

# Rotation of a Rigid Body

## Topics:

- Rotational Motion
- Rotation About the Center of Mass
- Rotational Energy
- Calculating Moment of Inertia
- Torque
- Rotational Dynamics
- Rotation About a Fixed Axis
- Static Equilibrium
- Rolling Motion
- Angular Momentum

# Rotational Motion

The figure shows a wheel rotating on an axle. Its angular velocity is

$$\omega = \frac{d\theta}{dt}$$

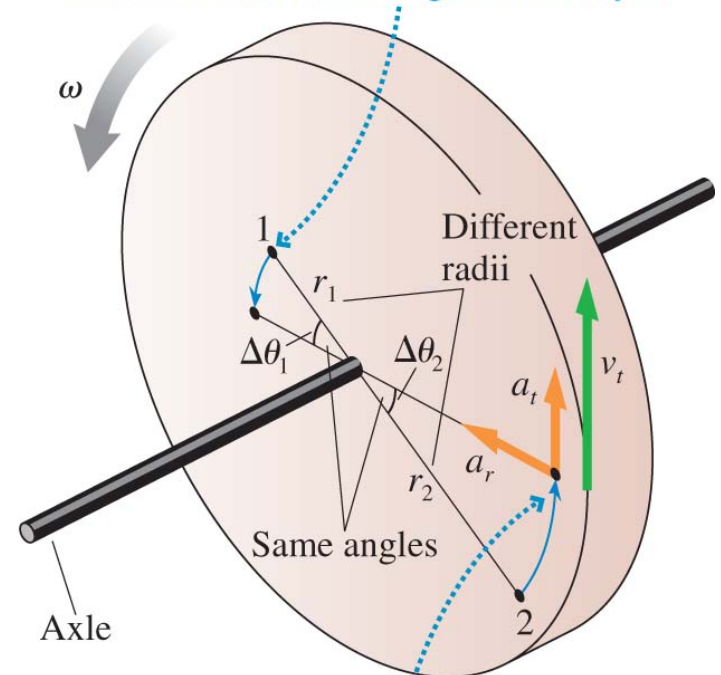
The units of  $\omega$  are rad/s. If the wheel is speeding up or slowing down, its angular acceleration is

$$\alpha = \frac{d\omega}{dt}$$

The units of  $\alpha$  are rad/s<sup>2</sup>.

**FIGURE 12.3** Two points on a wheel rotate with the same angular velocity.

Every point on the wheel turns through the same angle and thus undergoes circular motion with the same angular velocity  $\omega$ .



All points on the wheel have a tangential velocity and a radial (centripetal) acceleration. They also have a tangential acceleration if the wheel has angular acceleration.

# Rotational Motion

**TABLE 12.1** Rotational kinematics for constant angular acceleration

$$\omega_f = \omega_i + \alpha \Delta t$$

$$\theta_f = \theta_i + \omega_i \Delta t + \frac{1}{2}\alpha(\Delta t)^2$$

$$\omega_f^2 = \omega_i^2 + 2\alpha \Delta\theta$$

**FIGURE 12.4** The signs of angular velocity and angular acceleration.

