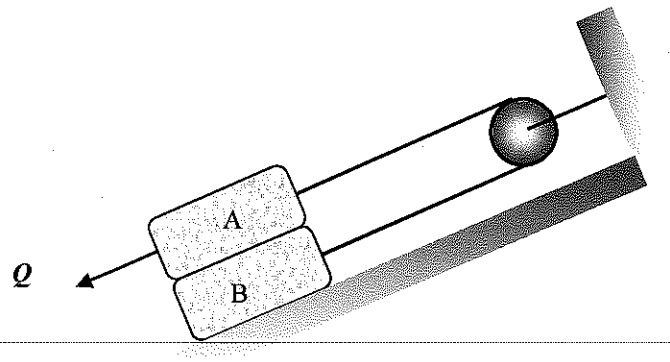
Example

A system of two blocks sits on an incline as shown in the figure.

(a) Do the blocks move?

(b) If the blocks do move, what are the accelerations of *A* and *B*, and what is the tension in the cable?



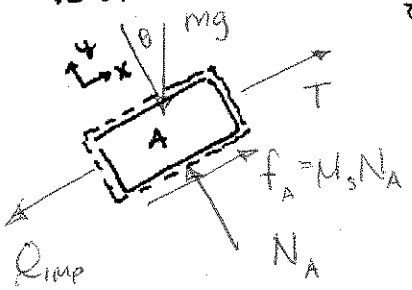
$m_A = 25$ kg
$m_B = 15$ kg
~~$Q = 250$ N~~ Forget Q first.

For all surfaces:
$\mu_s = 0.2$
$\mu_k = 0.15$

$\theta = 30^0$

ASSUME Impending motion ⟶ SOLVE FOR Q_{imp}

SYSTEM A:



y-DIR COLM:

$$\frac{d}{dt}(\cancel{P_{y,sys}}^{\to 0}) = \Sigma F_y + \cancel{L_0}^{\to 0} - \cancel{L_0}^{\to 0}$$

$$0 = N_A - m_A g \cos\theta$$

$$N_A = m_A g \cos\theta = \ldots = 212.3\ \text{N} \quad (1)$$

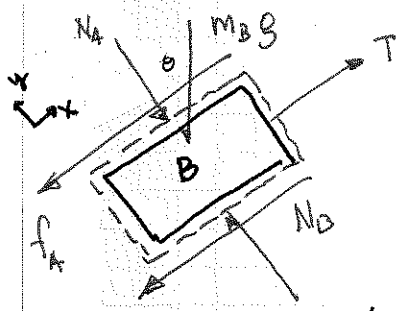
x-DIR COLM:

$$\frac{d}{dt}(\cancel{P_{x,sys}}^{\to 0}) = \Sigma F_x + \cancel{L_0}^{\to 0} - \cancel{L_0}^{\to 0}$$

$$= -Q_{imp} - m g \sin\theta + T + f_A$$

$$Q_{imp} = T - m_A g \sin\theta + \mu_s N_A \quad (2)$$

SYSTEM B:



y-DIR CoLM:

$$\frac{d}{dt}(P_{y,sys}) = \sum F_y + \mathcal{L}_0 - \mathcal{L}_0$$

$$0 = -N_A + N_B - m_B g \cos\theta$$

$$N_B = N_A + m_B g \cos(\theta) = \underline{339.8\ N} \quad (3)$$

X-DIR CoLM:

$$\frac{d}{dt}(P_{x,sys}) = \sum F_x + \mathcal{L}_0 - \mathcal{L}_0$$

$$0 = -f_A - f_B + T - m_B g \sin\theta$$

$$= -\mu_s N_A - \mu_s N_B + T - m_B g \sin\theta$$

$$T = \mu_s N_A + \mu_s N_B + m_B g \sin\theta = \underline{184\ N}$$

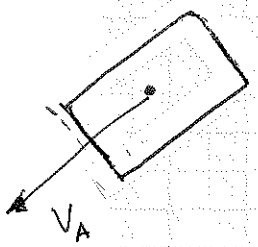
From (2) $Q_{IMP} = 184 - (25)(9.81)\sin 30° + (0.15)(212.3)$

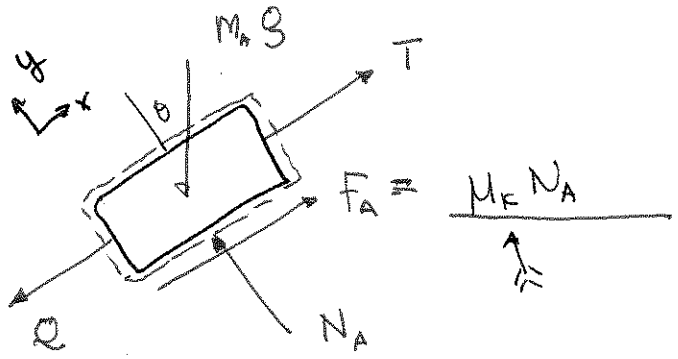
$Q_{IMP} = \underline{103\ N}$ $>, (<), = Q$?

$\Rightarrow$ (MOTION) / NO MOTION ?

$Q > Q_{IMP}$ $\therefore$ ↑

SYSTEM A:





HERE, y-COLM IS THE SAME. WHY?

(CAUTION!! NOT ALWAYS THE CASE!)

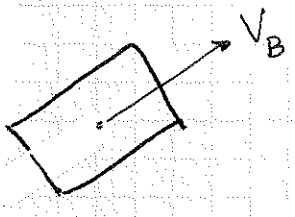
X-DIR COLM:

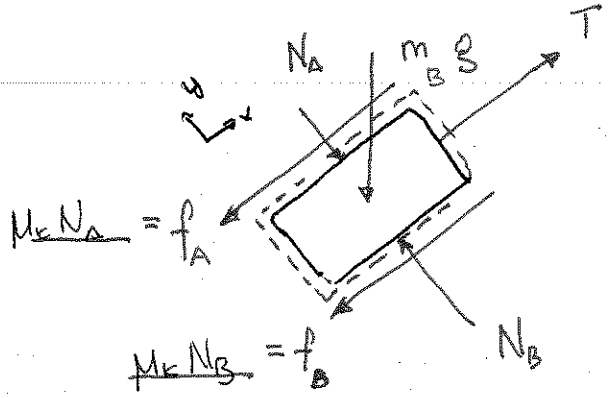
$$\frac{d}{dt}(P_{x,sys}) = \sum F_x + \angle \quad - \angle$$

$$\frac{d}{dt}(m(-V_A)) = -Q - m_A g \sin\theta + \overset{?}{T} + \mu_K N_A$$

$$-m_A \frac{dV_A}{dt} = -m_A(\overset{?}{a}_A) = \quad " \quad " \quad " \quad " \qquad (1)$$

SYSTEM B:





y-DIR COLM SAME. (AGAIN! CAREFUL!)

X-DIR COLM:

$$\frac{d}{dt}(m_B V_B) = -\mu_K N_A - \mu_K N_B + T - m_B g \sin\theta$$

$$m_B \frac{dV_B}{dt} = m_B a_B = -$$

$$m_B \overset{?}{a_B} = -\mu_k N_A - \mu_k N_B - m_B g \sin\theta + \overset{?}{T} \qquad (2)$$

TWO EQNS, THREE UNKNOWNS.

THIRD EQN?

$$a_A = a_B \qquad (3)$$

SOLVE...

$a_A =$ 4.61 m/s²

$a_B =$ " "

$T =$ 226 N