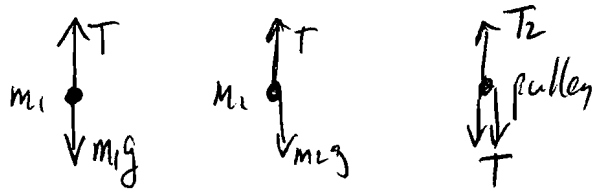
Practice Problems

① 

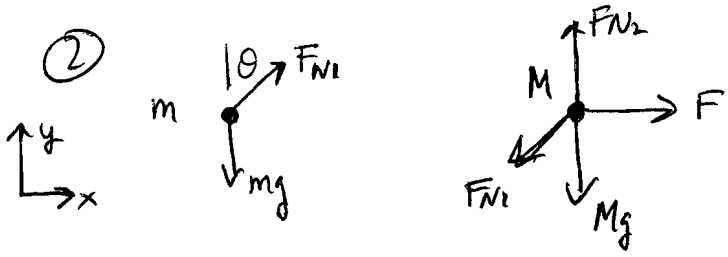
$F_{net,y} = T - m_1g$ $\quad F_{net,y} = m_2g - T$ $\quad F_{net,y} = T_2 - 2T = 0$

$T - m_1g = m_1\frac{\Delta v}{\Delta t}$ $\quad m_2g - T = m_2\frac{\Delta v}{\Delta t}$ $\Rightarrow$ $\frac{\Delta v}{\Delta t} = g - \frac{T}{m_2}$

$T - m_1g = m_1\left(g - \frac{T}{m_2}\right)$ $\Rightarrow$ $T\left(1 + \frac{m_1}{m_2}\right) = 2m_1g$

$$T = \frac{2m_1m_2g}{m_1+m_2}$$

$$T_2 = 2T = \frac{4m_1m_2g}{m_1+m_2} = 34.2N$$

② 

$F_{net,x} = F_{N1}\sin\theta = m\frac{\Delta v}{\Delta t}$ $\quad F_{net,x} = F - F_{N1}\sin\theta = M\frac{\Delta v}{\Delta t}$

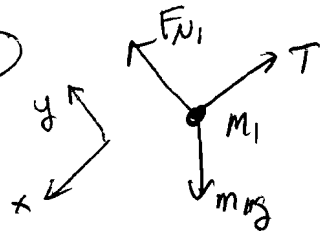
$F_{net,y} = F_{N1}\cos\theta - mg = 0$ $\quad F_{net,y} = F_{N2} - F_{N1}\cos\theta - Mg = 0$

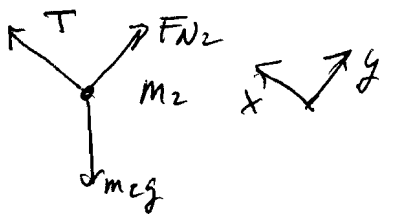
$F_{N1} = \frac{mg}{\cos\theta}$ $\Rightarrow$ $\frac{mg}{\cos\theta}\sin\theta = m\frac{\Delta v}{\Delta t}$ or $\frac{\Delta v}{\Delta t} = g\tan\theta$

for M: $F_{net,x} = F - F_{N1}\sin\theta = M\frac{\Delta v}{\Delta t}$ or $F - \frac{mg}{\cos\theta}\sin\theta = Mg\tan\theta$

$$F = g(m+M)\tan\theta$$

③





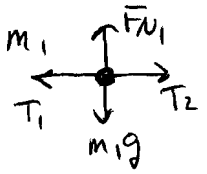
$F_{net,x} = m_1 g \sin\theta_1 - T = 0$ $\qquad$ $F_{net,x} = T - m_2 g \sin\theta_2 = 0$

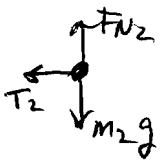
$F_{net,y} = F_{N_1} - m_1 g \cos\theta_1 = 0$ $\qquad$ $F_{net,y} = F_{N_2} - m_2 g \cos\theta_2 = 0$

$T = m_1 g \sin\theta_1 = m_2 g \sin\theta_2 \Rightarrow m_2 = m_1 \dfrac{\sin\theta_1}{\sin\theta_2} = 7.3\ kg$

$T = m_1 g \sin\theta_1 = 25N$

④





$F_{net,x} = T_1 - T_2 = \dfrac{m_1 v_1^2}{r_1}$ $\qquad$ $F_{net,x} = T_2 = \dfrac{m_2 v_2^2}{r_2}$

$F_{net,y} = F_{N_1} - m_1 g = 0$ $\qquad$ $F_{net,y} = F_{N_2} - m_2 g$

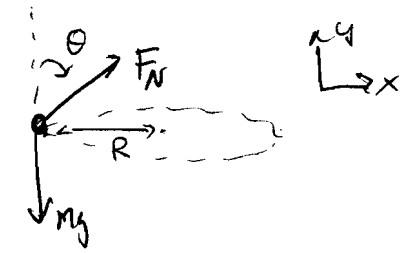
$v_1 = \dfrac{2\pi r_1}{t}$ $\qquad$ $v_2 = \dfrac{2\pi r_2}{t}$

$$T_2 = \frac{m_2 v_2^2}{r_2} = \frac{m_2}{r_2}\left(\frac{2\pi r_2}{t}\right)^2 = 4\pi^2 m_2 r_2 / t^2$$

$$T_1 = T_2 + \frac{m_1 v_1^2}{r_1} = \frac{4\pi^2 m_2 r_2}{t^2} + \frac{m_1}{r_1}\left(\frac{2\pi r_1}{t}\right)^2$$

$$T_1 = \frac{4\pi^2}{t^2}\left(m_1 r_1 + m_2 r_2\right)$$

(5)



$$F_{net,x} = F_N \sin\theta = \frac{mv^2}{R}$$

$$F_{net,y} = F_N \cos\theta - mg = 0$$

$$\Rightarrow F_N = mg/\cos\theta$$

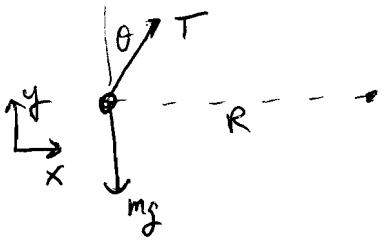
$R = r\sin\theta$

$v = 2\pi R/t$

$$\frac{mg}{\cos\theta}\sin\theta = \frac{mv^2}{R} = \frac{m}{r\sin\theta}\left(\frac{2\pi r\sin\theta}{t}\right)^2$$

$$\cos\theta = gt^2/4\pi^2 r$$

(6)



$$F_{net,x} = T\sin\theta = mv^2/R$$

$$F_{net,y} = T\cos\theta - mg = 0$$

$$\Rightarrow T = mg/\cos\theta$$

$$\frac{mg}{\cos\theta}\sin\theta = \frac{mv^2}{R}$$

$$v = \sqrt{gR\tan\theta} = 29.2 \text{ m/s}$$