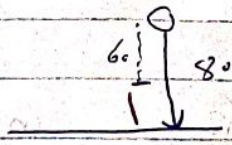
chapter 8

16 $m = 6\ kg \quad x_i = 80 \quad x_f = 60$



$K = \frac{1}{2}mv^2 = \frac{1}{2}(6)(34,29)^2 = 3500\ J$

$v = \sqrt{2gh} = \sqrt{2(9.8)(60)} = 34,29$

17 $m = 2 \quad h = 20\ m \quad U = 500\ J$

$\Delta U = mg(h-20) \Rightarrow h = \frac{\Delta U}{mg} + 20 = \frac{500}{2(9,8)} + 20 = 45,5\ m \approx 46\ m$

19 $m = ,5 \quad V = 10\ m/s \quad \theta = 60$

$U = mgh = 0,5(10)(3,75) = 18,75\ J$

$h = \frac{u^2 \sin^2\theta}{2g} = \frac{10^2 \sin^2 60}{20} = 3,75$

21 $m = 2,2\ kg \quad v_i = 0 \quad \theta = 25^\circ \quad \mu_k = ,25 \quad d = 2m$

$f_d = \mu f_N = \mu mgd\cos\theta = ,25(2,2)(9,8)(2)\cos 25 = 9,769 \approx 9,8$

22 $m = 2kg \quad v_i = 0$ ↓ $v = \sqrt{2gh} = \sqrt{20(1.85} = 6\ m/s$

23 $E = E$

$K + U = K + U \Rightarrow \frac{1}{2}mv^2 + mgy = \frac{1}{2}mv_i^2 + mgy$ (mgy → 0)

$v_f = \sqrt{2gy + v_i^2} = \sqrt{2(9,8)(,5)+(3)^2} = 4,33\ m/s$

24 $f = 8x^3$

$= \frac{8}{4}x^4 = \boxed{-2x^4}$

25 $m = .2kg \quad U(x) = 8x^2 + 2x^4 \quad v = 5 \quad at\ x = 1$

$E = K + U \qquad K = \frac{1}{2}mv^2, \frac{1}{2}(.2)(5)^2 = \boxed{2.5}$

$2.5 + 10 \qquad U = 8(1) + 2(1) = \boxed{10}$

$= \boxed{12.5}$

$a = \sqrt{\frac{2E}{K}} = \sqrt{\frac{2(12.5)}{2.5}} = \boxed{3.162}$

$w = \sqrt{\frac{K}{m}} = \sqrt{\frac{2.5}{.2}} = \boxed{3.535}$

$V = wa = 3.535\,(3.162) = \boxed{11\ m/s}$

27 $f = 10N \quad K = 20$

$f = -kx$

$x = \frac{f}{K} = \frac{10}{20} = \boxed{.5}$

$K = \frac{1}{2}kx^2 = \frac{1}{2}(20)(.5)^2 = 2.5J$

28 $m = 15g = .015\ kg$

$K = 70\ N/m$

$x_i = 7cm\left(\frac{1m}{100cm}\right) = .07 \qquad U = \frac{1}{2}K\left[x_f^2 - x_i^2\right]$

$x_f = 0 \qquad = \frac{1}{2}(20)\left[0^2 - .7^2\right]$

$= .049 = 4.9 \times 10^{-2}$

29 $m = .5\,kg \quad K = 80 \quad E = .12$

$$w = \sqrt{\frac{K}{m}} \qquad a = \sqrt{\frac{2E}{K}}$$

$$a = \sqrt{\frac{2(.12)}{80}} = .055\ m$$ خاص السؤال

31 $$v = wa = \sqrt{\frac{K}{m}}\, a = \sqrt{\frac{80}{.5}} \cdot .055 = 0.695$$

34 (ك)

$$PE_{man,i} + PE_{net\,f} = PE_{mf} + PE_{net\,f}$$

$$wh + PE = -wh + PE$$

$$PE_{net,max} = PE_{net\,f} - PE_{net\,i} = w_{men}(h_1 + h_2) = 700(10+12) = 8400$$ ↑

