

Recitation Week 11

Ch. 10 #3

$$F_1 = 18 \text{ N} \\ = (0\hat{x} - 18\hat{y}) \text{ N}$$

$$F_2 = 26 \text{ N} \\ = (0\hat{x} - 26\hat{y}) \text{ N}$$

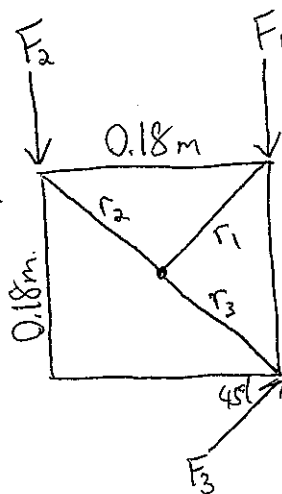
$$F_3 = 14 \text{ N} \\ = 14\left(\frac{\sqrt{2}}{2}\hat{x} + \frac{\sqrt{2}}{2}\hat{y}\right) \text{ N} \\ = (7\sqrt{2}\hat{x} + 7\sqrt{2}\hat{y}) \text{ N}$$

$$\tau_1 = \vec{r}_1 \times \vec{F}_1 = \begin{vmatrix} \hat{x} & \hat{y} & \hat{k} \\ 0.09 & 0.09 & 0 \\ 0 & -18 & 0 \end{vmatrix} = -1.62 \hat{k}$$

$$\tau_2 = \vec{r}_2 \times \vec{F}_2 = \begin{vmatrix} \hat{x} & \hat{y} & \hat{k} \\ -0.09 & 0.09 & 0 \\ 0 & -26 & 0 \end{vmatrix} = 2.34 \hat{k}$$

$$\tau_3 = \vec{r}_3 \times \vec{F}_3 = \begin{vmatrix} \hat{x} & \hat{y} & \hat{k} \\ 0.09 & -0.09 & 0 \\ 7\sqrt{2} & 7\sqrt{2} & 0 \end{vmatrix} = (0.89 + 0.89)\hat{k} = 1.78 \hat{k}$$

$$\tau = \tau_1 + \tau_2 + \tau_3 = -1.62 + 2.34 + 1.78 = \boxed{2.5 \hat{k} \text{ N}\cdot\text{m}}$$



~~Ch. 10 #27~~

Ch. 10 #27

$$r = 2.4 \text{ m}$$

$$I = 2100 \text{ kg}\cdot\text{m}^2$$

$$a) F = 18 \text{ N} \quad t = 15 \text{ s.}$$

$$\tau = \vec{r} \times \vec{F} = I\alpha$$

$$~~2.4(18)~~ \quad 2.4(18) = 2100(\alpha)$$

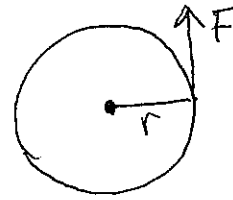
$$\alpha = 0.02 \text{ rad/s}^2$$

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

$$\omega = (0.02)(15) = \boxed{0.3 \text{ rad/s}}$$

$$b) W = \Delta E = \frac{1}{2} I \omega^2 = \frac{1}{2} (2100) (0.3)^2 = \boxed{94.5 \text{ J}}$$

$$c) P = \frac{W}{t} = \frac{94.5}{15} = \boxed{6.3 \text{ J/s}}$$



Ch. 10 #35

$$a) \vec{r} = (-8 \cos \theta \hat{i} + 8 \sin \theta \hat{j}) \text{ m}$$

$$= (-6.4 \hat{i} + 4.8 \hat{j}) \text{ m}$$

$$\vec{L} = \vec{r} \times m\vec{v}$$

$$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -6.4 & 4.8 & 0 \\ 24 & 0 & 0 \end{vmatrix} = \boxed{-115.2 \hat{k} \frac{\text{kg}\cdot\text{m}^2}{\text{s}}}$$

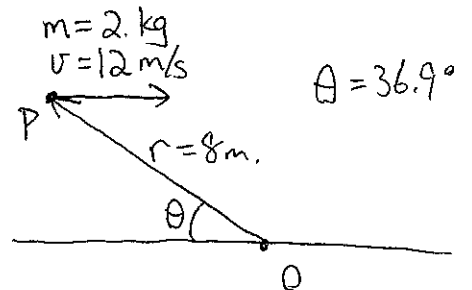
$$b) \Sigma \tau = \frac{d\vec{L}}{dt}$$

$$\tau = \vec{r} \times \vec{F}$$

$$\vec{F} = m\vec{a} = 0\hat{i} - 2(9.8)\hat{j} \frac{\text{kg}\cdot\text{m}}{\text{s}^2}$$

$$= -19.6 \hat{j} \text{ N}$$

$$\tau = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -6.4 & 4.8 & 0 \\ 0 & -19.6 & 0 \end{vmatrix} = \boxed{125.44 \hat{k} \text{ N}\cdot\text{m}}$$



