

This is the moment of initial your name? key

AP Physics 1: 8.4 Moment of Inertia

1. A hoop has a diameter of 0.5 meters and a mass of 3 kg. What is the moment of inertia of the hoop? (0.18 kgm²)

$$I = mr^2 = 3(.25)^2 = .19 \text{ kgm}^2$$

2. A bowling ball has a diameter of 0.2-meters and a mass of 7kg. It rolls down the alley at a speed of 0.5 m/s.

a) What is the moment of inertia? (0.03 kgm²)

$$I = \frac{2}{5}mr^2 = \frac{2}{5}(7)(.1)^2 = .03 \text{ kgm}^2$$

b) What is the angular speed of the bowling ball? (5 rad/sec)

$$\omega = \frac{v}{r} = \frac{.5}{.1} = 5 \frac{\text{rad}}{\text{sec}}$$

c) Calculate the frequency of the bowling ball. (0.8 Hz)

$$v = 2\pi r f$$

$$f = \frac{v}{2\pi r} = \frac{.5}{2\pi(.1)} = .8 \text{ Hz}$$

3. A wagon-wheel with a radius of r_w and a mass of m_w is rolling with an angular velocity of ω_1 .

a) Create a formula that solves for the linear velocity of the wheel.

$$v = \omega_1 r_w$$

b) Create a formula that solves for the frequency of the wheel.

$$v = 2\pi r f \quad f = \frac{v}{2\pi r} = \frac{\omega_1 r_w}{2\pi r_w} = \boxed{\frac{\omega_1}{2\pi}}$$

c) Create a formula that solves for the moment of inertia of the wheel.

$$I = mr^2 = \boxed{m_w (r_w)^2}$$

4. I have a hollow cylinder of mass 3kg and a radius of 0.4 meters, a solid cylinder of mass 5kg and a radius of 0.5 meters, a solid sphere of mass 8kg and a radius of 0.7 meters, and a hollow sphere of mass 2.5kg and a radius of 0.6 meters.

a) Rank them, from highest to lowest, by moments of inertia.

$$I_{SS} > I_{SC} > I_{HS} > I_{HC}$$

$$I_{HC} = 3(.4)^2 = .48$$

$$I_{SC} = \frac{1}{2}(5)(.5)^2 = .63$$

$$I_{SS} = \frac{2}{5}(8)(.7)^2 = 1.57$$

$$I_{HS} = \frac{2}{3}(2.5)(.6)^2 = .6$$

b) Rank them, from fastest to slowest, how they will roll.

$$I_{HC} > I_{HS} > I_{SC} > I_{SS}$$