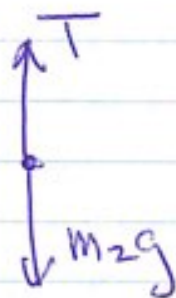


(a) Static

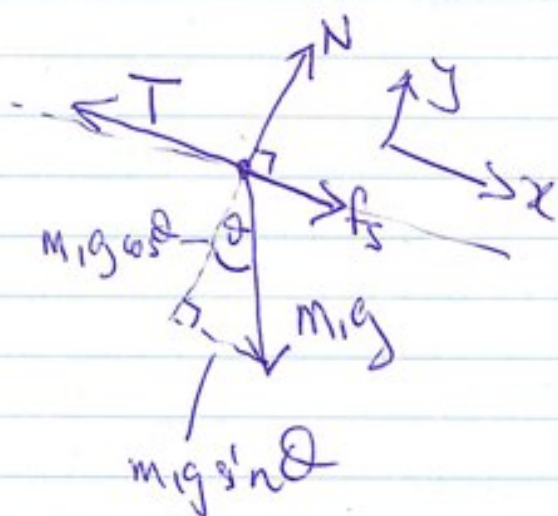
m_2



$$T - m_2 g = 0$$

$$T = m_2 g \quad (1)$$

m_1 At point of slipping up the plane:



$$y) \quad N - m_1 g \cos \theta = 0$$

$$N = m_1 g \cos \theta$$

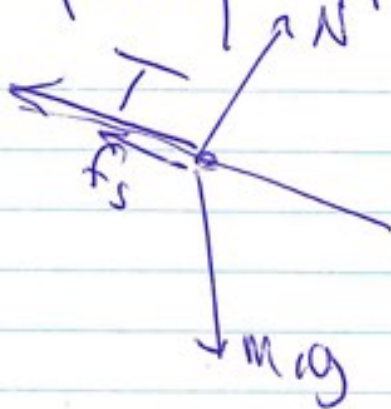
$$f_{s, \max} = \mu_s N = \mu_s m_1 g \cos \theta \quad (2)$$

$$x) \quad f_s + m_1 g \sin \theta - T = 0 \quad (3)$$

To eliminate T : $m_2 = m_1 (\sin \theta + \mu_s \cos \theta)$

This gives $(m_2)_{\max}$.

At point of slipping down the plane:



f_s has changed direction.

$$\therefore (M_2)_{\min} = m_1 (\sin \theta - \mu_s \cos \theta)$$

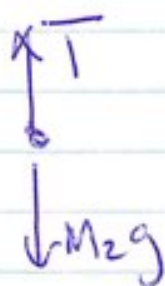
$$\theta = 37^\circ \quad m_1 = 10 \text{ kg} \quad \mu_s = 0.40$$

