p 221 43, 45 – 50

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

$= \frac{1}{2} I (2\pi f)^2$

$= \frac{1}{2}(3.75\times10^{-2})(2\pi)^2\left(\frac{8250}{60}\right)^2$

$\underline{K = 14000\ J}$

(45) $K_{TOTAL} = K_{rot} + K_{trans}$ $\omega = \frac{v}{r}$

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

$= \cancel{\frac{1}{2}}\left(\frac{\cancel{2}}{5} m\cancel{r^2}\right)\left(\frac{v}{\cancel{r}}\right)^2 + \frac{1}{2} mv^2$

$= \frac{2}{2}\frac{mv^2}{5} + \frac{5}{5}\frac{mv^2}{2} = \frac{7mv^2}{10}$

$= \frac{7(7.3)(3.3)^2}{10}$

$= \underline{56\ J}$

(46) (a) $K = \frac{1}{2} I \omega^2$ $\qquad I = \frac{2}{5} m r^2$

$$= \frac{1}{2}\left(\frac{2}{5} m r^2\right)\omega^2$$

$$= \frac{1}{2}\left(\frac{2}{5}(6\times10^{24})\right)(6.4\times10^{6})^2\left(\frac{2\pi}{24\times3600}\right)^2$$

$$= \underline{2.6\times10^{29}\ J}$$

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

$$= \frac{1}{2}(m r^2)\,\omega^2$$

$$= \frac{1}{2}(6\times10^{24})(1.5\times10^{11})^2\left(\frac{2\pi}{365\times24\times3600}\right)^2$$

$$= \underline{2.7\times10^{33}\ J}$$

Total $K = 2.6\times10^{29} + 2.7\times10^{33} = \underline{2.7\times10^{33}\ J}$

(47) $W = \Delta K$ $\qquad K_0 = 0$

$$= \frac{1}{2} I \omega^2 \qquad I = \frac{1}{2} m R^2$$

$$= \frac{1}{2}\left(\frac{1}{2} m R^2\right)\omega^2 \qquad \omega = 2\pi f$$

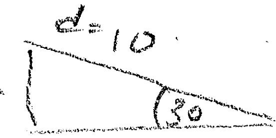
$$= \frac{1}{2}\left(\frac{1}{2}\right)(1640)(7.5)^2(2\pi)^2\left(\frac{1}{8}\right)^2$$

$$= 14226 = \underline{14000\ J}$$

(48) (a) Energy is conserved.

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

$$I = \frac{2}{5}mr^2 \qquad v = r\omega \qquad h = d\sin\theta$$



$$\cancel{m}gh = \frac{1}{2}\cancel{m}v^2 + \cancel{\frac{1}{2}}\left(\frac{2}{5}\right)\cancel{m}r^2\omega^2$$

$$gd\sin\theta = \frac{1}{2}v^2 + \frac{1}{5}\cancel{r^2}\frac{v^2}{\cancel{r^2}}$$

$$gd\sin\theta = \frac{7}{10}v^2$$

$$v = \sqrt{\frac{10}{7}gd\sin\theta}$$

$$v = \sqrt{\frac{10}{7}(9.8)(10)\sin 30} = \underline{8.4\ m/s}$$

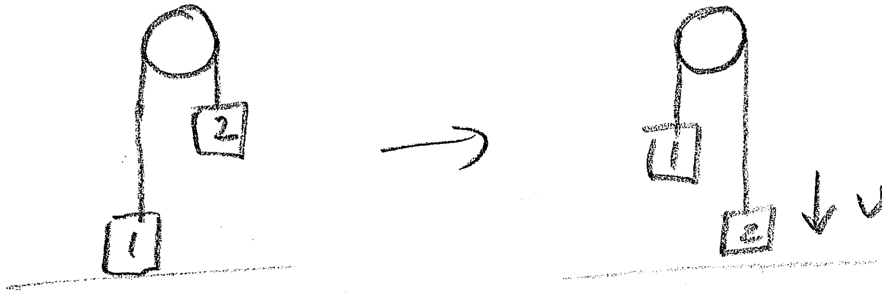
$$\omega = \frac{v}{r} = \frac{8.4}{.2} = 41.8 = \underline{42\ rad/s}$$

(b) $$\frac{K_{trans}}{K_{rot}} = \frac{\frac{1}{2}mv^2}{\frac{1}{2}I\omega^2} = \frac{\cancel{\frac{1}{2}}\cancel{m}v^2}{\cancel{\frac{1}{2}}\left(\frac{2}{5}\cancel{m}\cancel{r^2}\right)\frac{v^2}{\cancel{r^2}}} = \frac{5}{2} = \underline{2.5}$$

(c) No results depend on mass.

Only angular speed depends on radius.

49



$$m_2 g h_2 = \frac{1}{2} m_2 v_2^2 + \frac{1}{2} I \omega^2 + \frac{1}{2} m_1 v_1^2 + m_1 g h_1$$

$V_2 = V_1$ → blocks are attached to each other, they have to move at the same speed.

$h_2 = h_1$ → blocks are attached to each other, when block 2 hits the ground, block 1 will be at its original height

$$m_2 g h = \frac{1}{2} m_2 v^2 + \frac{1}{2} I \omega^2 + \frac{1}{2} m_1 v^2 + m_1 g h$$

$$I = \frac{1}{2} M R^2 \qquad \omega = \frac{v}{R}$$

$$m_2 g h = \frac{1}{2} m_2 v^2 + \frac{1}{2}\left(\frac{1}{2} M \cancel{R^2}\right)\frac{v^2}{\cancel{R^2}} + \frac{1}{2} m_1 v^2 + m_1 g h$$

$$\frac{1}{2} m_2 v^2 + \frac{1}{4} M v^2 + \frac{1}{2} m_1 v^2 = m_2 g h - m_1 g h$$

$$v^2 = \frac{m_2 g h - m_1 g h}{\frac{1}{2} m_2 + \frac{1}{4} M + \frac{1}{2} m_1}$$

49

$$v = \sqrt{\frac{(m_2 - m_1)gh}{\frac{1}{2}(m_2 + \frac{1}{2}M + m_1)}}$$

$$= \sqrt{\frac{(26.5 - 18)(9.8)(3)}{\frac{1}{2}(26.5 + \frac{7.5}{2} + 18)}} = \sqrt{\frac{249.9}{24.125}}$$

$$= \underline{3.22 \text{ m/s}}$$

50

Treat object as one point (center of mass)

$$mgh = \frac{1}{2} I \omega^2 \qquad I = \frac{1}{3} m L^2$$

$$\cancel{m} g \frac{\cancel{L}}{2} = \frac{1}{2}\left(\frac{1}{3} \cancel{m} \cancel{L^2}\right)\frac{v^2}{\cancel{L^2}}$$

$$v = \sqrt{3gL}$$

$$= \sqrt{3(9.8)(2.3)}$$

$$v = 8.22 \text{ m/s}$$