r}{1\text{ rev}}$ ← circumference

* 1 mi = 5280 ft. 1 km = 1000 m 12 in = 1 ft.

Example 1: a) A bicycle messenger rides his bike to make deliveries. During one delivery, the tires rotate at a rate of 140 revolutions per minute. Find the angular speed of the tire in radians per minute.

$$\frac{140 \cancel{\text{rev}}}{1 \text{ min}} \cdot \frac{2\pi \text{ rad}}{1 \cancel{\text{rev}}} = \boxed{879.6 \text{ rad/min}}$$

b) On part of the trip to the next delivery, the tire turns at a constant rate of 2.5 revolutions per second and the tire has a diameter of 30 in. Find the linear speed of the tire in miles per hour.

$r = 15 \text{ in}$

$$\frac{2.5 \cancel{rev}}{1 \cancel{sec}} \cdot \frac{60 \cancel{sec}}{1 \cancel{min}} \cdot \frac{60 \cancel{min}}{1 \text{ hr}} \cdot \frac{2\pi(15) \cancel{in}}{1 \cancel{rev}} \cdot \frac{1 \cancel{ft}}{12 \cancel{in}} \cdot \frac{1 \text{ mi}}{5280 \cancel{ft}}$$

$$\frac{848230.0165 \text{ mi}}{63360 \text{ hr}} = \boxed{13.4 \text{ mi/hr}}$$

Example 2: A carousel is rotating at a rate of 6 revolutions per minute. Billy is sitting on a horse on the outside, 25 feet from the center of the ride. Hannah is sitting on an innermost horse, 15 feet from the center. Find the angular (degrees per minute) and linear speeds (feet per minute) of both riders.

Angular: $\frac{6 \cancel{rev}}{1 \text{ min}} \cdot \frac{360°}{1 \cancel{rev}} = \boxed{2160°/\text{min}}$

Linear: Billy: $\frac{6 \text{ rev}}{1 \text{ min}} \cdot \frac{2\pi(25 \text{ ft})}{1 \text{ rev}} = \boxed{942.5 \text{ ft/min}}$

Hannah: $\frac{6 \cancel{rev}}{1 \text{ min}} \cdot \frac{2\pi(15 \text{ ft})}{1 \cancel{rev}} = \boxed{565.5 \text{ ft/min}}$

Example 3:
a) Find the angular speed of the DVD in radians per second if the disc rotates at a rate of 3.5 revolutions per second.

$$\frac{3.5 \cancel{rev}}{1 \text{ sec}} \cdot \frac{2\pi \text{ rad}}{1 \cancel{rev}} = \boxed{21.99 \text{ rad/sec}}$$

b) If the DVD player overheats and the disc begins to rotate at a slower rate of 3 revolutions per second, find the disc's linear speed in meters per minute. The diameter of the DVD is 120 mm.

$$\frac{3 \cancel{rev}}{1 \cancel{sec}} \cdot \frac{60 \cancel{sec}}{1 \text{ min}} \cdot \frac{2\pi(60 \cancel{mm})}{1 \cancel{rev}} \cdot \frac{1 \text{ m}}{1000 \cancel{mm}} = \boxed{67.9 \text{ m/min}}$$

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