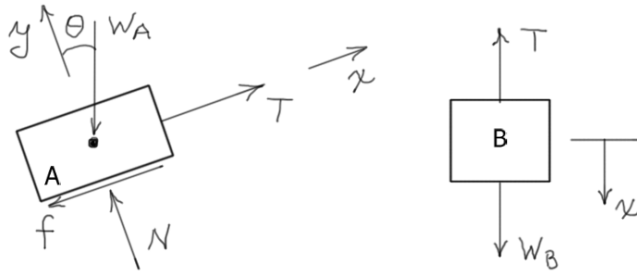
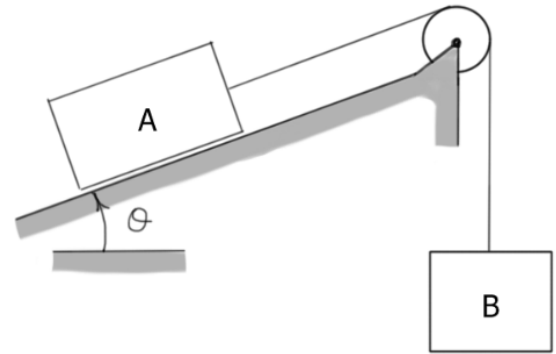


ME 2580 Example #23: (Impulse & Momentum)

Given: $W_A = 100$ (lb), $W_B = 110$ (lb), $\mu_k = 0.3$
 $\theta = 20$ (deg), system is **released from rest**
 A moves **up the plane** and B moves **down**

Find: v_2 the velocities of the two blocks $\frac{1}{2}$ (sec) after release

Solution: (using the **principle of impulse & momentum**)



Free body diagrams for motion up the plane

Newton's Law:

$$A: \boxed{+\nearrow \sum F_y = N - W_A \cos(\theta) = 0} \Rightarrow \boxed{f = \mu_k N = \mu_k W_A \cos(\theta)}$$

Impulse and Momentum:

$$A: \boxed{L_{1x} + \sum (I_{1 \rightarrow 2})_x = L_{2x}} \quad \text{with} \quad \boxed{L_{1x} = \left(\frac{W_A}{g}\right) v_{1x} = 0} \quad (\text{released from rest})$$

$$\boxed{L_{2x} = \left(\frac{W_A}{g}\right) v_2} \quad \text{and} \quad \boxed{\sum (I_{1 \rightarrow 2})_x = (T - W_A \sin(\theta) - \mu_k W_A \cos(\theta)) \Delta t} \quad (\text{constant forces})$$

$$\Rightarrow \boxed{[T - W_A \sin(\theta) - \mu_k W_A \cos(\theta)] \Delta t = \left(\frac{W_A}{g}\right) v_2} \quad (1)$$

$$B: \boxed{L_{1x} + \sum (I_{1 \rightarrow 2})_x = L_{2x}} \quad \text{with} \quad \boxed{L_{1x} = \left(\frac{W_B}{g}\right) v_{1x} = 0} \quad (\text{released from rest})$$

$$\boxed{L_{2x} = \left(\frac{W_B}{g}\right) v_2} \quad (\text{same velocity as A}) \quad \text{and} \quad \boxed{\sum (I_{1 \rightarrow 2})_x = (W_B - T) \Delta t} \quad (\text{constant forces})$$

$$\Rightarrow \boxed{[W_B - T] \Delta t = \left(\frac{W_B}{g}\right) v_2} \quad (2)$$

Adding equations (1) and (2) gives:

$$\boxed{[W_B - W_A \sin(\theta) - \mu_k W_A \cos(\theta)] \Delta t = \left(\frac{W_A + W_B}{g}\right) v_2}$$

$$\Rightarrow \boxed{v_2 = \left(\frac{g \Delta t}{W_A + W_B}\right) [W_B - W_A \sin(\theta) - \mu_k W_A \cos(\theta)] = 3.64989 \approx 3.65 \text{ (ft/s)}}$$