35 $K = 10\ N/m \quad x = .05\ m \quad m = 6\times10^{-3}\,kg \quad x_2 = .01\ m$

$$\cancel{K} + U = K + U$$

$$\tfrac{1}{2}Kx^2 = \tfrac{1}{2}mv^2 + \tfrac{1}{2}Kx^2$$

$$\tfrac{1}{2}(6)(.05)^2 = \tfrac{1}{2}(3\times10^{-3})v^2 + \tfrac{1}{2}(10)(.01)^2$$

$$.0125 = 3\times10^{-3}v^2 + 5\times10^{-4}$$

$$.012 = 3\times10^{-3}v^2 \Rightarrow v^2 = 4 \Rightarrow v = 2\ m/s$$

37 $$\frac{mv^2}{2} = 5\ J$$ or $v = \sqrt{2gL}$

$$\sqrt{2(10)(0.5)} = \sqrt{10} = 3.1$$

$$v^2 = 10$$

$$v = \sqrt{10} = 3.1$$

μ_0

$\gamma = 5/2 R$

44 $U(x) = 8x^2 + 2x^4$

$E = 9J$

$U = E$

$8x^2 + 2x^4 = 9 \Rightarrow 2x^4 + 8x^2 - 9 = 0$

$x^2 = \frac{-8 + \sqrt{8^2 + 4(2)9}}{(2\times2)\ 4}$

$x^2 (-2 \mp 2,915)$

$x = ,96$

45 $m = ,2\ kg$, $U(x) = 8x^2 + 2x^4$ at $x = 1\ m$

$v = 5$

$x = ?$

$E = K + U$

$= \frac{1}{2}mv^2 + 10$

$\frac{1}{2}(,2)(25) + 10$

$12,5 + 10$

$= 12,5$

$E = U$

$12,5 = 8x^2 + 2x^4$

$2x^4 + 8x^2 - 12,5 = 0$

$x^2 = \frac{-8 \mp \sqrt{8^2 + 4(2)(-12,5)}}{4}$

$= -2 + 3,2 = 1,2$

59 $m = ,025\ kg$ $h = 80\ m$ $K = 15J$

$K = mgh - \frac{1}{2}mv^2$

$15 = ,025(9,8)(80) - \frac{1}{2}(,025)v^2$

$15 = 19,6 - ,0125v^2$

$-4,6 = -,0125v^2$

$v = 19,1\ m/s$

60 $m = 5\ kg$ $v_i = 200$ $v_f = 150$ $\theta = 25$

$DK = \frac{1}{2}m\{v_i^2 - v_f^2\} = \frac{1}{2}(5)(200^2 - 150^2) = 43,750\ J$

$= 44002J$

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Chapter 9

2 $x_{com} = \frac{m_1 x_1 + m_2 x_2 + m_3 x_3}{m_1 + m_2 + m_3} = \frac{4(0) + 5(3) + 6(1)}{4+5+6} = \boxed{1,4}$

$y_{com} = \frac{m_1 y_1 + m_2 y_2 + m_3 y_3}{m_1 + m_2 + m_3} = \frac{4(0) + 5(2) + 6(3)}{4+5+6} = \boxed{1,9}$ (C)

8 $m_A = 4\,kg$ $v_A = 2\,m/s$ $m_B = 8\,kg$ $v_B = -3\,m/s$

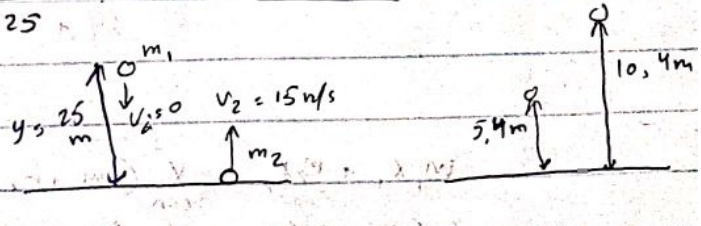
$com = \frac{4(2) + 8(-3)}{12} = \frac{-16}{12} = \boxed{-1,3}$ (B)

9 $m_1 = 0,5\,kg$ $d = 25\,m$ $m_2 = 0,25\,kg$ $v_i = 15\,m/s$ $t = 2\,s$

$y_{1f} = 25 + (0 * t) - \frac{gt^2}{2} = 25 - \frac{9,8 * 2^2}{2} = 5,4\,m$

$y_{2f} = v_{2i} t - \frac{gt^2}{2} = 15 \times 2 - \frac{9,8 \times 2^2}{2} = 10,4\,m$

$y_{com} = \frac{m_1 y_1 + m_2 y_2}{m_1 + m_2} = \frac{0,5(5,4) + 0,25(10,4)}{0,5 + 0,25} = \boxed{7,1\,m}$



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(10) $m = 50\,kg$ $d = 25m$ $m_2 = 25$ $v = 15 m/s$ $t = 2s$

