READ 9.1 - 9.2

Evaluations today

Conservation of angular momentum

We know linear momentum ($\vec{p}$) is conserved
Let's look at angular momentum

Linear	Angular	
Force (F)	Torque (τ)	$x \leftrightarrow \theta$
		$v \leftrightarrow \omega$
		$a \leftrightarrow \alpha$
Kinetic Energy $\frac{1}{2}mv^2$	$\frac{1}{2}I\omega^2$	$m \leftrightarrow I$

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

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

$$\Sigma \vec{F} = m\vec{a} = \frac{\Delta \vec{p}}{\Delta t}$$

$$\Sigma \vec{\tau} = I\vec{\alpha} = \frac{\Delta \vec{L}}{\Delta t}$$

linear momentum conserved if no net external forces

$$\Sigma \vec{P}_i = \Sigma \vec{P}_f$$

angular momentum conserved if no net external torques

$$\Sigma \vec{L}_i = \Sigma \vec{L}_f$$

$$\Sigma I_i \omega_i = \Sigma I_f \omega_f$$

$$\Sigma m r_i^2 \omega_i = \Sigma m r_f^2 \omega_f$$

Interactive Question

An ice skater performs a pirouette by pulling her outstretched arms close to her body. What happens to her moment of inertia about the axis of rotation?

A) It does not change.
B) It increases.
C) It decreases.
D) It changes, but it is impossible to tell which way.

Interactive Question

An ice skater performs a pirouette by pulling her outstretched arms close to her body. What happens to her angular momentum about the axis of rotation?

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Interactive Question

An ice skater performs a pirouette by pulling her outstretched arms close to her body. What happens to her rotational kinetic energy about the axis of rotation?

A) It does not change.
B) It increases.
C) It decreases.
D) It changes, but it is impossible to tell which way.

$K.E._i = \frac{1}{2} I_i \omega_i^2$

$K.E._f = \frac{1}{2} I_f \omega_f^2$

$I_i \omega_i = I_f \omega_f$ conservation of angular momentum

$$I_f = \frac{I_i \omega_i}{\omega_f}$$

$$K.E._f = \frac{1}{2} \frac{I_i \omega_i}{\omega_f} \omega_f^2$$

$K.E._f = \frac{1}{2} I_i \omega_i \omega_f$

$K.E._i = \frac{1}{2} I_i \omega_i^2$

$\omega_f > \omega_i$ so $K.E._f > K.E._i$

why is it increasing?

Work $= \Delta K = F d \cos\theta$

am I doing work?

yes

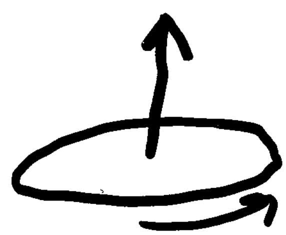
Force → centripetal

d in same direction as Force

Note Angular momentum is a vector and so has a direction.

Direction can be determined using right hand rule

Fingers in direction of rotation
thumb points in direction of vector



$$\Sigma \vec{\tau} = \frac{\Delta \vec{L}}{\Delta t}$$

Need a net torque to change angular momentum. So need a net torque to change direction of L.

→ stability of bicycle