Announcements

PRACTICE	LABS	TESTS
Unit 12 Problems (1-22)	Balancing Lab Due TODAY	Unit 12 Test Thursday (4/4/19)

1 D E

Angular Momentum

12.3	I can define, analyze, and solve problems involving torque.

TORQUE 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.

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

Angular Momentum

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

$p = mv$

$$L = I\omega$$

Angular Impulse

Angular Impulse $= \Delta L$

Angular Impulse $= L_f - L_i$

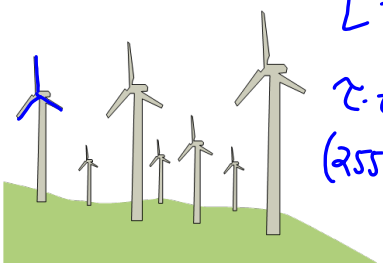
$F \cdot t = \Delta p$

Angular Impulse - Angular Momentum Theorem

$$\tau \, \Delta t = \Delta L$$

UNIT 12 IN CLASS PROBLEMS

20. In a light wind, a windmill experiences a constant torque of 255 N·m. If the windmill is initially at rest, what is its angular momentum 2.00 s later?



$L = I\omega$

$\tau \cdot t = \Delta L = L_f - L_i^{\,0}$

$(255\ \text{N·m})(2\ \text{s}) = L_f$

$L_f = 510\ \frac{\text{kg·m}^2}{\text{s}}$

N·m·s

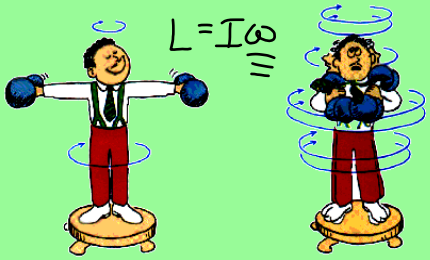
Conservation of Angular Momentum

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

$$\tau^{\,0} \Delta t = \Delta L = 0$$

$L_i = L_f$

Changing M.O.I.

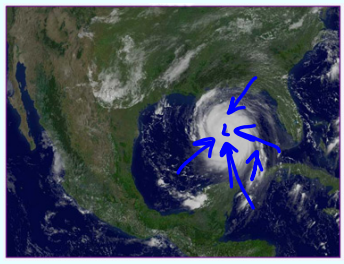


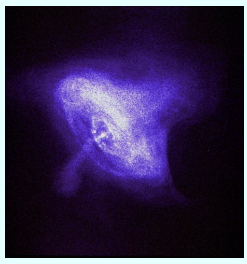
$L = I\omega$

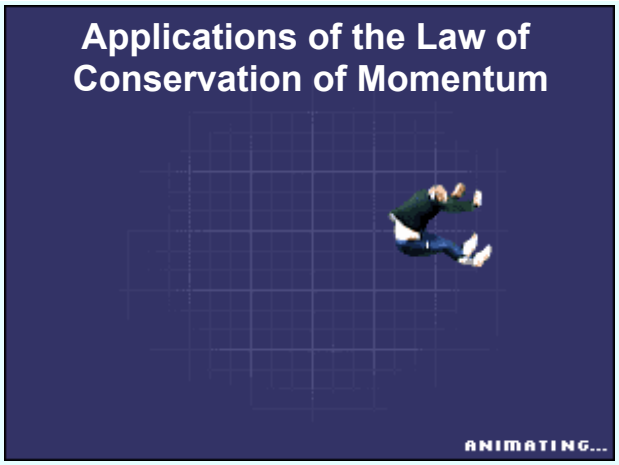
$L_i = L_f$

$I\omega = I\omega$

Applications of the Law of Conservation of Momentum



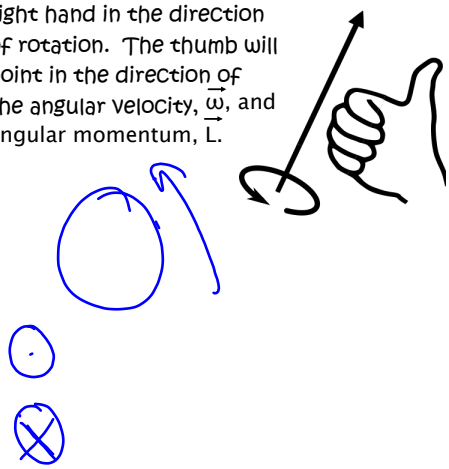




Helicopters

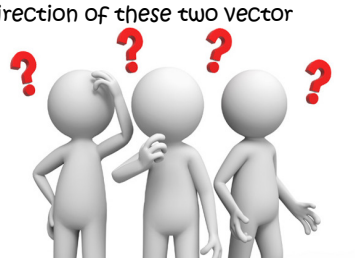
The Right-Hand Rule

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, $\vec{L}$.



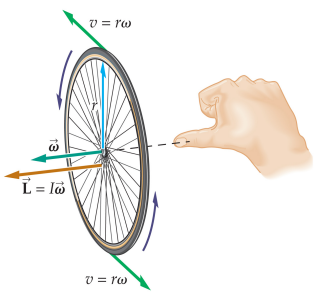
The Vector Nature of Angular Velocity and Momentum

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?

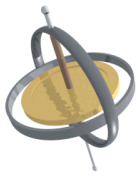


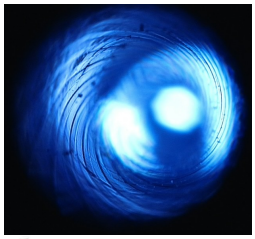
Angular Momentum

$$\vec{L} = I\vec{\omega}$$



Gyroscopic Effect





UNIT 12 PROBLEMS

(1-22)