$$\Rightarrow (M_2)_{\min} = 2.8 \text{ kg.}$$

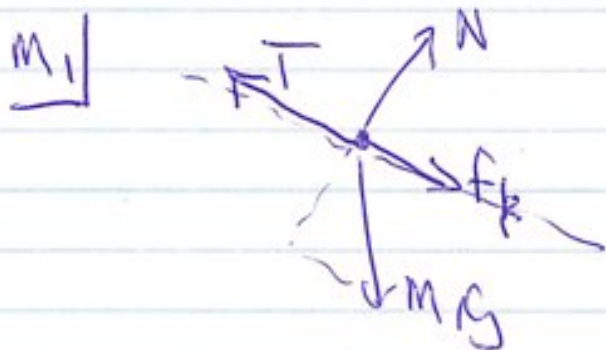
$$(M_2)_{\max} = 9.2 \text{ kg.}$$

$$\Rightarrow 2.8 \text{ kg} \leq m_2 \leq 9.2 \text{ kg.}$$

(b) dynamic
 M_2



$$T - M_2g = M_2a_2 \quad (1)$$



$$N = M_1g \cos \theta$$

$$f_k = \mu_k M_1g \cos \theta \quad (3)$$

$$f_k + M_1g \sin \theta - T = M_1a_1 \quad (2)$$

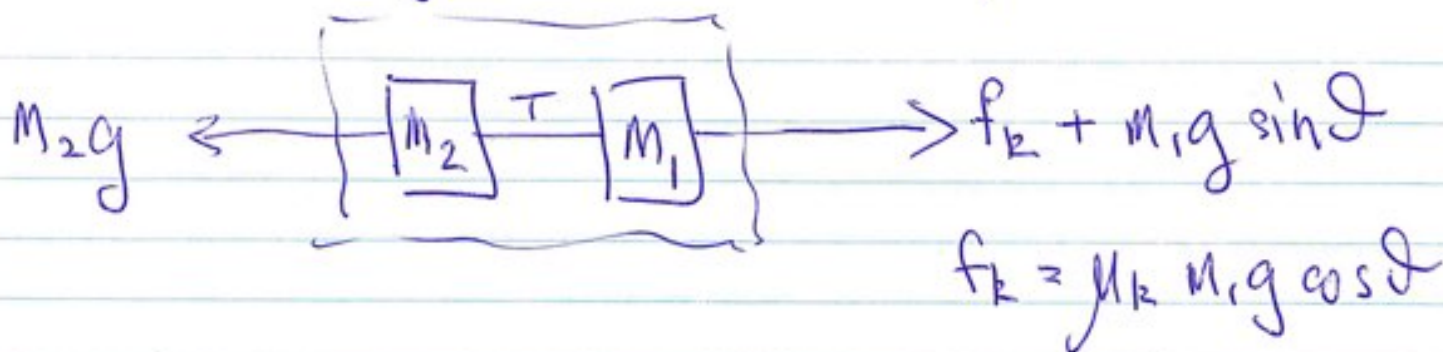
$$\boxed{a_1 = a_2}$$

$$T = M_2g + M_2a_1$$

$$= \mu_k M_1g \cos \theta + M_1g \sin \theta - M_1a_1$$

$$\therefore (M_1 + M_2)a_1 = g(M_2 + \mu_k M_1 \cos \theta + M_1 \sin \theta)$$

Alternatively; Consider as a system :



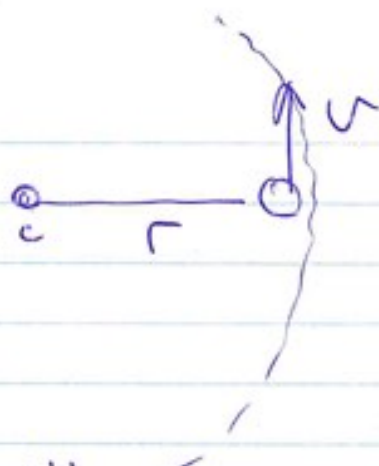
$m_2g \leftarrow \left[\boxed{m_2} \text{---} T \text{---} \boxed{m_1} \right] \rightarrow f_k + m_1g \sin \theta$

$f_k = \mu_k m_1g \cos \theta$

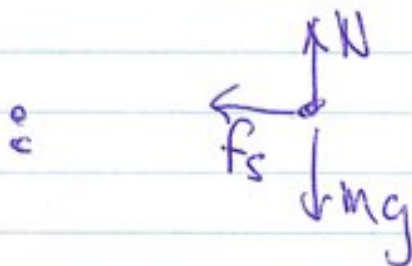
$$\begin{aligned} \Sigma F &= \mu_k m_1g \cos \theta + m_1g \sin \theta - m_2g \\ &= (m_1 + m_2)a \end{aligned}$$

Coin top view

$$a_c = \frac{v^2}{r} \text{ (inward)}$$



side view



$$N = mg$$

$$f_{s, \max} = \mu_s N = \mu_s mg$$

$$f_{s, \max} = m \frac{v^2}{r}$$

$$\mu_s mg = m \frac{v^2}{r}$$

$$\mu_s = \frac{v^2}{gr}$$

$$v = \frac{(2\pi \times 0.15 \text{ m})^2}{9.8 \frac{\text{m}}{\text{s}^2} \times 1.8 \text{ s}} = 0.05$$

$$r = 0.15 \text{ m}$$

$$v = \frac{2\pi r}{T}$$

$$T = \frac{1 \text{ min}}{33\frac{1}{3} \text{ rev}} = \frac{60 \text{ s}}{100/3} = 1.8 \text{ s}$$

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