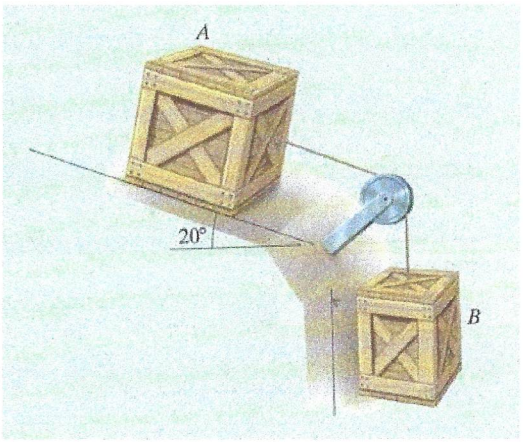
Force Acceleration II – Problem 1

The two crates are released from rest. Their masses are $m_A = 40$ kg and $m_B = 30$ kg, and the coefficients of friction between crate A and the inclined surface are $\mu_s = 0.2$ and $\mu_k = 0.15$. What is the acceleration of the crates?



CLASSIFY MOTION

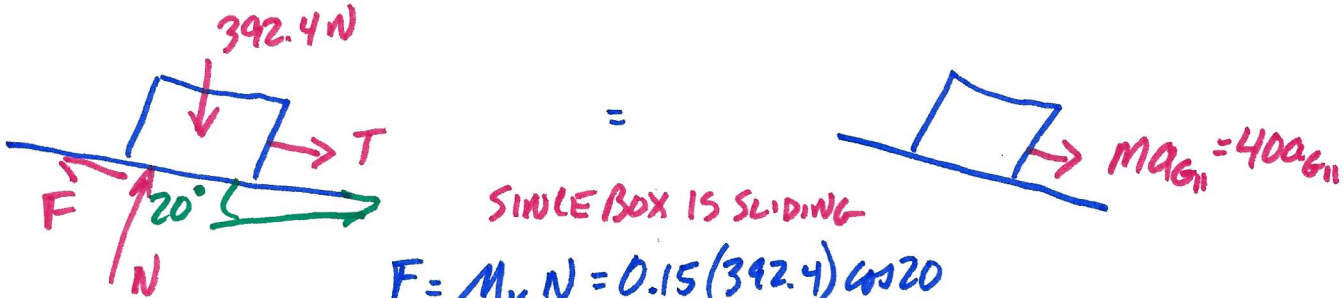
BOTH TRANSLATION

PROPERTIES

$m_A = 40 kg$ $W_A = 40(9.81) = 392.4 N$

$m_B = 30 kg$ $W_B = 30(9.81) = 294.3 N$

FBD = KD



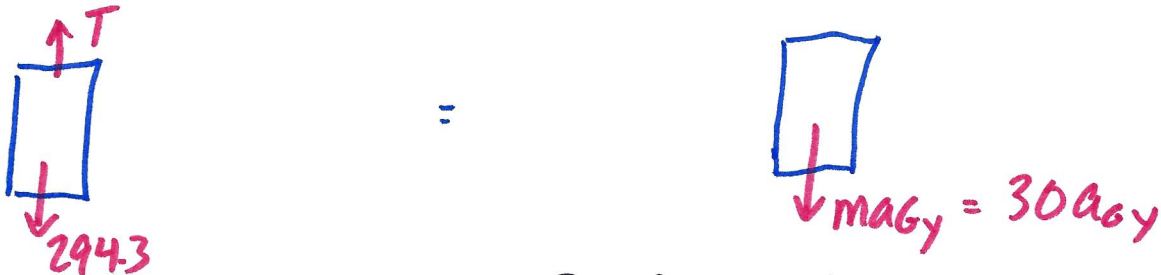
SINGLE BOX IS SLIDING

$F = \mu_K N = 0.15(392.4)\cos 20$

$= 55.31 N$

$\rightarrow \Sigma F$ $\quad T - 55.31 + 392.4\sin 20 = 40 a_{G_{11}}$

① $\quad T - 40 a_{G_{11}} = -78.86$ $\quad a_{G_{11}} = a_{G_y} = a$



$\uparrow \Sigma F$ $\quad T - 294.3 = -30 a_{G_y}$

② $\quad T + 30 a_{G_y} = 294.3$

SOLVE ① + ②

$$\begin{bmatrix} 1 & -40 \\ 1 & 30 \end{bmatrix} \begin{Bmatrix} T \\ a \end{Bmatrix} = \begin{Bmatrix} -78.86 \\ 294.3 \end{Bmatrix}$$

$T = 134 N$

$a = 5.32 m/s^2 \downarrow$