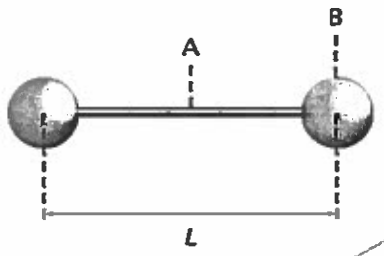
Pre-AP Physics Rotational Motion Name Key

Part 3 Moment of Inertia an Angular Acceleration

Delete 1. An athlete exercises using a dumbbell consisting of a long, thin, lightweight rod with a heavy sphere at each end, as shown below. The length of the rod is $L = 0.78$ m, and the mass of each sphere is 22.0 kg. The mass of the rod can be neglected.



$r = \frac{L}{2} = \frac{(0.78)}{2} = 0.39\text{m}$

a. Find the moment of inertia of the system for rotation about axis A, at the midpoint between the two spheres.

b. Find the moment of inertia of the system for rotation about axis B, at one end of the rod. 13 kg·m²

a) $I_{one\,sphere} = mr^2 = (22.0\text{kg})(0.39\text{m})^2$

$I_{system} = 2\,I_{one\,sphere} = 2(22.0\text{kg})(0.39\text{m})^2) = 6.7\ \text{kg}\cdot\text{m}^2$

2. Calculate the moment of inertia for a solid sphere with a mass of 10 kg and a radius of 0.2 m.

$I = 2/5\ mr^2 = (.4)(10)(0.2)^2 = .16\ \text{kg}\cdot\text{m}^2$

3. Calculate the moment of inertia for a hollow sphere with a mass of 10 kg and a radius of 0.2m.

$2/3mR^2 \quad 2/3(10)(.2\text{m})^2 = 0.27\ \text{kg}\cdot\text{m}^2$

4. Calculate the moment of inertia for a long thin rod with a mass of 2 kg and length of 1m rotating around the center of its length. $1/12\,mL^2$

$(.083)(2)(1)^2 = .1666\ \text{kg}\cdot\text{m}^2$

5. Calculate the moment of inertia for a long thin road with a mass of 2 kg and a length of 1m rotating about its end. $1/3\,mL^2$

$(.34)(2\text{kg})(1)^2 = .68\ \text{kg}\cdot\text{m}^2$

6. A carnival Ferris wheel takes 45.0 seconds to move from rest to the maximum ride speed. At its maximum speed, the ride makes one complete revolution ever 12.0 s. Calculate the angular acceleration of this ride.

$\alpha = \frac{\omega - \omega_0}{t} = \frac{.52 - 0}{45} = .01163$

$\frac{1\text{rev}}{12\text{s}} \left| \frac{2\pi\text{rad}}{1\text{rev}} \right. = .5235$