Announcements

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

Angular Momentum

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

TORQUE SUMMARY

Torque due to a tangential force: $\tau = rF$

Torque in general: $\tau = rF\sin\theta$

Newton's second law for rotation: $\tau = I\alpha$

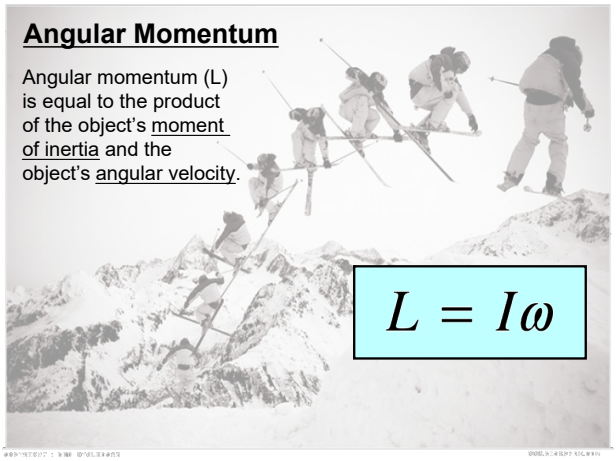
Kinetic energy of rotation: $K = \frac{1}{2}I\omega^2$

Moment of inertia: $I = \sum m_i r_i^2$

Angular momentum: $L = I\omega$

Angular Momentum

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



$$L = I\omega$$

Angular Impulse

Angular Impulse $= \Delta L$

Angular Impulse - Angular Momentum Theorem

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

Define the conservation of momentum and give three real world applications.

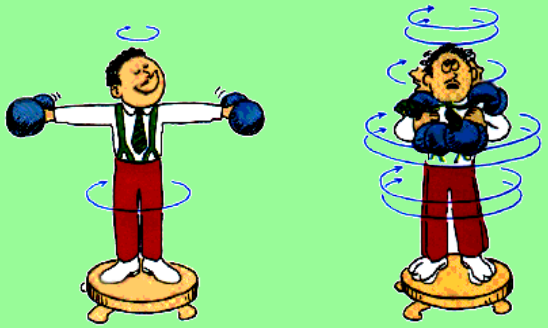
Retrieval Practice
[Practice Testing]

Conservation of Angular Momentum

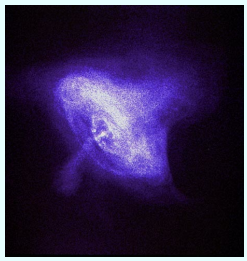
If no net external torque acts on an object, then its angular momentum does not change.

$$L_i = L_f$$

Changing M.O.I.



Applications of the Law of Conservation of Momentum

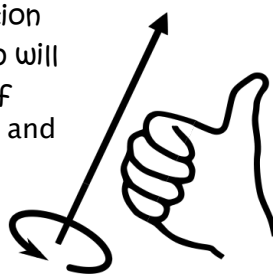


Applications of the Law of Conservation of Momentum

Helicopters

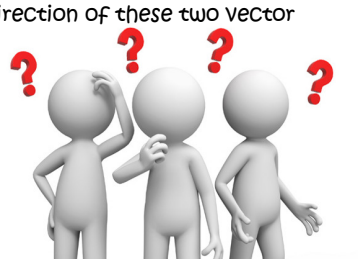
The Right-Hand Rule

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, $\vec{L}$.



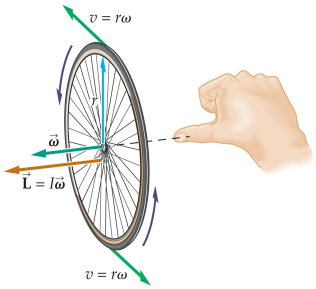
The Vector Nature of Angular Velocity and Momentum

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

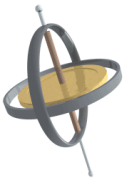


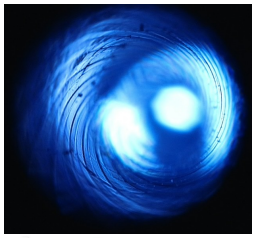
Angular Momentum

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



Gyroscopic Effect





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?

21. Initially holding her arms outstretched, a figure starts to spin with an angular speed of 3.7 rad/s. Her moment of inertia in this case is 5.33 kg·m^2. While still spinning, the figure skater pulls her arms in to her chest, reducing the moment of inertia to 1.60 kg·m^2. What is the figure skater's angular speed now?

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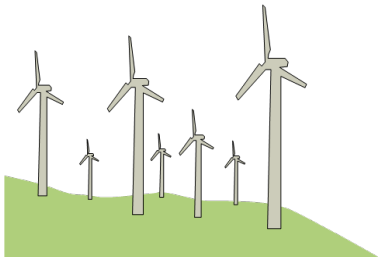

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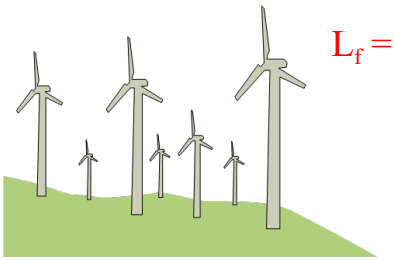

$$L_f = \tau\,\Delta t$$

$$L_f = 510\ \text{kg}\cdot\text{m}^2$$

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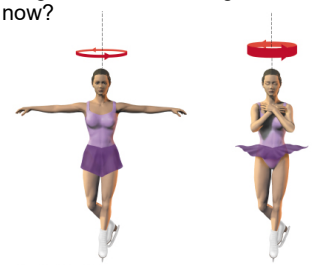

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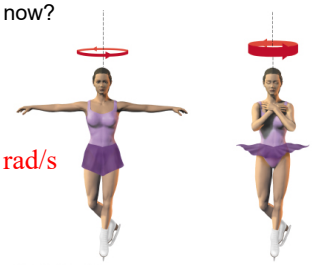
$$L_i = L_f$$

$$I_i\omega_i = I_f\omega_f$$

$$\omega_f = \left(\frac{I_i}{I_f}\right)\omega_i = 12.5\ \text{rad/s}$$



UNIT 12 PROBLEMS

(1-23)