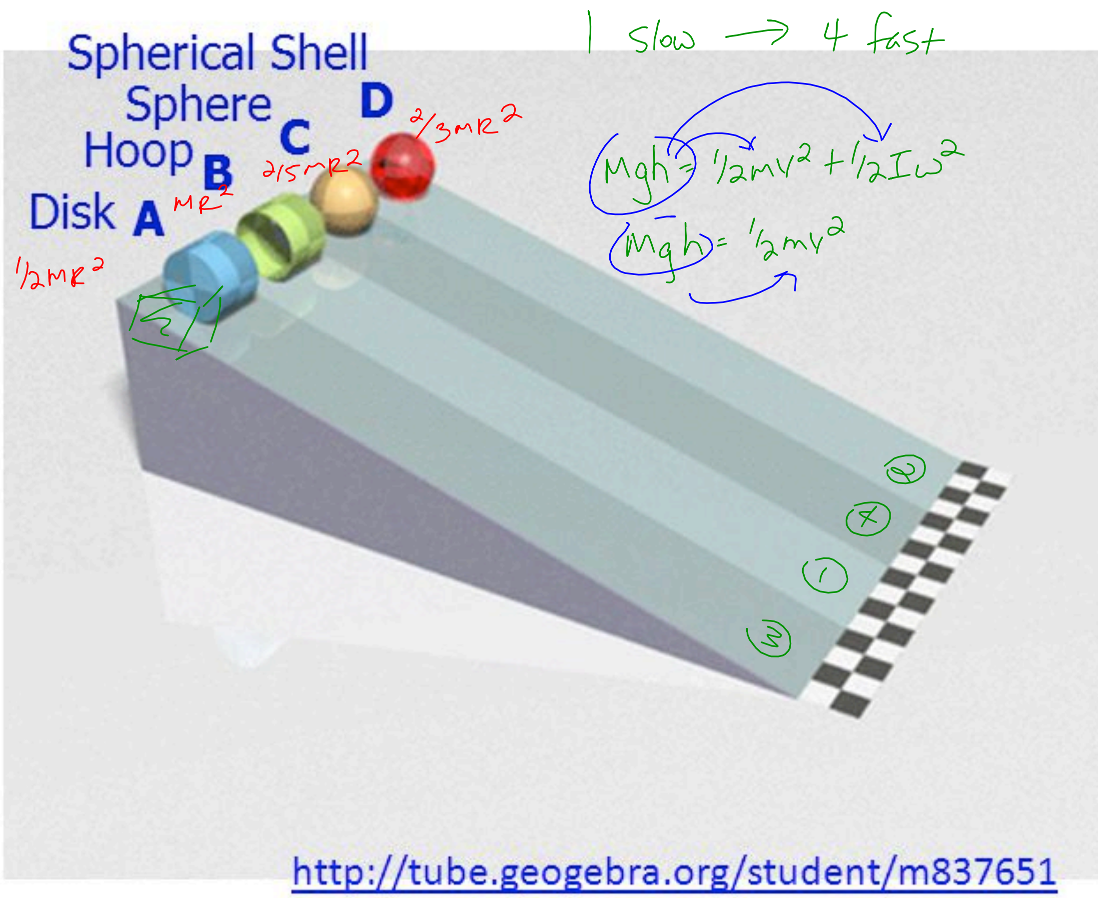
Who Wins the Race!?



