Pre-Calculus: Linear and Angular Speed

1. **Car Wheels.** The radius of each wheel of a car is 15 inches. If the wheels are turning at a rate of 3 revolutions per second, how fast is the car moving? Express your answer in inches per second and in miles per hour.

2. **Pulleys.** Two pulleys, one with radius 2 inches and the other with radius 8 inches, are connected by a belt. If the 2-inch pulley is caused to rotate at 3 revolutions per minute, determine the revolutions per minute of the 8-inch pulley.

3. **Ferris Wheels.** A neighborhood carnival has a Ferris wheel whose radius is 30 feet. You measure the time it takes for one revolution to be 70 seconds. What is the linear speed (in feet per second) of this Ferris wheel? What is the angular speed in radians per second?

4. **Bicycle Wheels.** The diameter of each wheel of a bicycle is 26 inches. If you are traveling at a speed of 35 miles per hour on this bicycle, through how many revolutions per minute are the wheels turning?

5. **Computing the Speed of a River Current.** To approximate the speed of the current of a river, a circular paddle wheel with radius 4 feet is lowered into the water. If the current causes the wheel to rotate at a speed of 10 revolutions per minute, what is the speed of the current? Express your answer in miles per hour.

6. **Spin Balancing Tires.** A spin balancer rotates the wheel of a car at 480 revolutions per minute. If the diameter of the wheel is 26 inches, what road speed is being tested? Express your answer in miles per hour. At how many revolutions per minutes should the balancer be set to test a road speed of 80 miles per hour?

7. **The Cable Cars of San Francisco.** At the Cable Car Museum you can see the four cable lines that are used to pull cable cars up and down the hills of San Francisco. Each cable car travels at a speed of 9.55 miles per hour, caused by a rotating wheel whose diameter is 8.5 feet. How fast is the wheel rotating? Express your answer in revolutions per minute.

8. **Circular Gear.** A circular gear rotates at the rate of 200 revolutions per minute (rpm). What is the angular speed of the gears in radians per minute? What is the linear speed of a point on the gear 2 inches from the center in inches per minute? In feet per minute?

9. **Lawn Mower.** A riding lawn mower has wheels that are 15 inches in diameter, which are turning at 2.5 revolutions per second. What is the angular speed of a wheel? How fast is the lawn mower traveling in miles per hour?

10. **Merry-Go-Round.** A merry-go-round horse is traveling at 10 feet per second when the merry-go-round is making 6 revolutions per minute. How far is the horse from the center of the merry-go-round?
Linear & Angular Speed

1) \( \frac{3 \text{ rev}}{1 \text{ sec}} \) is given. How fast is car moving in \( \text{in/sec} \)?

\[
\frac{3 \text{ rev}}{1 \text{ sec}} \times \frac{30 \text{ in}}{1 \text{ rev}} = 90 \text{ in/rev} 
\approx 282.7 \text{ in/sec}
\]

b) \( \frac{90 \pi \text{ in}}{\text{sec}} \times \frac{1 \text{ ft}}{12 \text{ in}} \times \frac{1 \text{ mi}}{5280 \text{ ft}} \times \frac{3600 \text{ sec}}{1 \text{ hr}} = 16.1 \text{ mi/hr} \)

2) \[
\frac{3 \text{ rev}}{1 \text{ min}} = \frac{2 \text{ rev}}{m \text{ in}} \times \frac{165 \text{ cm}}{\text{rev}}
\]

\[
\frac{3 \text{ rev}}{1 \text{ min}} \times \frac{45 \text{ cm}}{\text{rev}} = 12 \text{ cm/min}
\]

3) \[
1 \text{ rev} \times \frac{1 \text{ degree}}{30^\circ} = \frac{12 \text{ cm}}{70 \text{ sec}}
\]

**Linear Speed:**
\[
V = \frac{\theta}{t} = \frac{30 \text{ ft}}{70 \text{ sec}} = \frac{60 \pi \text{ rad}}{70 \text{ sec}} 
\approx 2.7 \text{ rad/sec}
\]

