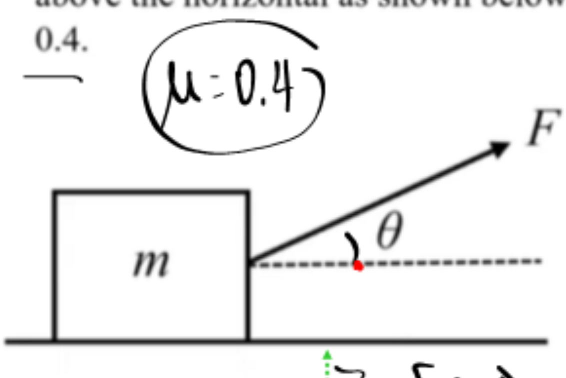
A box of mass $m = 2.4$ kg is pulled across a rough surface by an applied force of 20 N at an angle of 37° above the horizontal as shown below. The coefficient of kinetic friction between the surface and the box is 0.4.

$\mu = 0.4$

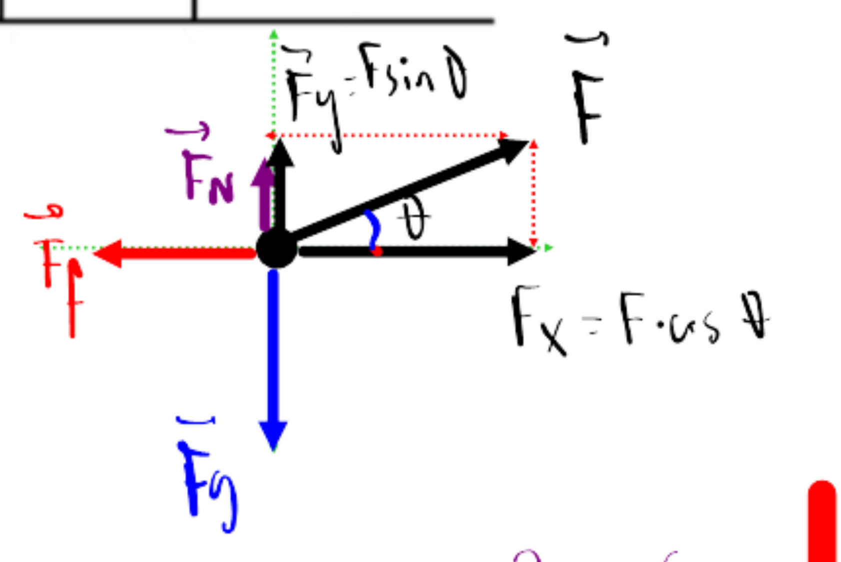


a) What is the normal force acting on the box?
b) What is the acceleration of the box?

$$\boxed{\vec{a} = \frac{\vec{F}_{net}}{m}}$$

$$\boxed{F_g = m \cdot g = W}$$

$$\boxed{F_f = \mu \cdot F_N}$$



$F_N = ?$

Zero $= a_y$
only moves horizontally

$\vec{F}_{net\,y} = m \cdot a_y$

$F_N + F_y - F_g = 0$

$F_N = F_g - F_y$

$F_N = mg - F\sin\theta$

$F_N = 2.4 \times 9.8 - 20 \cdot \sin(37°)$

$$\boxed{F_N = 11.5\text{ N}}$$

$a = a_x = ?$

$F_{net_x} = m \cdot a_x$

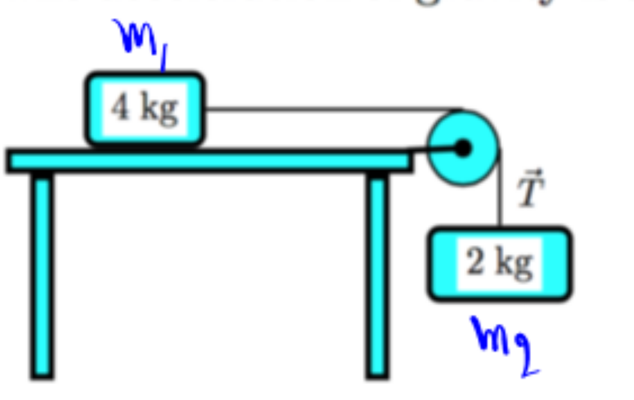
$F_x - F_f = m \cdot a$

$F\cos\theta - \mu \cdot F_N = m \cdot a$

$[20 \cdot \cos(37°) - 0.4 \times 11.5] = 2.4 \times a$

$a = 4.74\ \frac{m}{s^2}$

A 4 kg block rests on a horizontal table, attached to a 2 kg block by a light string as shown in the figure.
The acceleration of gravity is 9.81 m/s^2.