Angular Momentum

- Consider the linear momentum equivalent

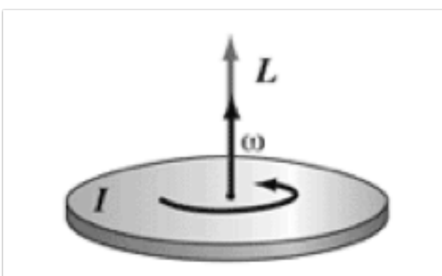
- Linear Momentum

  p = mv

- Angular Momentum

  L = I ω

- SI Unit: $\frac{kg \cdot m^2}{s}$



Angular Momentum of a Rotating Rigid Body

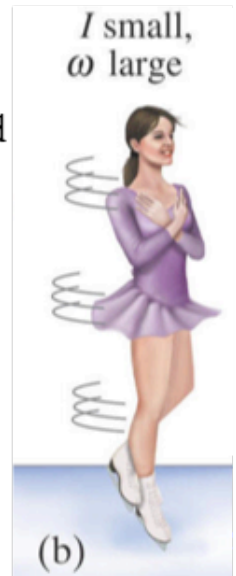
- Linear momentum tells you how difficult it would be to stop an object from moving. Therefore, angular momentum tells you how difficult it would be to stop an object's rotation.

Conservation of Angular Momentum

- With no external forces (torques for rotational motion) angular momentum is conserved.

For the ice skater, angular momentum is conserved

When she pulls her hands in....



...she decreases her moment of inertia, thereby increasing her angular velocity

Conservation of Angular Momentum

- Formula:

$$L_o = L_f = \text{constant}$$

$$I_o \omega_o = I_f \omega_f$$

Alternate formulas:

$$L = mrv$$

Derivation?

$L = I \cdot \omega$ $\quad$ $L = mvr$

$I \cdot \frac{v}{R}$

$mR^2 \cdot \frac{v}{R}$

mrv

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

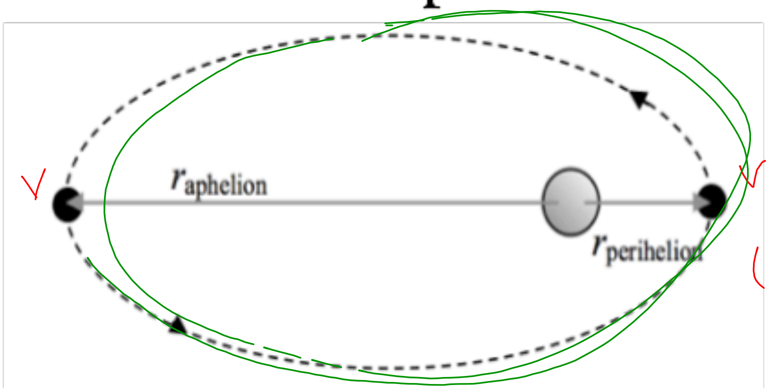
$\Delta L = \tau \cdot \Delta t$

$\Delta p = F \cdot \Delta t$

impulse-momentum theory

if you want change angular momentum you need torque

Example 11



$L_0 = L_f$

$I \cdot \omega$

$(mrv)_a = (mrv)_p$ mrv

A planet has an elliptical orbit around a large star as shown. If the planet has a speed of $v_{aphelion}$ as its farthest distance from the star which of the following statements about the planet's velocity at the perihelion must be true?

A. $v_{perihelion} < v_{aphelion}$, because the angular momentum of the system has decreased

B. $v_{perihelion} < v_{aphelion}$, because the angular momentum of the system is the same

C. $v_{perihelion} > v_{aphelion}$, because the angular momentum of the system has increased

D. $v_{perihelion} > v_{aphelion}$, because the angular momentum of the system is the same

E. $v_{perihelion} = v_{aphelion}$, because the angular momentum of the system is the same

Example 12

A potter's wheel is rotating around a vertical axis through its center at a frequency of 1.5 rev/s. The wheel can be considered a uniform disk of mass 5.0 kg and a diameter of 0.40 m. The potter then throws a 3.10 kg chunk of clay, approximately shaped also as a flattened disk of radius 8.00 cm onto the rotating wheel. What will be the frequency of the wheel after the clay sticks to it?

$L_o = L_f$

$mrv = (mrv + mrv)$

$I \cdot \omega$

mrv

$f \rightarrow \frac{rev}{s}$ θ

ω rad/s

$\frac{1.5\ rev}{s}$