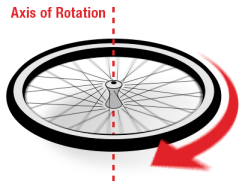
PRACTICE	LABS	TESTS
Unit 12 Problems (1-12)	Roller Coaster Lab Corrections	Unit 12 Test Tuesday (4/4/19)

Prom Royalty ➡ bit.ly/bshprom19

Rolling Motion and the Moment of Inertia

12.2 I can describe, interpret, and solve problems involving rolling motion and the moment of inertia.



Moment Of Inertia

The resistance to rotation is called the **moment of inertia**.

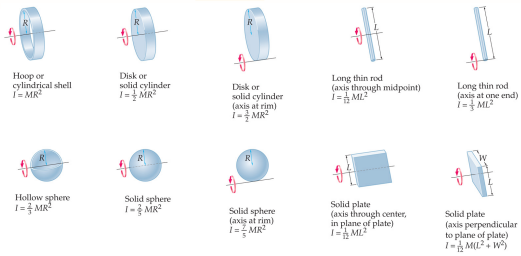
I PULL Units $kg \cdot m^2$

UNIT 12 REVIEW

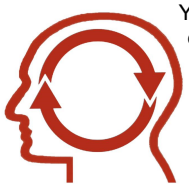
Key Concepts

- The moment of inertia of an object depends on the way the object's mass is distributed about the rotational axis. For a point object:

$I = mr^2$



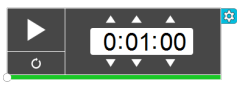
UNIT 12 IN CLASS PROBLEMS



Retrieval Practice [Practice Testing]

You learned that an object's motion can be described using big picture concepts of kinetic energy and momentum.

12. In one minute, write down at least 3 things that you remember about kinetic energy and at least 3 things you remember about momentum.



KE

mass in motion

$K = \frac{1}{2}mv^2$

$K + U = E$

Scalar

J

Momentum

mass in motion

$\vec{P} = m\vec{V}$

Vector

$kg \cdot \frac{m}{s}$

Dir. Prop.

Mass → Dir. Prop.

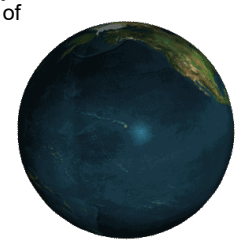
$\vec{V}$ → Dir. Quad.

Rotational Kinetic Energy

The rotational kinetic energy of an object is one-half the product of its moment of inertia and the square of its angular speed.

$K = \frac{1}{2}mv^2$

$$K = \frac{1}{2}I\omega^2$$



Rotational Kinetic Energy

Vector of Scalar?

$$K = \frac{1}{2}I\omega^2$$

Units? $kg \cdot m^2 \left(\frac{rad}{s}\right)^2 = J$

Relationship?

$I \rightarrow$ Direct. Prop. $I = mr^2$

$\omega \rightarrow$ Direct. Quad.

Angular Momentum

Angular momentum (L) is equal to the product of the object's moment of inertia and the object's angular velocity.

$\vec{p} = m\vec{v}$

$$L = I\omega$$

Angular Momentum

Vector of Scalar?

$$L = I\omega$$

Units? $kg \cdot m^2 \left(\frac{rad}{s}\right) = \frac{kg \cdot m^2}{s}$

Relationship?

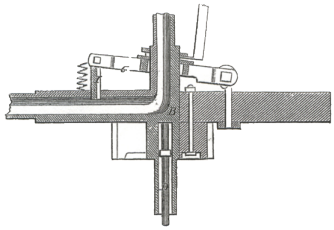
Direct. Prop.

Confederate Steam Gun

On April 19, 1861 there was a clash between secessionists and Federal troops in Baltimore, Maryland. Readers of newspapers across the United States learned of a strange, and allegedly powerful steam powered weapon brought forth to fend off more Union troops seeking to pass through the town by rail to Washington.

Confederate Steam Gun

A steam engine powered a rotary wheel that flung ball ammunition in a closed circle before releasing it at high speeds from a barrel that could pivot within a large metal shield protecting the crew. The entire device was weighty, requiring a large boiler in addition to the barrel, rotary, and shield, and typically had to be moved with horses. A member of the crew needed to keep feeding ammunition into the weapon as it tore through rounds.

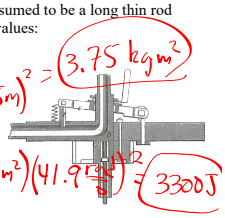


Confederate Steam Gun

The rotating barrel had a mass of 5.0 kg and rotated with a radius of 1.5 m. The barrel rotated at 400 rpm and it can be assumed to be a long thin rod rotating at one end. Calculate the following values:

a) the moment of inertia for the barrel.

$I = \frac{1}{3}mL^2 = \frac{1}{3}(5\text{kg})(1.5\text{m})^2 = 3.75\ \text{kg}\cdot\text{m}^2$



b) the kinetic energy of the barrel.

$K = \frac{1}{2}I\omega^2 = \frac{1}{2}(3.75\ \text{kg}\cdot\text{m}^2)(41.9\ \text{rad/s})^2 = 3300\text{J}$

c) the angular momentum of the barrel.

$L = I\omega$

$\omega = 400\frac{\text{rev}}{\text{min}} \times \frac{2\pi\text{ rad}}{1\text{ rev}} \times \frac{1\text{ min}}{60\text{ s}}$

$L = (3.75\ \text{kg}\cdot\text{m}^2)(41.9\ \text{rad/s})$

$L = 160\ \frac{\text{kg}\cdot\text{m}^2}{\text{s}}$