Ch.10 #56

$$r_1 = 30 \text{ cm} = 0.3 \text{ m}$$

$$r_2 = 50 \text{ cm} = 0.5 \text{ m}$$

$$I = \frac{1}{2} M (r_1^2 + r_2^2)$$

$$= \frac{1}{2} M (0.3^2 + 0.5^2) = 0.17 M$$

$$\Delta PE = Mgh = M(9.8)(1.2)$$

$$= 11.76 M$$

$$\Delta PE = \Delta KE = \frac{1}{2} I \omega^2 + \frac{1}{2} M v^2$$

$$11.76 M = \frac{1}{2} (0.17 M) \omega^2 + \frac{1}{2} M v^2$$



Ch.10 #64

$$F_{\text{tot}} = F_g + F_f + T$$

$$ma = mg \cos \theta - \mu_k mg \sin \theta + T$$

$$\tau = r \times F = I \alpha$$

$$r \cdot T = I \frac{a}{r}$$

$$T = I \frac{a}{r^2} = 0.5 \left(\frac{1}{0.2^2} \right) a$$

$$= 12.5 a$$

$$ma = mg \cos \theta - \mu_k mg \sin \theta - 12.5 a$$

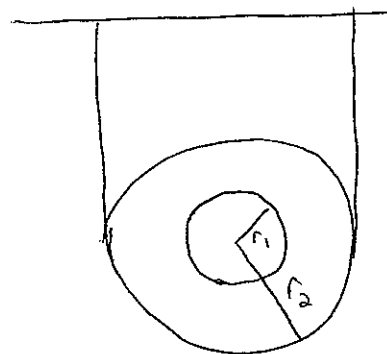
$$(m + 12.5) a = mg \cos \theta - \mu_k mg \sin \theta$$

$$17.5 a = 5(9.8) \cos(36.9) - 0.25(5)(9.8) \sin(36.9)$$

$$17.5 a = 39.2 - 7.4$$

$$17.5 a = 31.8$$

$$a = \boxed{1.82 \text{ m/s}^2}$$



$$v = \omega r_2$$

$$\omega = \frac{v}{r_2}$$

$$11.76 M = \frac{1}{2} (0.17 M) \left(\frac{v}{r_2} \right)^2 + \frac{1}{2} M v^2$$

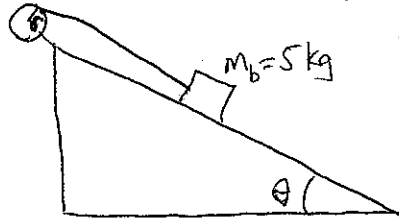
$$11.76 = 0.34 v^2 + \frac{1}{2} v^2$$

$$11.76 = 0.84 v^2$$

$$v^2 = 14$$

$$v = \boxed{3.74 \text{ m/s}}$$

$$m_w = 25 \text{ kg} \quad I_w = 0.5 \text{ kg} \cdot \text{m}^2 \quad \mu_k = 0.25$$



$$\theta = 36.9^\circ$$

$$b) T = 12.5 a$$

$$= 12.5 (1.82)$$

$$= \boxed{22.75 \text{ N}}$$

Ch. 10 #67

$$\begin{aligned}\Sigma \tau &= -rT_1 + rT_2 = I\alpha \\ r(-T_1 + T_2) &= \frac{1}{2}m_3r^2 \frac{a}{r} \\ -T_1 + T_2 &= \frac{1}{2}m_3a\end{aligned}$$

$$\Sigma F_1 = T_1 - m_1g = m_1a$$

$$\Sigma F_2 = -T_2 + m_2g = m_2a$$

$$T_1 - T_2 - m_1g + m_2g = m_1a + m_2a$$

$$-\frac{1}{2}m_3a - m_1g + m_2g = (m_1 + m_2)a$$

$$(m_2g - m_1g) = (m_1 + m_2 + \frac{1}{2}m_3)a$$

$$125 - 75 = (7.65 + 12.76 + \frac{1}{2}(5.1))a$$

$$50 = 22.96a$$

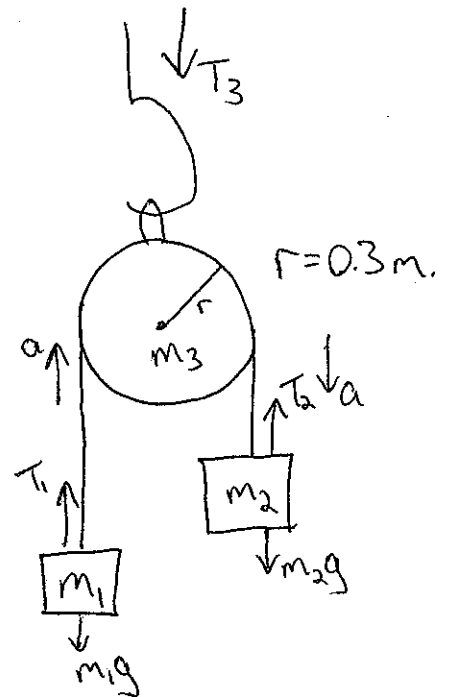
$$a = 2.18 \text{ m/s}^2$$

$$T_3 = m_3g + T_1 + T_2$$

$$= m_3g + (m_1a + m_1g) + (m_2g - m_2a)$$

$$= 50 + 75 + 125 + 7.65(2.18) - 12.76(2.18)$$

$$= \boxed{239 \text{ N}}$$



$$\begin{aligned}m_1g &= 75 & m_2g &= 125 \\ m_1 &= 7.65 & m_2 &= 12.76\end{aligned}$$

$$\begin{aligned}m_3g &= 50 \\ m_3 &= 5.1\end{aligned}$$