Chapter 10 - 6, 8, 13, 16, 27,
30, 38, 54, 62, 71

6) $\overset{0}{\cancel{\omega}}{}^2 = \omega_0^2 + 2\alpha\theta$

$\alpha = \frac{\omega_0^2}{2\theta}$ $\quad \omega_0 = \frac{3600\ 2\pi}{60}$ $\quad \Rightarrow \alpha = -\frac{(60\ 2\pi)^2}{2\ 50\ 2\pi}$ $\quad -\frac{60\ 60\ 2\pi\ \cancel{2\pi}}{2\ 50\ \cancel{2\pi}}$

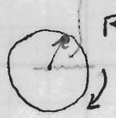
$\theta = 50 \times 2\pi$

$\frac{3600\ 2\pi}{180} = \boxed{-36\ 2\pi\ s^{-2}}$

8) $\theta = \theta_0 + \omega t - \frac{1}{2}\alpha t^2$

$-\frac{((\theta - \theta_0) - \omega t)2}{t^2} = -\frac{[(37\ 2\pi) - (98)3]2}{9} = \boxed{13.7\ s^{-2}}$

13)



$\theta_0 = 57.3°$

$R = 1.00$

$\alpha = 4 s^{-2}$

$\omega = \overset{0}{\cancel{\omega_0}} + \alpha t = 4 \cdot 2 = \boxed{8\ s^{-1}}$

$v = R\omega = \boxed{8\ m/s}$

$\left[\left(\frac{v^2}{R}\right)^2 + (R\alpha)^2\right]^{1/2} = (64^2 + 4^2)^{1/2} = \boxed{64.1\ m/s^2}$

$\theta = \theta_0 + \underset{0}{\cancel{\omega t}} + \frac{1}{2}\alpha t^2 = 57.3\ \frac{2\pi}{360} + \frac{1}{2}(4)2^2 = \boxed{9.0\ rad}$

16)

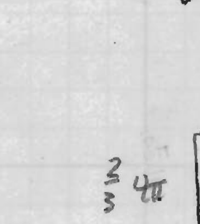
$R = .29\ m$

$x = \bar{v}t = 11\ m/s \times 9 = 99\ m$

$\frac{99}{2\pi R} = \boxed{54.3\ \text{revolutions}}$

$\omega = v/R = \frac{22}{.29} = \boxed{75.9\ sec^{-1} = 12.1\ rev/s}$

27) $\rho = 14.2 - 11.6\left(r/R\right) \times 10^3$ $\qquad I_{shell} = \frac{2}{3}MR^2$



$\int_0^R \frac{2}{3}\underset{dM}{(\rho 4\pi r^2 dr)}\, r^2 = I$

$\int_0^R \underbrace{\rho 4\pi r^2 dr}_{dM} = M \rightsquigarrow 4\pi\int_0^R r^2(14.2 - 11.6\ r/R)dr$

$\frac{2}{3}4\pi\int_0^R r^4(14.2 - 11.6\ r/R)dr$

$= 4\pi(14.2)\frac{R^3}{3} - 4\pi(11.6)\frac{R^3}{4}$

$\frac{2}{3}4\pi\left[14.2\frac{R^5}{5} - 11.6\frac{R^5}{6}\right]$

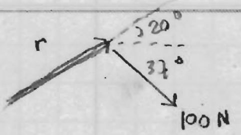
$M = 4\pi R^3\left[\frac{14.2}{3} - \frac{11.6}{4}\right]$

$\frac{2}{3}4\pi R^5\left(\frac{14.2}{5} - \frac{11.6}{6}\right)$

$R^3 = \frac{M}{4\pi\left(\frac{14.2}{3} - \frac{11.6}{4}\right)}$

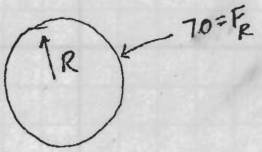
So $I = \frac{\frac{2}{3}\cancel{4}\pi R^2(M)\ \frac{14.2}{5} - \frac{11.6}{6})}{\cancel{4}\pi\left(\frac{14.2}{3} - \frac{11.6}{4}\right)} = \boxed{.330\ MR^2}$

30)



$r \times F = rF\sin 57 = 2(100).839 = \boxed{167\text{ N-m}}$

38)



$R = .5$

$M = 100$

$I_{cm} = \frac{1}{2}MR^2$

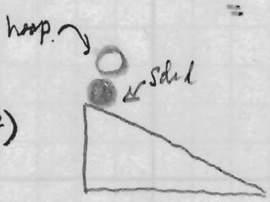
$\frac{\Delta\omega}{\Delta t} = \alpha$ and $\tau = I\alpha$

$\tau = R\mu F_R$

So $R\mu F_R = I\alpha \Rightarrow \mu = \frac{I\alpha}{RF_R} = \frac{MR^2}{2}\frac{\Delta\omega}{\Delta t\, RF_R}$

$= \frac{MR\Delta\omega}{2\Delta t F_R} = (100)(\frac{1}{2})\frac{50\ 2\pi}{60\ 2\ 6\ 70} = \boxed{.312}$

54)



$I_H = MR^2$

$I_S = \frac{1}{2}MR^2$

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

$$= \frac{1}{2}Mv^2 + \frac{1}{2}I\left(\frac{v}{R}\right)^2$$

$$= \frac{1}{2}v^2\left[M + I/R^2\right]$$

$$\Rightarrow v = \left(\frac{2Mgh}{M + I/R^2}\right)^{1/2}$$

for hoop, we have $v_H = \left(\frac{2Mgh}{M + MR^2/R^2}\right)^{1/2} = \boxed{\sqrt{gh}}$

for solid $v_S = \left(\frac{2Mgh}{M + \frac{1}{2}MR^2/R^2}\right)^{1/2} \cdot \frac{2Mgh}{3/2 M} = \boxed{(\tfrac{4}{3}gh)^{1/2} \text{ which is faster, so solid wins}}$

62) $\omega = \omega_0 + \alpha t$

$$\omega = \omega_0 + \int_{t=0}^{3}\alpha\, dt = 65 - \int 10\, dt - \int 5t\, dt$$

$$= 65 - 10t\Big|_0^3 - \frac{5t^2}{2}\Big|_0^3$$

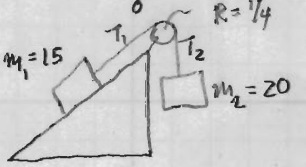
$$= 65 - 30 - 22.5 = \boxed{12.5\text{ s}^{-1}}$$

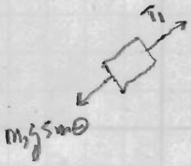
$$\theta = \theta_0 + \int_0^3 \omega(t)\,dt = 0 + \int_0^3\left[\omega_0 + \int^{t'}\alpha\, dt\right]dt' = \int 65\, dt - \int 10t\, dt - \int 5/2\, t^2\, dt$$

$$= 195 - 5t^2\Big|^3 - \frac{5}{6}t^3\Big|^3$$

$$= 195 - 45 - \frac{5\cdot 27}{6} = \boxed{127.5}$$

(71)





$$\left.\begin{aligned} T_1 - m_1 g\sin\theta &= m_1 a \\ m_2 g - T_2 &= m_2 a \\ (T_2 - T_1)R &= I\frac{a}{R} \end{aligned}\right\}$$ 3 equations in 3 unknowns $(T_1, T_2, I$