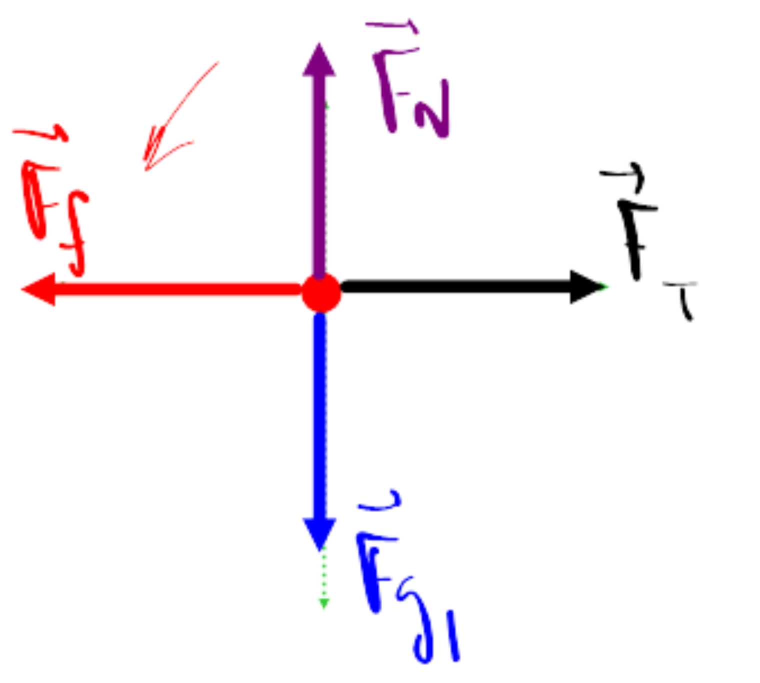
$\mu = ?$

$$\boxed{\vec{a} = \frac{\vec{F}_{net}}{m}}$$

$$\boxed{F_g = m \cdot g = W}$$

$$\boxed{F_f = \mu \cdot F_N}$$

What is the minimum coefficient of static friction such that the objects remain at rest?