$V_{com} = ??$

$1,7 = 2v_0 - \frac{9,8(4)}{2} = 13,35 \approx 15$

(11) $a = ??$ $v = v_0 + at$

$15 = 15 * a(2) \Rightarrow (9)$

(13) $m_1 = 4kg$ $m_2 = 4kg$ $\theta = 45$ $v_c = 35$ $t = 2s$

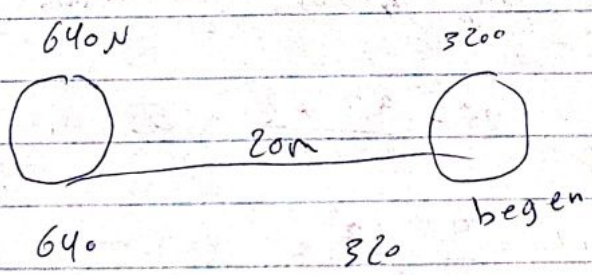
$v = gt \Rightarrow t = \frac{v}{g} = \frac{35 \sin 45}{9,8} = 2,53\,s$

$y_h = v_{oy} t_h - \frac{gt^2}{2} = 35 \sin 45 \cdot 2,53 - \frac{9,8(2,53)^2}{2} = 31,25\,m$

$y = v_0 t - \frac{g t^2}{2} = 35 \sin 45 \cdot 4,53 - \frac{9,8(4,53)^2}{2} = 11,56\,m$

$Dy = y_h - y = 19,69 \approx 20\,cm$

(17)



$= 640$ 320

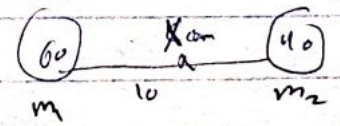
$X_{com} = \frac{320 \times 0 + 64(20)}{64 + 320} = \frac{1280}{384} = 3,3\,m$

(18)

$m_1 x_1 + m_2 x_2 = X_{com}(m_1 + m_2)$

$60(0) + 40(10) = X_{cm}(60 + 40)$

$X_{cm} = \frac{400}{100} = 4m$



(20) $V_x = 6\ m/s$ $V_y = 3\ m/s$ $m = 10$ $m = 5$

$V_{com} = 0$ in Horizontal dir.

$0 = 6(5) + V(10) \Rightarrow V = \frac{-30}{10} =$ **3 Right**

(22) $m = 2kg$ $K = 100\ N/m$ $m_2 = 4kg$

$v = ,36\ m/s$

$KE = KE_0 - KE_f$

$= ,5 - \left[,5(2)(,36^2) + \frac{1}{2}(4)(,18^2)\right] = \frac{1}{2}(100)(,1)^2$

$= ,55$

$= \boxed{0,35}$

$P = P$

$mv_i = mv$

$\frac{2(,36)}{4} = \frac{2}{4}v$

$v = ,18\ m/s$

(28) $m = 1kg$ $v_i = 2$ $v_f = 1,5$

$\Delta P = P_f - P_i = P_f - (-P_i) = P_f + P_i = mv_f + mv_i$

$= 1(1,5) + 1(2) = 1,5 + 2 =$ **3,5**

(31) $m = 2,5kg$ $v_i = 0$ $t = 4s$ $v_f = ?$

$P = mv$

$2,5(39,2)$

$= 98\ kg.m/s$

$v_f = v_i + at$

$v_f = 0 + 9,8(4)$

$= 39,2$

(32) $m_{ball} = 64kg$ $m_{rifle} = ,1$ $v = ,0017\ m/s$

$P_i = P_f$

$0 = mv_{ball} + mv_{rifle} = 64(,0017) + ,1(v)$

$-,1088 = ,1v \Rightarrow v = -1,1$ left

(33) $P_i = P_f$

$0 = m_{man}v_f + m_{bot}v_f$

$= 73,46v_f + 0,408(15)$

$-6,12 = 73,46v_f$

$v_f = 8,3 \times 10^{-2}\ m/s$

(34) $m_A = 120kg$ $m_B = 40$ $V_{Bf} = .5$ $V_{Af} = ??$

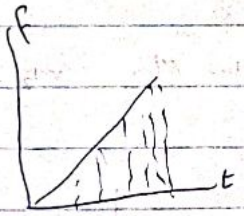
$P_i = P_f$

$0 = mV_A + mV_B$

$= 120(V) + 40(.5) \Rightarrow .38$

(38) $m = 5kg$

$\uparrow$ = DP



$\int$ = area under the curve

$\frac{1}{2}(2)(4) = mv$

$\frac{4}{5} = \frac{5}{5}v \Rightarrow v = .8\ m/s$

(40) $m_A = .2kg$ $m_B = .4$ $V_A = 2$

$P = P$

$mv + mv = (m+m)v'$

$\frac{.2(3) - .4(2)}{.2+.4} = v' \Rightarrow v = .33$

(41) $m = 500kg$ $m_2 = 2000$ $v = 3\ m/s$

$m_1v_1 + m_2v_2 = (m_1+m_2)v'$

(rest)