**Angular Speed:**
\[
\omega = \frac{\text{measure of angle of rotation}}{\text{time}} = \frac{\theta}{t}
\]

\[
\omega = \frac{2\pi \text{ radians}}{70 \text{ sec}} \approx 0.09 \text{ radians/sec}
\]
4) \( \frac{26 \text{ in}}{\text{rev}} \) traveling 35 mi/hr
\[
\left( \frac{35 \text{ mi}}{1 \text{ hr}} \right) \left( \frac{1 \text{ hr}}{60 \text{ min}} \right) \left( \frac{5280 \text{ ft}}{1 \text{ mi}} \right) \left( \frac{12 \text{ in}}{1 \text{ ft}} \right) \left( \frac{1 \text{ rev}}{261 \text{ in}} \right) = 452.5 \text{ rev/min}
\]

5) \( r = 4' \) current \( \frac{10 \text{ rev}}{\text{min}} \)
\[
\left( \frac{10 \text{ rev}}{\text{min}} \right) \left( \frac{60 \text{ min}}{1 \text{ hr}} \right) \left( \frac{8 \text{ ft}}{1 \text{ rev}} \right) \left( \frac{1 \text{ mi}}{5280 \text{ ft}} \right) = 2.86 \text{ mi/hr}
\]

6) Given \( \frac{480 \text{ rev}}{26 \text{ min}} \)
\[
\text{Find road speed of test (k.s.)}
\left( \frac{480 \text{ rev}}{\text{min}} \right) \left( \frac{60 \text{ min}}{1 \text{ hr}} \right) \left( \frac{264 \text{ ft}}{1 \text{ rev}} \right) \left( \frac{1 \text{ mi}}{5280 \text{ ft}} \right) = 37.1 \text{ mi/hr}
\]

\( \frac{80 \text{ mi}}{\text{hr}} \) 
\[
\left( \frac{80 \text{ mi}}{\text{hr}} \right) \left( \frac{1 \text{ hr}}{60 \text{ min}} \right) \left( \frac{5280 \text{ ft}}{1 \text{ mi}} \right) \left( \frac{12 \text{ in}}{1 \text{ ft}} \right) \left( \frac{1 \text{ rev}}{261 \text{ in}} \right) = 1034.3 \text{ rev/min}
\]
7) \[ \text{cable car rate } \frac{9.55 \text{mi}}{\text{hr}} \]
\[ c = 8.5 \text{ft} \]
\[ \frac{9.55 \text{mi}}{\text{hr}} \left( \frac{1 \text{hr}}{60 \text{min}} \right) \left( \frac{5280 \text{ft}}{1 \text{mi}} \right) \left( \frac{1 \text{Rev}}{8.5 \text{ft}} \right) = \frac{50,424 \text{ Rev}}{570 \text{ min}} \]
\[ \approx 31.5 \frac{\text{Rev}}{\text{min}} \]

8) \[ \frac{200 \text{ Rev}}{\text{min}} \left( \frac{2\pi \text{ radians}}{1 \text{ Rev}} \right) = 400\pi \frac{\text{rad}}{\text{min}} \]
\[ \text{A.S.} \]

9) \[ \frac{2.5 \text{ Rev}}{\text{sec}} \left( \frac{2\pi \text{ rad}}{1 \text{ Rev}} \right) = 5\pi \frac{\text{rad}}{\text{sec}} \]

10) \[ \text{Given } 10 \text{ ft/sec } \Rightarrow 6 \text{ Rev/min} \]
\[ \text{Find } r. \]
\[ \frac{10 \text{ ft}}{\text{sec}} \left( \frac{60 \text{ sec}}{1 \text{ min}} \right) = \frac{600 \text{ ft}}{\text{min}} \]
\[ \frac{600 \text{ ft}}{\text{min}} \left( \frac{1 \text{ min}}{6 \text{ Rev}} \right) = \frac{600 \text{ ft}}{6 \text{ Rev}} \]
\[ \Rightarrow \text{ or } \frac{100 \text{ ft}}{1 \text{ Rev}} \text{ since } 1 \text{ Rev } = 100 \text{ ft and } 1 \text{ Rev } = 2\pi r \]
\[ \Rightarrow 2\pi r = 100 \text{ ft} \]
\[ r = \frac{100 \text{ ft}}{2\pi} \approx 15.9 \text{ ft from center} \]