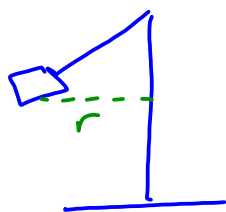


CIRCULAR MOTION PROBLEM SET

1)



$$T = 5.8 \text{ s}$$

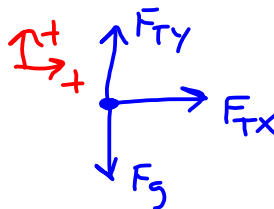
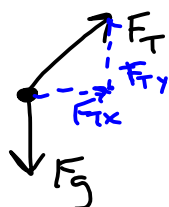
Top View



$$\begin{aligned} \text{a) } v &= \frac{2\pi r}{T} \\ &= \frac{2\pi(6.5 \text{ m})}{5.8 \text{ s}} \\ &= 7.04 \text{ m/s} \end{aligned}$$

$$\begin{aligned} \text{b) } a_c &= \frac{v^2}{r} && \text{centripetal acceleration} \\ &= \frac{(7.04 \text{ m/s})^2}{6.5 \text{ m}} \\ &= 7.62 \text{ m/s}^2 \end{aligned}$$

c)



$$\sum \vec{F}_y = \emptyset$$

$$\sum \vec{F}_x = ma_c$$

$$F_{Ty} - F_g = \emptyset$$

$$F_{Tx} = ma_c$$

$$F_{Ty} = F_g = ma_g$$

$$= (80 \text{ kg})(7.62 \text{ m/s}^2)$$

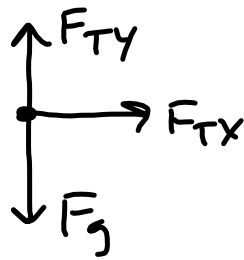
$$= (80 \text{ kg})(9.8 \text{ m/s}^2)$$

$$= 609.6 \text{ N}$$

$$= 784 \text{ N}$$



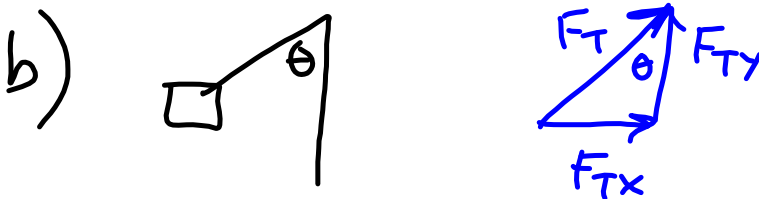
$$F_T = \sqrt{F_{Tx}^2 + F_{Ty}^2} = 993 \text{ N}$$

2) FBDfrequency (f) is cycles/second

$$3 \frac{\text{rev}}{\text{s}} \Rightarrow T = 0.33 \text{ s}$$

$$f = \frac{1}{T}$$

$$\begin{aligned} \text{a) } F_c &= \frac{mv^2}{r} & v &= \frac{2\pi r}{T} \\ &= \frac{(0.63 \text{ kg})(6.66 \text{ m/s})^2}{0.35 \text{ m}} & &= 6.66 \text{ m/s} \\ &= 80.8 \text{ N} \end{aligned}$$

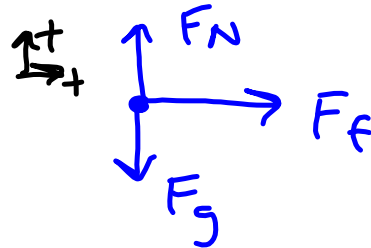
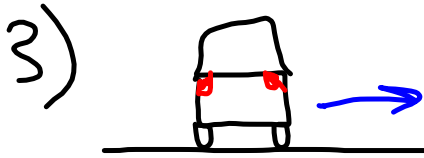


$$\tan \theta = \frac{F_{TX}}{F_{TY}}$$

$$\theta = \tan^{-1} \left(\frac{F_{TX}}{F_{TY}} \right)$$

$$\begin{aligned} \text{c) } \theta &= \tan^{-1} \left(\frac{80.8 \text{ N}}{6.17 \text{ N}} \right) \\ &= 85.6^\circ \end{aligned}$$

$$\begin{aligned} F_{TY} &= F_g \\ &= ma_g \\ &= (0.63 \text{ kg})(9.8 \text{ m/s}^2) \\ &= 6.17 \text{ N} \end{aligned}$$



$$\sum \vec{F}_x = m a_c$$

$$F_f = m a_c$$

$$\mu m a_g = m a_c$$

$$\mu = \frac{\cancel{m} a_c}{\cancel{m} a_g}$$

$$\mu = \frac{a_c}{a_g}$$

$$= \frac{10.3 \text{ m/s}^2}{9.8 \text{ m/s}^2}$$

$$= 1.05$$

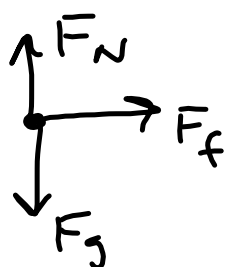
$$F_f = \mu F_N = \mu F_g$$

$$= \mu m a_g$$

$$a_c = \frac{v^2}{r} = \frac{(19 \text{ m/s})^2}{35 \text{ m}}$$

$$= 10.3 \text{ m/s}^2$$

4)



$$\mu = \frac{a_c}{a_g}$$

$$a_c = \frac{v^2}{r}$$

$$a_c = \mu a_g$$

$$\frac{v^2}{r} = \mu a_g$$

$$v^2 = \mu a_g r$$

$$v = \sqrt{\mu a_g r}$$

$$= \sqrt{(0.3)(9.8 \text{ m/s}^2)(35 \text{ m})}$$

$$= 10.2 \text{ m/s}$$