$2000(3) = (500+2000)v' \Rightarrow v' = \frac{6000}{2500} = 2.4\ m/s$

(44) $V_i = 2500$ rate = $100\ kg/s$ $V_f = 1500$

thrust (F) = mass flow rate (m) fuel exhausted velocity (V_j)

$F = 100 \times 1500 = 1.5 \times 10^5\ N$

(45) $V = 1500$ $v = .8$ $= .8 \times 1500 = 1200 \times 2 = 2400$

(46) mass of probe = 1000 kg $V_{i(Probe)} = 0$ $V_{gass} = 5000$

$V_{Probe} = 20$

$1000(20) = m(5000)$

$m = \frac{20000}{5000} = 4$

(51) $m = 0.2\,kg$ $v_i = -30$ (نازل) $v_f = 30$

$\Delta P = m[v_f - v_i] = 0.2[30 - (-30)] = 10\ kg\,m/s$

(52) $m = 10\,kg$ $v_i = 0$ $f = 1\ N$ $t = 10\,s$

$f = ma$

$1 = 10a \Rightarrow a = 0.1\ m/s^2$

$v_f = v_0 + at = 0 + 0.1(10) = 1\ m/s$

$J = m[v_f - v_i] = 10[1 - 0] = 10\ kg\,m/s$

(62) $w = 4N$ $v = 3\,m/s$ $w_2 = 8N$

$mv + 0 = (m+m)v' \Rightarrow v' = \frac{mv}{m+m} = \frac{4 \times 3}{8+4} = \frac{12}{12} = 1$

(63) $m_{bullet} = 3g = 3 \times 10^{-3}\,kg$ $v = 400$ $m_{block} = 3\,kg$

$mv_{bullet} + mv_{block} = (m+m)v'$ (block $v = 0$)

$v' = \frac{mv}{m+m} = \frac{3 \times 10^{-3}(400)}{3 \times 10^{-3} + 3} = 0.4$

(64) $m_1 = 2\,kg$ $v = 3\,m/s$

$m_2 = 4\,kg$ $v = ?$

$P_i = P_f : mv + 0 = (m+m)v'$

$v' = \frac{mv}{m+m} = \frac{2(3)}{6} = \frac{6}{6} = 1$

$J = \Delta P = m[v_f - v_i] = 2[3 - (-1)] = 8\ kg\,m/s$

(65) $m_{bullet} = 3 \times 10^{-3}\,kg$ $m = 10\,kg$ $h = 3 \times 10^{-2}$

$v' = \sqrt{2(9.8)(3 \times 10^{-2})} = 0.24$

$mv_i = (m+m)v'$

$v_i = \frac{(m+m)v'}{m} = \frac{(3 \times 10^{-3} + 10)(0.24)}{3 \times 10^{-3}} = \frac{2.40072}{3 \times 10^{-3}} = 8 \times 10^2$

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(66) $m_1 = 3kg \quad m_2 = 2kg \quad KE = 40J$

$(m+m)V_{com} = (m+m)V'$

$\frac{5}{5}V_{com} = \frac{5}{5}(4)$

$V_{com} = 4 m/s$

$KE = \frac{1}{2}(m+m)v'^2$

$40 = \frac{1}{2}(3+2)v'^2$

$40 = 2.5v^2$

$v^2 = \frac{40}{2.5} \Rightarrow v = 4$

(67) $m_A = 2 \quad v = 50$

$m_B = 4 \quad v = -25$

$KE = \frac{1}{2}mv_i^2 + \frac{1}{2}mv_f^2$

$\frac{1}{2}(2)(50)^2 + \frac{1}{2}(4)(-25)^2 =$

$2500 + 1200 = 3750 J$

(69) $mv = mv \rightarrow v = 5$

(75) $mv + mv = P_0$

$2(50) + 4(-25) = 0$

(77)

(80)

