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(51) $L = I\omega$ $I = mr^2$

$= mr^2\omega$

$= (.210)(1.10)^2(10.4)$

$= 2.64 \text{ kg m}^2/\text{s}$

(52) (a) $L = I\omega$ $I = \frac{1}{2}mr^2$

$L = \frac{1}{2}mr^2\omega$

$= \frac{1}{2}(2.8)(.18)^2\left(\frac{1500(2\pi)}{60}\right)$

$= 7.1 \text{ kg m}^2/\text{s}$

(b) $\Delta L = \tau \Delta t$

$\tau = \frac{\Delta L}{\Delta t} = \frac{0 - 7.1}{6} = -1.2 \text{ mN}$

(53) (a) The system is the person on the platform.
Angular momentum must be conserved.
The moment of inertia changes when the arms are raised.
Therefore, the angular velocity must change.

(b) $L = I\omega$

$I_i \omega_i = I_f \omega_f$

$\frac{I_f}{I_i} = \frac{\omega_i}{\omega_f} = \frac{1.3}{.8} = 1.6$

(54) $L = I\omega$

$I_1 \omega_1 = I_2 \omega_2$

$\omega_2 = \frac{I_1}{I_2}\omega_1 = \frac{1}{3.5}\left(\frac{2}{1.5}\right) = 0.38$ rev/s

(55) $L = I\omega$

$I_i \omega_i = I_f \omega_f$

$I_f = \frac{I_i \omega_i}{\omega_f} = \frac{4.6\left(\frac{1}{2}\right)}{3} = 0.77\ kg\,m^2/s$

She starts with her arms outstreched and then pulls them towards the center of her body.

(56) $L = I\omega$ $\qquad I = \frac{1}{2}mr^2$

$I_i \omega_i = I_f \omega_f$

$\omega_f = \frac{I_i \omega_i}{I_f} = \frac{\left(\frac{1}{2} m_{wheel} r^2_{wheel}\right)\omega_i}{\left(\frac{1}{2} m_{wheel} r^2_{wheel} + \frac{1}{2} m_{clay} r^2_{clay}\right)}$

$= \frac{\frac{1}{2}(5)(.2)^2(1.5)}{\frac{1}{2}(5)(.2)^2 + \frac{1}{2}(3.1)(.08)^2}$

$= 1.4$ rev/s

57 (a) $L = I\omega \qquad I = \frac{1}{2}mr^2$

$$L = \frac{1}{2}mr^2\omega$$

$$= \frac{1}{2}(55)(.15)^2(3.5)(2\pi)$$

$$= 14 \ kg\,m^2/s$$

(b) $\Delta L = \tau \Delta t$

$$\tau = \frac{\Delta L}{\Delta t} = \frac{0-14}{5} = -2.8 \ mN$$

58 (a) $L = I\omega \qquad I = \frac{2}{5}mr^2$

$$= \frac{2}{5}mr^2\omega$$

$$= \frac{2}{5}(5.98\times10^{24})(6.38\times10^{6})^2\left(\frac{2\pi}{24\times60\times60}\right)$$

$$= 7.1\times10^{33} \ kg\,m^2/s$$

(b) $L = I\omega \qquad I = mr^2$

$$= mr^2\omega$$

$$= (5.98\times10^{24})(1.496\times10^{11})^2\left(\frac{2\pi}{365\times24\times60\times60}\right)$$

$$= 2.7\times10^{40} \ kg\,m^2/s$$

(59) $L_i = L_f$

$I_i \omega_i = I_f \omega_f$

$\omega_f = \dfrac{I_i \omega_i}{I_f} = \dfrac{I \omega}{(2I)} = \dfrac{\omega}{2}$

(60) $L_i = L_i$

$I_{disk} = \frac{1}{2} m r^2$

$I_{rod} = \frac{1}{12} m L^2$

$L = 2r$

$m_{disk} = m_{rod} = m$

$I_i \omega_i = I_f \omega_f$

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

$= \dfrac{\frac{1}{2} m r^2 (2.4)}{\frac{1}{2} m r^2 + \frac{1}{12} m (2r)^2}$

$= \dfrac{\cancel{mr^2}\, \frac{1}{2}(2.4)}{\cancel{mr^2}\left(\frac{1}{2} + \frac{4}{12}\right)} = 1.4 \text{ rad/s}$

