PHYSICS ANNOUNCEMENTS

PRACTICE	LABS	TESTS
Unit 12 Problems (1-23)	Balancing Lab Corrections	Unit 12 Test Tuesday (3/26/19)

Zero Torque and Static Equilibrium



12.4	I can describe, interpret, and solve problems involving static equilibrium.

SUMMARY

Key Concepts

- Angular position and its changes are measured in radians. One complete revolution is 2π rad.
- Angular velocity is given by the following equation.

$$\omega = \frac{\Delta\theta}{\Delta t}$$

- Angular acceleration is given by the following equation.

$$\alpha = \frac{\Delta\omega}{\Delta t}$$

- For a rotating, rigid object, the angular displacement, velocity, and acceleration can be related to the linear displacement, velocity, and acceleration for any point on the object.

$$d = r\theta \qquad v = r\omega \qquad a = r\alpha$$

SUMMARY

Key Concepts

- When torque is exerted on an object, its angular velocity changes.
- Torque depends on the magnitude of the force, the distance from the axis of rotation at which it is applied, and the angle between the force and the radius from the axis of rotation to the point where the force is applied.

$$\tau = Fr \sin\theta$$

- 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:

$$I = mr^2$$

- Newton's second law for rotational motion states that angular acceleration is directly proportional to the net torque and inversely proportional to the moment of inertia.

$$\alpha = \frac{\tau_{net}}{I}$$

SUMMARY

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

$$L = I\omega$$

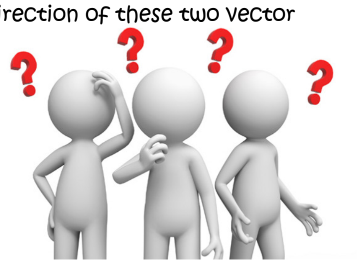
Conservation of Angular Momentum

If no net external torque acts on an object, then its angular momentum does not change.

$$L_i = L_f$$

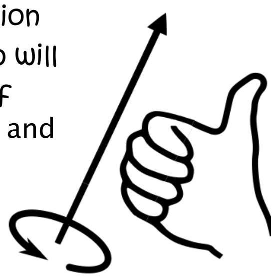
The Vector Nature of Angular Velocity and Momentum

When an object rotates it is said to have an angular velocity, ω, and therefore angular momentum, L. How do we determine the direction of these two vector quantities?

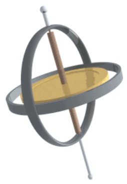


The Right-Hand Rule

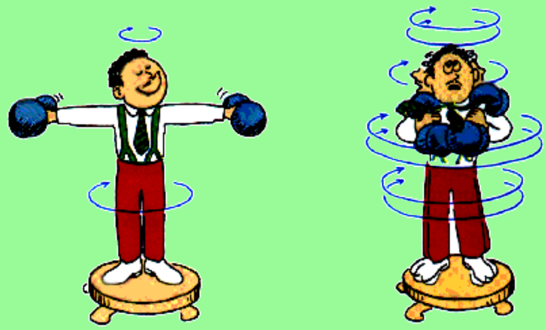
Curl the fingers of the right hand in the direction of rotation. The thumb will point in the direction of the angular velocity, $\vec{\omega}$, and angular momentum, $\vec{L}$.



Gyroscopic Effect



Changing M.O.I.



Center Of Mass

The center of mass of an object is the point on the object that moves in the same way that a point particle would move.

Finding the Center of Mass

1.) Balance Method GO

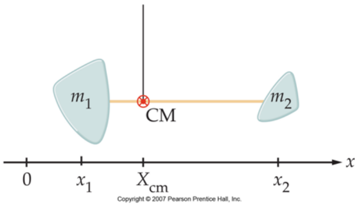
2.) Hanging Method GO

3.) Projectile Method GO

Center of Mass

The **center of mass** of a system of masses is the point where the system can be balanced in a uniform gravitational field.

$$X_{cm} = \frac{m_1x_1 + m_2x_2}{m_1 + m_2} = \frac{m_1x_1 + m_2x_2}{M}$$

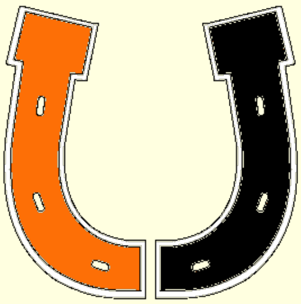


Two Dimensional Center of Mass

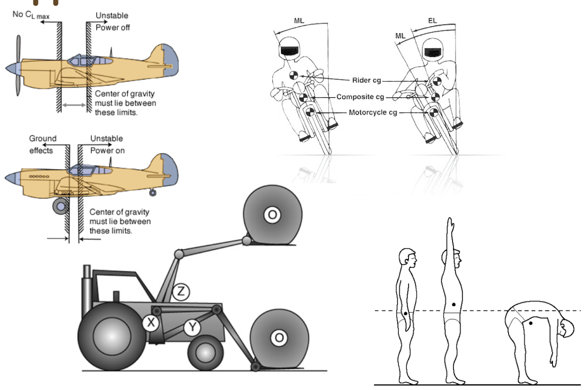
$$X_{cm} = \frac{m_1x_1 + m_2x_2}{m_1 + m_2} = \frac{m_1x_1 + m_2x_2}{M}$$

$$y_{cm} = \frac{m_1y_1 + m_2y_2}{m_1 + m_2} = \frac{m_1y_1 + m_2y_2}{M}$$

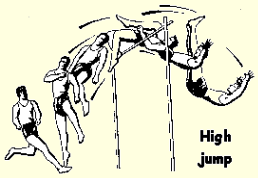
Where is the Center of Mass?



Applications of Center of Mass



Fosbury Flop



Conditions For Equilibrium

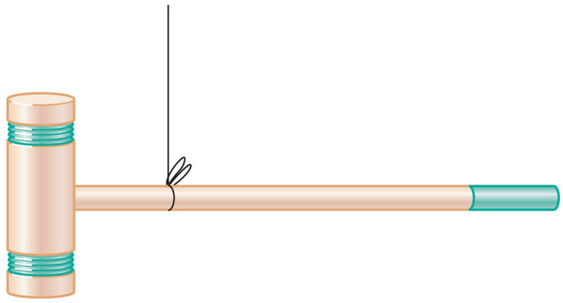
1.) Translational Equilibrium — Net Force = 0

2.) Rotational Equilibrium — Net Torque = 0

Balance Method

BACK

Center of Mass



Center of Mass

BACK

Projectile Method

BACK