Chapter 10

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(5) $w = 3\ rad/sec$ 1 rev

$t = \frac{2\pi}{3} = 2,1$

(6) 100 rev $t = 10\ sec$ $w = ??$

$t = \frac{2\pi}{w}$

$\frac{10}{1}w = \frac{2\pi(100)}{10} \Rightarrow w = 63\ rad/sec$

(9) $w_0 = 20\ rad/sec$ $t = 9s$ $\theta = 450$

$\theta = w_0 t + \frac{1}{2}\alpha t^2$

$450 = 20(9) + \frac{1}{2}\alpha(9)^2 \Rightarrow 450 = 180 + 40,5\alpha$

$\Rightarrow 270 = 40,5\alpha$

$\alpha = \frac{270}{40,5} = 6,7$

(10) $t = 10s$ $w = 300\ \frac{rev}{min} = 31,4$

$\alpha = \frac{w}{t} = \frac{31,4}{10} = 3,14\ rad/sec^2$

(11) $\alpha = \pi$ $\theta = \pi$ $w = 2\pi$ $w_f = ??$

$w_f^2 = w_0^2 - 2\alpha\theta$

$w_f^2 = (2\pi)^2 - 2(\pi)(\pi) \Rightarrow w^2 = 4\pi^2 - 19,7192$

$w^2 = 39,4384 - 19,7192 = 4,4$

$= \pi\sqrt{2}$

(12) $w = 12\ rev/sec = 75,36\ rad/sec$ $t = 6s$

$\alpha = \frac{w}{t} = \frac{75,36}{6} = 12,56 = 4\pi$

(13) $w_0 = ,75\ rev/sec = 4,71\ rad/sec$ $w_f = 0$ $t = 30sec$

$\alpha = \frac{w_f - w_i}{t} = \frac{0 - 4,71}{30} = ,157 = \pi/20$

(14) $\omega = 2 \text{ rev/sec} = 12,56 \text{ rad/sec}$ $t = 1 \text{ min} = 60 \text{ sec}$

$\alpha = \frac{\omega}{t} = \frac{12,56}{60} = ,2 = \frac{\pi}{15}$

(15) $\omega_0 = 18$ $\alpha = 2$ $\omega_f = -18$

$\omega_f = \omega_0 + \alpha t$

$-18 = 18 + 2t$

$-36 = 2t \Rightarrow t = 18 \text{ sec}$

(16) $\omega_0 = 36$ $t = 8s$ $\omega_f = 24$

$\omega_f = \omega_0 + \alpha t$

$24 = 36 + \alpha(6)$

$-12 = 6\alpha \Rightarrow \alpha = -2 \text{ rad/sec}^2$

(18) $\omega_0 = 18 \text{ rad/sec}$ $\omega_f = 0$ $\alpha = 2$

$\omega_f = \omega_0 + \alpha t$

$0 = 18 + 2t$

$-18 = 2t \Rightarrow t = 9 \text{ sec}$

$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$

$\theta = 0 + \frac{1}{2}(2)(9)^2 = 81$

(19) $\omega_0 = 0$ $\alpha = 4$ $\theta = 10 \text{ rev} = 62,8 \text{ rad}$

$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$

$62,8 = 0 + \frac{1}{2}(2)t^2$

$62,8 = 4t^2$

$t = 5,60 \text{ sec}$

$\omega_f = \omega_0 + \alpha t$

$\omega_f = 0 + 2(5,60) = 22,4$

(20) $\omega_0 = 0$ $\alpha = 4$ $t = ??$ $\theta = 62,8$

$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$

$62,8 = 0 + \frac{1}{2}(4)t^2 \Rightarrow t = 5,6$

(22) $\alpha(t) = 6t^2$ $\theta = 62,8 \text{ rad/sec}$

$\omega = 2t^3$

$\theta = \frac{1}{2}t^4$

$62,8 = \frac{1}{2}t^4$

$t = 3,3$

(23)

(24)

