(71) $\Gamma = I\alpha$ $\quad I = \frac{1}{2}mr^2$

$\omega_f = \omega_i + \alpha t$

$\alpha = \frac{\omega_f - \omega_i}{t}$

$\alpha = \frac{2\pi f}{t}$

$\Gamma = \left(\frac{1}{2}mr^2\right)\left(\frac{2\pi f}{t}\right)$

$= \frac{1}{2}(1.4\,kg)(.2\,m)^2 \frac{2\pi\,(1800\,Hz)}{6\,s}$

$= \underline{53\,Nm}$

(81) $\omega = \omega_0 + \alpha t$

$\alpha = \frac{\omega}{t} = \left(\frac{2\pi(120)}{60}\right)\frac{1}{5} = 2.51\,rad/s$

$\tau = I\alpha$

$= mr^2\alpha$

$= (0.5)(1.5)^2(2.51)$

$\tau = \underline{2.8\,Nm}$

The torque comes from the arm muscles.

65

$$= \frac{(1\times10^{5})(30\times10^{3})}{\frac{2}{5}(6\times10^{24})\left(\frac{1}{24\times3600}\cdot 2\pi\right)(6.4\times10^{6})}$$

$$= 2.686\times10^{-16}$$

$$= 2.7\times10^{-16}\ \%$$

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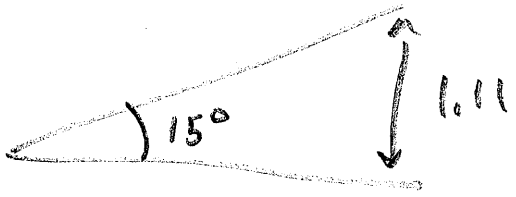
(77) (a) Conservation of Energy.

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

$$\frac{1}{2}mv^2 + \frac{1}{2}(mr^2)\left(\frac{v^2}{r^2}\right) = mgh$$

$$h = \frac{v^2}{g} = \frac{(3.3)^2}{9.8} = 1.11\ m$$



$$\sin\theta = \frac{1.11}{d}$$

$$d = \frac{1.11}{\sin 15} = \underline{4.3}$$

77 (b) time up the ramp.

$$V_{average} = \frac{x}{t}$$

$$\frac{V + V_0}{2} = \frac{x}{t}$$

$$t = \frac{2x}{V_0} = \frac{2(4.3)}{3.3} = 2.61 \text{ s}$$

Total time = 5.2 s

(83) (a) $L = I\omega$

$= \frac{1}{2} m_A R^2 \omega$

$= \frac{1}{2}(6)(0.6)^2 (7.2)$

$= \underline{7.8 \text{ kg m}^2/\text{s}}$

(b) $\tau = \frac{\Delta L}{\Delta t} = \frac{7.8}{2}$

$\tau = 3.9 \text{ Nm}$

(c) $L_i = L_f$

$I_i \omega_1 = I_f \omega_2$

$\frac{1}{2} m_A R^2 \omega_1 = \left(\frac{1}{2} m_A R^2 + \frac{1}{2} m_B R^2\right) \omega_2$

$\omega_2 = \left(\frac{m_A}{m_A + m_B}\right) \omega_1$

$= \left(\frac{6}{6+9}\right) 7.2$

$\omega_2 = 2.9 \text{ rad/s}$

(86) (a) $\omega^2 = \omega_0^2 + 2\alpha\theta$ $\qquad \omega = \frac{v}{r}$

$\frac{v^2}{r^2} = \frac{v_0^2}{r^2} + 2\alpha\theta$ $\qquad 90 \times \frac{1000}{3600} = 25$

$\frac{v^2}{r^2} - \frac{v_0^2}{r^2} = \alpha$ $\qquad 60 \times \frac{1000}{3600} = 16.67$

2θ

$$\alpha = \frac{v^2 - v_0^2}{2\theta r^2} = \frac{(16.67)^2 - (25)^2}{2(85.2\pi)(.45)^2} = \frac{-347}{216.3}$$

$$\alpha = -1.6 \text{ rad/s}^2$$

(b) $\omega = \omega_0 + \alpha t$

$$t = -\frac{\omega_0}{\alpha} = -\frac{v}{r\alpha} = \frac{-16.67}{.45(-1.6)}$$

$$t = 23 \text{ s}$$