

Angular and Linear Speed Key

Angular Speed:

$$\omega = \theta/t$$

Problem:

A wheel completes 120 revolutions in 2 minutes. What is its angular speed in radians per second?

Solution:

1. First, convert revolutions to radians:

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

$$120 \text{ rev} = 120 \times 2\pi = 240\pi \text{ radians}$$

2. Convert time to seconds:

$$2 \text{ minutes} = 120 \text{ seconds}$$

3. Angular speed ω is:

$$\omega = \frac{\theta}{t} = \frac{240\pi}{120} = 2\pi \text{ rad/s}$$

Answer: $\omega = 2\pi \text{ rad/s}$

Problem:

A fan blade rotates at 900 revolutions per minute (rpm). What is its angular speed in radians per second?

Solution:

1. Convert rpm to radians per second:

$$900 \text{ rpm} = 900 \times \frac{2\pi}{60}$$

$$\omega = 900 \times \frac{2\pi}{60} = 30\pi \text{ rad/s}$$

Answer: $\omega = 30\pi \text{ rad/s} \approx 94.25 \text{ rad/s}$

Problem:

A car tire with a radius of 0.3 meters is rolling without slipping at a linear speed of 18 m/s. What is the angular speed of the tire?

Solution:

Use the relation between linear speed v and angular speed ω :

$$v = r\omega \Rightarrow \omega = \frac{v}{r}$$
$$\omega = \frac{18}{0.3} = 60 \text{ rad/s}$$

Answer: $\omega = 60 \text{ rad/s}$

Problem:

A cyclist travels 120 meters in 20 seconds. What is the cyclist's linear speed?

Solution:

Use the basic linear speed formula:

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

$$v = \frac{120 \text{ m}}{20 \text{ s}} = 6 \text{ m/s}$$

Answer: $v = 6 \text{ m/s}$

Problem:

A wheel with a radius of 0.5 meters is spinning at an angular speed of $\omega = 8 \text{ rad/s}$. What is the linear speed of a point on the edge of the wheel?

Solution:

Use the formula:

$$v = r\omega$$

$$v = 0.5 \times 8 = 4 \text{ m/s}$$

Answer: $v = 4 \text{ m/s}$

Problem:

A Ferris wheel with a radius of 10 meters makes one complete revolution every 20 seconds. What is the linear speed of a seat on the edge?

Solution:

1. First, find angular speed:

$$\omega = \frac{2\pi}{T} = \frac{2\pi}{20} = \frac{\pi}{10} \text{ rad/s}$$

2. Then find linear speed:

$$v = r\omega = 10 \times \frac{\pi}{10} = \pi \text{ m/s}$$

Answer: $v = \pi \text{ m/s} \approx 3.14 \text{ m/s}$