12
Rolling

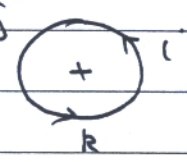
Q.1 $\vec{\tau} = \vec{r} \times \vec{F} = 3\hat{i} \times 8\hat{i}$

$\vec{\tau} = 0$

Q.2 $\vec{\tau} = \vec{r} \times \vec{F} = (0.5\hat{i} + 2\hat{j}) \times (2\hat{i} - 3\hat{j})$

$= -1.5\hat{k} - 4\hat{k}$

$\vec{\tau}_{net} = -5.5\hat{k}$ (N.m)



Q.3 $\vec{l}_1 = m_1(\vec{r}_1 \times \vec{v}_1) = 3(2\hat{i} \times 3\hat{j}) = 18\hat{k}$ kg.m²/s

$\vec{l}_2 = m_2(\vec{r}_2 \times \vec{v}_2) = 6(1\hat{j} \times 2\hat{i}) = -12\hat{k}$ "

$\Rightarrow \vec{L} = \Sigma \vec{l} = 18\hat{k} - 12\hat{k} = 6\hat{k}$ kg.m²/s

Q.4 $L_i = L_f \Rightarrow I_1\omega_1(i) + I_2\omega_2(i) = (I_1 + I_2)\omega_f$

$I\omega + 2I(2\omega) = (I + 2I)\omega_f$

$\Rightarrow \omega_f = \frac{5}{3}\omega$

Q.5 $L_i = L_f \Rightarrow I_1\omega_1(i) + 0 = (I_1 + I_2)\omega_f$

$I(500) = (I + I)\omega_f$, same (I) same Disk

$\omega_f = 250$ rpm

$l_i = l_f$ $(\theta = 90)$

Q.6 $L_i = L_f \Rightarrow m r_i v_i = m r_f v_f$

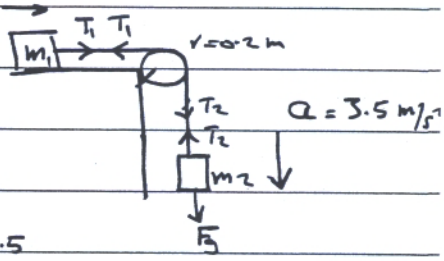
$0.75 \times 5 = 0.25 \times V_f$

$V_f = 15$ m/s

Cont. Ch #12 →

Cont CH 12

Q.7



for m_1:

$$T_1 = m_1 a \Rightarrow T_1 = 5 \times 3.5$$

$$T_1 = 17.5 \text{ N}$$

for m_2: $m_2 g - T_2 = m_2 a \Rightarrow 4 \times 9.8 - T_2 = 4 \times 3.5$

$$\Rightarrow T_2 = 25.2 \text{ N}$$

for The Pully: $\tau_{net} = I\alpha$

$$\tau_2 - \tau_1 = I\alpha \quad , \text{where} \quad \alpha = \frac{a}{r} = \frac{3.5}{0.2} = 17.5 \text{ rad/s}^2$$

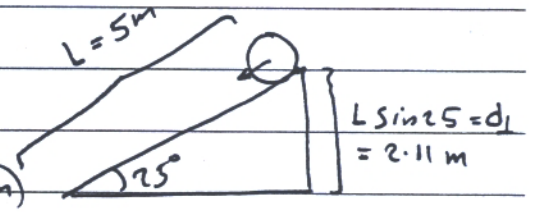
$$\Rightarrow$$

$$r T_2 - r T_1 = I(17.5) \Rightarrow I = \frac{0.2(25.2 - 17.5)}{17.5}$$

$$I = 0.088 \text{ kg.m}^2$$

Q.8 $I_{\text{solid sphere}} = \frac{2}{5} MR^2 = \frac{2}{5}(8.5)(0.1)^2 = 0.034 \text{ kg.m}^2$

$$\Delta U + \Delta K = 0$$



$$mg(\Delta y) + K_f - \overset{\text{zero}}{(K_i)} = 0 \quad , (\Delta y = -2.11 \text{ m})$$

$$\Rightarrow K_f = -mg\Delta y = -8.5(9.8)(-2.11)$$

$$\frac{1}{2} I \omega_f^2 + \frac{1}{2} M V^2 = 175.8 \quad , \quad \omega = \frac{V}{r}$$

$$\frac{1}{2}(0.034)\frac{V^2}{(0.1)^2} + \frac{1}{2}\overset{(8.5)}{(\quad)} V^2 = 175.8$$

$$1.7 V^2 + \overset{4.25}{\quad} V^2 = 175.8$$

$$6V^2 = 175.8$$

$$V = 5.4 \text{ m/s}$$

Ch.12 →

Cont Ch 12

Q.9 $\ell = m r v = 2.5 \times 0.5 \times (0.5 \times 12)$ (rw)

$\ell = 7.5 \text{ kg} \cdot m^2/s$

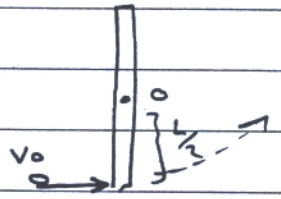
or $L = Iw = (mr^2)(w) = 2.5(0.5)^2(12)$

$= 7.5 \text{ kg} \cdot m^2/s$

Q.10

$L_i = L_f$

$w_0 = \frac{V_0}{(L/2)}$



$I_{w_{(i)}}$ (obj) + $I_{w_{(i)}}$ (rot) = $(I_0 + I_r) w_f$

$(mr^2)\left(\frac{V_0}{L/2}\right) + 0 = \left(mr^2 + \frac{1}{12} ML^2\right) w_f$

$r = \frac{L}{2}$

$0.1\left(\frac{0.4}{2}\right)^2 \left(\frac{V_0}{0.4/2}\right) = \left(0.1\left(\frac{0.4}{2}\right)^2 + \frac{1}{12}(1)(0.4)^2\right) \times 10$

$0.02 V_0 = 0.17$

$V_0 = 8.5 \text{ m/s}$