LAW of ACCELERATION (p. 110)

$$\Sigma \underline{F} = m\,\underline{a}$$
$$\Sigma F_x = ma_x$$
$$\Sigma F_y = ma_y$$

1.

$$a = \left(\frac{v_f^2 - v_i^2}{2(x_f - x_i)}\right) = \left(\frac{0 - 9^2}{2(30 - 0)}\right) = \frac{-81}{60} = -1.350 \text{ m/s}^2$$

$$F = ma = 60.0(-1.350) = -81.0 \text{ N}$$

3.

$$\Sigma F_y = ma_y = F_{lifter} - mg$$

$$a_y = \left(\frac{v_{yf} - v_{yi}}{t}\right) = \frac{2 - 0}{1} = 2.00$$

$$F_{lifter} = ma_y + mg = 40(2) + 40(9.81) = 472 \text{ N}$$

5.

$$F_{normal} = mg = 70(9.81) = 686.7$$

$$F_{kinetic} = F_{normal}\,\mu_{kinetic} = 686.7 \times 0.6 = 412 \text{ N}$$

$$\Sigma F_x = ma_x = -F_{kinetic}$$

$$a_x = \frac{-Fkinetic}{70} = -5.886 \text{ m/s}^2$$

$$\text{Thus, } x_f = x_i + \left(\frac{v_{fx}^2 - v_{ix}^2}{2a_x}\right) = 0 + \left(\frac{0 - 10^2}{2(-5.886)}\right) = 8.49 \text{ m}$$

7.

$$\Sigma F = ma = 1000 = 900a$$

$$a = 1000/900 = 1.111 \text{ m/s}^2$$

$$t = \frac{v_f - v_i}{a} = \frac{3 - 0}{1.111} = 2.70 \text{ s}$$

9.

$$a = \frac{v_f - v_i}{t} = \frac{0 - 20}{0.3} = -66.67 \text{ m/s}^2$$

$$F = ma = 0.180(-66.67) = -12.00 \text{ N}$$

11.

$$\Sigma F_x = ma_x = 35 + 58 - 52 = 41.0 \text{ N}$$

$$\Sigma F_y = ma_y = 25 - 20 + 23 - mg = 28 - 196.2 = -168.2 \text{ N}$$

$$a_x = 41/20 = 2.05 \text{ m/s}^2$$

$$a_y = -168.2/20 = -8.41 \text{ m/s}^2$$

MOMENT of FORCE (p. 115)

$$\Sigma M = I\,\alpha$$
$$M = F\,d$$

1.

$$\alpha = \frac{M}{I} = 35/2 = 17.50 \text{ rad/s}^2$$

3.

$$M = Fd = 150(0.35) = 52.5 \text{ N.m}$$
$$\alpha = M / I = 2.10 \text{ rad/s}^2$$

5.

$$\alpha = \frac{\omega_f - \omega_i}{t} = \frac{2.35 - 4.45}{5.00} = -0.420$$
$$M = I\alpha = 32.0(-0.42) = -13.44 \text{ N.m}$$

7.

$$M = Fd = 400 \times 0.35 = 140.0 \text{ N.m}$$

9.

$$M = Fd = 500 \times 0.40 = 200 \text{ N.m}$$
$$I = M / \alpha = 200/20 = 10.00 \text{ kg.m}^2$$

MOMENT of INERTIA (p. 122)

$$K_{cg} = k_{cg}/L$$
$$I_{cg} = mk_{cg}^2$$
$$I_{axis} = I_{cg} + mr^2$$

1.

$$k_{cg} = \sqrt{\frac{I_{cg}}{m}} = \sqrt{\frac{0.5}{8}} = 0.250 \text{ m}$$
$$I_{axis} = I_{cg} + mr^2 = 0.5 + 8(0.25)^2$$
$$= 1.000 \text{ kg.m}^2$$

3.

$$k = KL = 0.60(0.95) = 0.57 \text{ m}$$
$$I_{cg} = mk^2 = 12.00(0.57)^2 = 3.90 \text{ kg.m}^2$$
$$I_{hip} = I_{cg} + mr^2$$
$$= 3.90 + 12.00(0.50)^2 = 6.90 \text{ kg.m}^2$$

5. (a)

$$I_{bar} = I_{cg} + mr^2 = 15.80 + 80.0(1.450)^2$$
$$= 15.8 + 168.2 = 184.0 \text{ kg.m}^2$$

(b)

$$k = \sqrt{\frac{15.80}{80.0}} = \sqrt{0.1975} = 0.444 \text{ m}$$

7.

$$M = Fd = 300(0.15) = 45.0 \text{ N.m}$$
$$\alpha = (\omega_f - \omega_i)/t = 20/1 = 20.0 \text{ rad/s}^2$$
$$I = M/a = 45/20 = 2.25 \text{ kg/m}^2$$
$$k = \sqrt{I/m} = \sqrt{2.25/90.0} = 0.1581 \text{ m}$$

9.

$$I_{proximal} = I_{cg} + mr^2 = 0.1489 + 7.05(0.1925)^2$$
$$= 0.410 \text{ kg.m}^2$$
$$k_{proximal} = \sqrt{I_{proximal}/m} = \sqrt{0.453/7.05} = 0.241 \text{ m} = 2.41 \text{ cm}$$

LAW of REACTION (p. 129)

1.

$$\Sigma F_x = F_{gx} = ma_x$$

$$a_x = F_{gx} / m = 227 / 53.8 = 4.22 \text{ m/s}^2$$

$$\Sigma F_y = F_{gy} - mg = ma_y$$

$$a_y = (1345 - 53.8 \times 9.81) / 53.8 = 15.19 \text{ m/s}^2$$

3.

$$s = r\theta$$

$$r = s / \theta = 100 / \pi = 31.83$$

$$\theta = \tan^{-1}\left(\frac{v^2}{rg}\right) = \frac{11^2}{31.83 \times 9.81}$$

$$= \tan^{-1}(0.3875) = 21.2 \text{ deg}$$

5.

$$mg = m\frac{v^2}{r}$$

$$r = \frac{v^2}{g} = \frac{250^2}{9.81} = 6371 \text{ m} = 6.37 \text{ km}$$

7.

$$\Sigma Fy = ma_y = F_{gy} - mg$$

$$F_{gy} = ma_y + mg = 65.0(0.75 + 9.81)$$

$$= 686 \text{ N}$$

9.

$$ma_r = -mv_t^2 / r = -mr\omega^2$$

$$= -3.50(2.00)5^2 = -175.0 \text{ N}$$

11.

$$F = ma = 75(20 \times 9.81) = 14\,720 \text{ N}$$