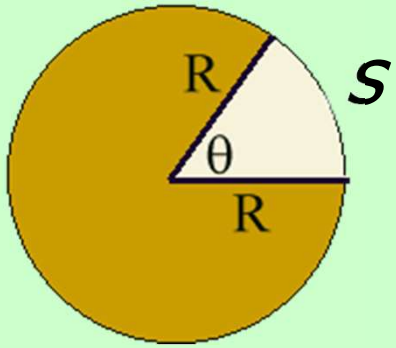
Definition of the Radian

One radian is the angle θ subtended at the center of a circle by an arc length s equal to the radius R of the circle.

$$\theta = \frac{s}{R}$$



$$1 \text{ rad} = \frac{R}{R} = 57.3^0$$

Example 2: A bicycle tire has a radius of 25 cm. If the wheel makes 400 rev, how far will the bike have traveled?

$$\theta = (400 \text{ rev})\left(\frac{2\pi \text{ rad}}{1 \text{ rev}}\right)$$

$$\theta = 2513 \text{ rad}$$

$$s = \theta R = 2513 \text{ rad } (0.25 \text{ m})$$

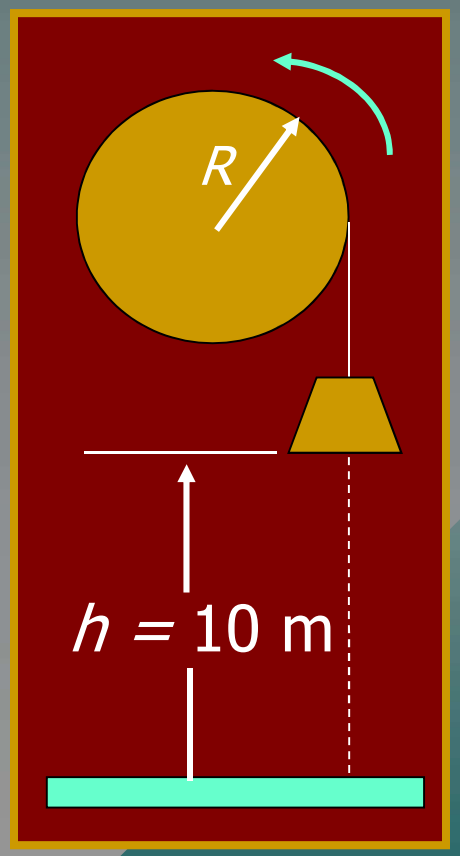
$$s = 628 \text{ m}$$

Example 3: A rope is wrapped many times around a drum of radius 20 cm. What is the angular velocity of the drum if it lifts the bucket to 10 m in 5 s?

$$\theta = \frac{s}{R} = \frac{10\text{ m}}{0.20\text{ m}} \qquad \theta = 50\text{ rad}$$

$$\omega = \frac{\Delta\theta}{\Delta t} = \frac{50\text{ rad}}{5\text{ s}}$$

$$\omega = 10.0\text{ rad/s}$$



A Comparison: Linear vs. Angular

$$s = \bar{v}t = \left(\frac{v_0 + v_f}{2}\right)t \qquad \theta = \bar{\omega}t = \left(\frac{\omega_0 + \omega_f}{2}\right)t$$

$$v_f = v_o + at \qquad \omega_f = \omega_o + \alpha t$$

$$s = v_0 t + \tfrac{1}{2}at^2 \qquad \theta = \omega_0 t + \tfrac{1}{2}\alpha t^2$$

$$s = v_f t - \tfrac{1}{2}at^2 \qquad \theta = \omega_f t - \tfrac{1}{2}\alpha t^2$$

$$2as = v_f^2 - v_0^2 \qquad 2\alpha\theta = \omega_f^2 - \omega_0^2$$