(61) (a) $L_i = L_f$

$I_i \omega_i = I_f \omega_f$

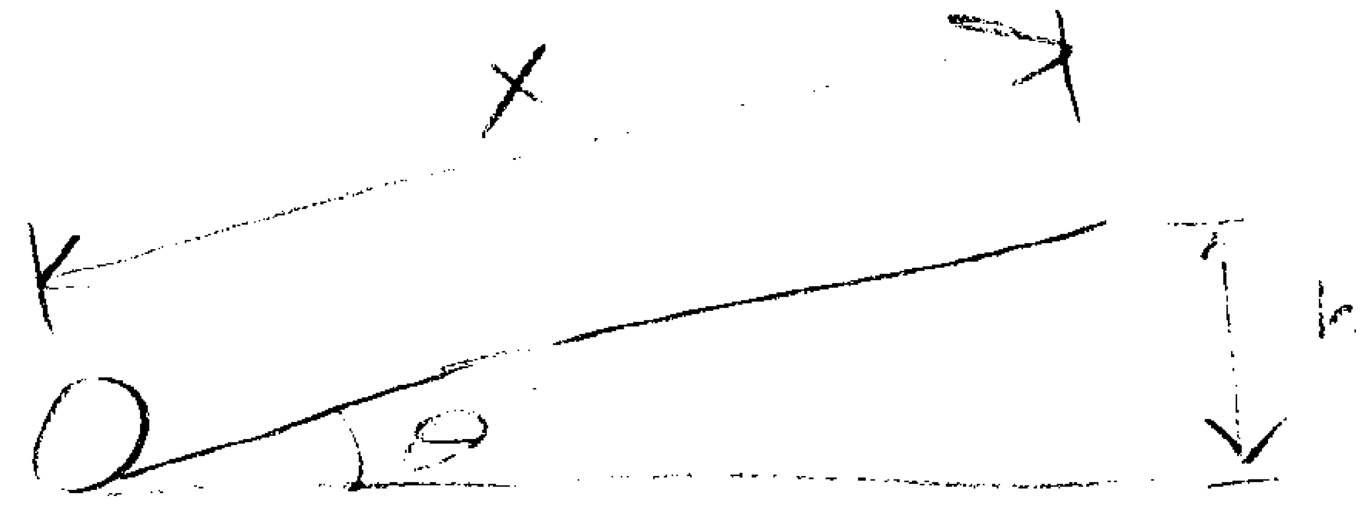
$\omega_f = \dfrac{I_i \omega_i}{I_f} = \dfrac{I_{platform}\, \omega_i}{I_{platform} + m r^2} = \dfrac{(920)(2)}{(920 + 75(3)^2)} = 1.2 \text{ rad/s}$

(b) $K = \frac{1}{2} I \omega^2$

$K_i = \frac{1}{2}(920)(2)^2 = 1840 \text{ J} = 1800 \text{ J}$

$K_f = \frac{1}{2}\left(920 + 75(3)^2\right)(1.2)^2 = 1148 \text{ J} = 1100 \text{ J}$

(77) (a)



$I = mr^2$

$E_{bottom} = E_{top}$

$\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 = mgh$

$\frac{1}{2}\cancel{m}v^2 + \frac{1}{2}(\cancel{m}r^2)\left(\frac{v}{\cancel{r}}\right)^2 = \cancel{m}gh$

$h = \frac{v^2}{g}$ $\qquad \sin\theta = \frac{h}{x}$

$x = \frac{v^2}{g\sin\theta} = \frac{(3.3)^2}{9.8\sin 15} = 4.293 = 4.3\text{ m}$

(b) acceleration is constant

$\Delta x = \left(\frac{v_x + v_{x0}}{2}\right)t$

$t = \frac{2\Delta x}{v_x + v_{x0}} = \frac{2(4.293)}{0 + 3.3} = 2.601$ time to go up

total time on ramp $= 2(2.601) = 5.2\text{ s}$

(81) $\Delta L = \tau \Delta t$ $L = I\omega$

$$\tau = \frac{\Delta L}{\Delta t} = \frac{I\omega}{\Delta t} \qquad I = mr^2$$

$$\tau = mr^2 \frac{\Delta\omega}{\Delta t} = \frac{.5(1.5)^2\left(\frac{120(2\pi)}{60} - 0\right)}{5} = 2.8 \text{ mN}$$

The torque comes from the arm muscles.

(83) (a) $L = I\omega$ $I = \frac{1}{2}mr^2$

$$= \frac{1}{2}mr^2\omega = \frac{1}{2}(6)(.6)^2(7.2) = 7.776 = 7.8 \text{ kgm}^2/\text{s}$$

(b) $\Delta L = \tau \Delta t$

$$\tau = \frac{\Delta L}{\Delta t} = \frac{7.776}{2} = 3.888 = 3.9 \text{ mN}$$

(c) $L_i = L_f$

$$L_i = (I_A + I_B)\omega_f$$

$$\omega_f = \frac{L_i}{I_A + I_A} = \frac{L_i}{\frac{1}{2}m_A r^2 + \frac{1}{2}m_B r^2}$$

$$= \frac{7.776}{\frac{1}{2}(.6)^2(6+9)} = 2.88 = 2.9 \text{ rad/s}$$