Name: Key

Notes - 10.5 Angular Momentum and Its Conservation

1. Write the equation for linear momentum. $p = mv$

2. Write the equation for angular momentum. $L = I\omega$ $L = rp$ $L = rp\sin\theta$

3. Calculate the angular momentum of the Earth. Show your work.

$$L = I\omega = \left(\frac{2}{5}MR^2\right)\omega$$

$$= \frac{2}{5}(5.979\times10^{24}\,kg)(6.376\times10^{6}\,m)^2\left(\frac{1\,rev}{1\,day}\right)\left(\frac{1\,day}{24\,h}\right)\left(\frac{1\,h}{3600\,s}\right)\left(\frac{2\pi\,rad}{1\,rev}\right)$$

$$= \boxed{7.06\times10^{33}\,\frac{kg\,m^2}{s}}$$

4. State the Law of Conservation of Angular Momentum in words.

When there is no net torque, the angular momentum remains constant

5. Write the equation for the Conservation of Momentum.

$L_i = L_f$ $\quad I_i\omega_i = I_f\omega_f$ $\quad \tau_{NET} = \frac{\Delta L}{\Delta t} = 0$

6. Suppose an ice skater, such as the one in Figure 10.23, is spinning at 0.800 rev/ s with her arms extended. She has a moment of inertia of 2.34 kg·m^2 with her arms extended and of 0.363 kg·m^2 with her arms close to her body. (These moments of inertia are based on reasonable assumptions about a 60.0-kg skater.)

A. What is her angular velocity in revolutions per second after she pulls in her arms?

$$I_i\omega_i = I_f\omega_f \Rightarrow \omega_f = \frac{I_i\omega_i}{I_f} = \frac{2.34\,kgm^2}{0.363\,kgm^2}\,0.800\,\frac{rev}{s}$$

$$= \boxed{5.16\,\frac{rev}{s}}$$

B. What is her rotational kinetic energy before and after she does this?

$$K_i = \frac{1}{2}I_i\omega_i^2 = \frac{1}{2}(2.34\,kgm^2)\left(0.800\,\frac{rev}{s}\times\frac{2\pi\,rad}{1\,rev}\right)^2 = \boxed{29.6\,J}$$

$$K_f = \frac{1}{2}I_f\omega_f^2 = \frac{1}{2}(0.363\,kgm^2)\left(5.16\,\frac{rev}{s}\times\frac{2\pi\,rad}{rev}\right)^2 = \boxed{191\,J}$$

It takes work to pull the arms in $\Rightarrow$ increased K