$\mu = ?$

static
$a = 0$

$\vec{F}_{net_x} = m \cdot \cancel{\vec{a}_x}$

$F_T - F_f = 0$

$F_T = F_f$

$F_T = \mu \cdot F_N$

$F_T = 19.6\text{ N}$

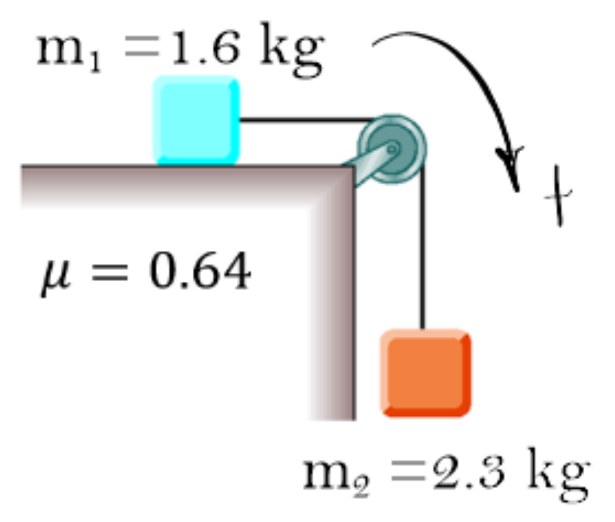
$F_T = F_{g2} = m_2 g = 2 \times 9.8$

$F_N = F_{g1} = m_1 g$

$F_N = 4 \times 9.8 = 39.2\text{ N}$

$\frac{F_T}{F_N} = \mu = \frac{19.6\ \cancel{N}}{39.2\ \cancel{N}}$

$$\boxed{\mu = 0.5}$$

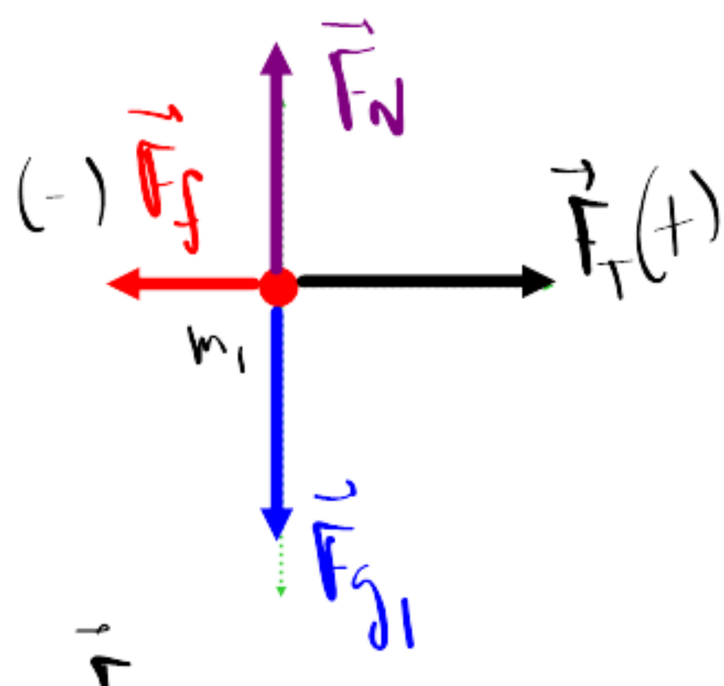


$$\boxed{\vec{a} = \frac{\vec{F}_{net}}{m}}$$

$$\boxed{F_g = m \cdot g = W}$$

$$\boxed{F_f = \mu \cdot F_N}$$

a = ?
F_T = ?



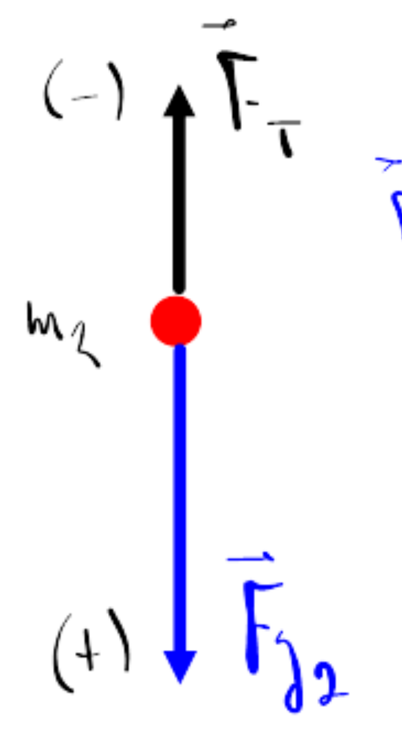
$\vec{F}_{net_x} = m_1 \cdot \vec{a}_x$

$F_T - F_f = m_1 \cdot a$

$F_T - \mu \cdot F_N = m_1 \cdot a$

$F_N = F_{g1} = m_1 g$

$F_T - \mu m_1 g = m_1 a$



$\vec{F}_{net_y} = m_2 \vec{a}_y$

$F_{g2} - F_T = m_2 \cdot a$

$m_2 g - F_T = m_2 \cdot a$

$F_T = ?$
$a = ?$

Same!

$F_T = ?$
$a = ?$

$\cancel{F_T} - \mu m_1 g = m_1 a$

$+ \quad m_2 g - \cancel{F_T} = m_2 a$

$m_2 g - \mu m_1 g = m_1 a + m_2 a$

$m_2 g - \mu m_1 g = a(m_1 + m_2)$

$\frac{(2.3 \times 9.8 - 0.64 \times 1.6 \times 9.8)}{(2.3 + 1.6)} = \frac{m_2 g - \mu m_1 g}{(m_1 + m_2)} = a$

$$\boxed{a = 3.20\ \frac{m}{s^2}}$$

$F_T = ?$

$F_T - \mu m_1 g = m_1 a$

$F_T = m_1 a + \mu m_1 g = 1.6 \times 3.2 + 0.64 \times 1.6 \times 9.8$

$$\boxed{F_T = 15.2\text{ N}}$$