(27) $r = 20\ m \quad s = 3000\ m$

$\theta = \frac{s}{r} = \frac{3000}{20} = 150$

(28) $r = .7 \quad w = 10$

$v = rw = .7(10) = 7$

(30) $r = 1.5\ cm = .015\ m \quad s = 4\ m \quad w_0 = 0 \quad \alpha = 2$

$\theta = \frac{s}{r} = \frac{4}{.015} \approx 267$

$\theta = w_0 t + \frac{1}{2}\alpha t^2$

$267 = 0 + \frac{1}{2}(2)t^2$

$267 = t^2$

$t = 16.3\ sec$

(31) $r = .1\ m \quad w = 10\pi = 31.4\ rad/sec \quad \alpha = 21$

$v = rw = .1(31.4) = 3.14$

$\alpha = \frac{v^2}{r} = \frac{(3.14)^2}{.1} = 98.596 = 10\pi^2$

(33) $r = .05\ m \quad v = .1\ m/sec$

$v = rw$

$w = \frac{v}{r} = \frac{.1}{.05} = 2\ rad/sec$

(34) $r = .05\ m$ $v = 1$ $a = ??$

$a = \frac{v^2}{r} = \frac{(1)^2}{.05} = 2$

(35) $r = 0.6\ m$ $\alpha = 5$ $a = ??$

$a = r\alpha = 5(.6) = 3$

(43) $m = 2$ $a = 1\ m$

$I = mr^2 = 2(0) + 2(1)^2 + 2(2)^2 + 2(1)^2 = 12$

(52) $I = .7$ $m = 2$ $r = .4$

$I = I + I = .7 + 2(.4)^2 = .7 + .32 = 1.0$

(58) $\tau = fr\sin\theta + fr\sin\theta$

$5(4)\sin 30 + 5(2)\sin 30 = 10 + 5 = 15$

(63) $r = .1$ $l = .2$ $I = .02$ $f = 1\ N$

$\tau = I\alpha \Rightarrow \alpha = \frac{\tau}{I} = \frac{fr}{I} = \frac{1(0.1)}{.02} = 5$

(64) $I = 2\ kg.m^2$ $r = .4$ $f = 1\ N$

$\alpha = \frac{\tau}{I} = \frac{fr}{I} = \frac{1(.4)}{2} = 1$

(66) $I = 5$ $r = .25$ $f = 8$ $w_0 = 0$ $w_f = ??$

$\tau = I\alpha$

$fr = I\alpha$

$\alpha = \frac{fr}{I} = \frac{8(.25)}{5} = \frac{2}{5}$ (.4)

$w^2 = w_0^2 + 2\alpha D\theta$

$w_f^2 = 0 + 2(.4)(\pi)$

$w_f^2 = 3.512$

$w = 1.6$

(67) $m = 1kg \quad r = 2 \quad \alpha = 7 \quad \tau = ?$

$\tau = I\alpha \Rightarrow mr^2\alpha$

$1(2)^2(7) \Rightarrow 4(7) = 28$

(68) $I = 12 \quad \theta = 31,4 \quad w_i = 5 \quad w_f = 6$

$w_f^2 - w_i^2 = 2\alpha\theta$

$\alpha = \frac{w_f^2 - w_i^2}{2\theta} = \frac{6^2 - 5^2}{2(31,4)} = 0,175$

$\tau = I\alpha = 12(,175) = 1,2$

(69)

(70) $r = ,08 \quad I = ,12 \quad m = 10kg \quad \tau = 9$

$\tau = I\alpha$

$fr = I\alpha$

$mgr = I\alpha$

$\alpha = \frac{mgr}{I} = \frac{10(9,8)(,08)}{,12} = 65,33$

$a = r\alpha$

$,08(65,33)$

$= 0,5$

(71) $m = ,7 \quad I = mR^2/2 \quad m = 2kg$

$ma = mg - f$

$f = \frac{I\alpha}{r}$

$mg - ma = \frac{I\alpha}{r^2}$

$mg - ma = \frac{ma}{2}$

$a = \frac{mg}{m + ,5M}$

$\Sigma F_y = F_N - Mg - Ma$

$M[g + a] = 9,77$

79) $I = 6 \quad \alpha = 2 \quad t = 5$

$K_f = \frac{1}{2} I \omega^2$

$\frac{1}{2}(6)(10)^2$

$300\,J$

$\omega_f = \omega_0 + \alpha t$

$\omega_f = 0 + 2(5)$

$= 10$

$\omega = v/r \quad \alpha = v^2/r$

78) $, 8(20)(60)$

$= 960$

77) $I = 5 \quad r = ,25 \quad f = 8 \quad \theta = \frac{1}{2}\,rev. = 1\pi = \pi$

$\tau = I\alpha$

$fr = I\alpha$

$8(,25) = 5\alpha$

$\alpha = ,4$

$\omega^2 = \omega_0^2 + 2\alpha\theta$

$= 0 + 2(,4)(\pi)$

$\omega = 1,6$