

Elementary Dynamics Example #14: (Newton's Laws, Rectangular Components)

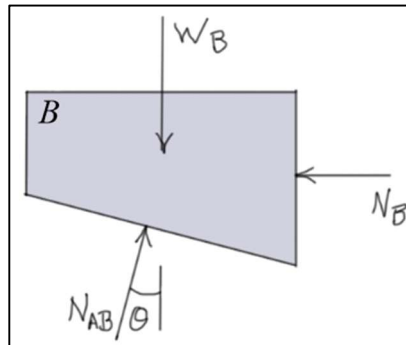
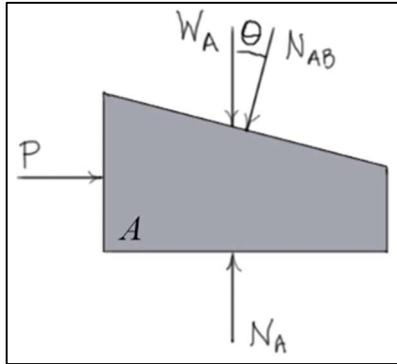
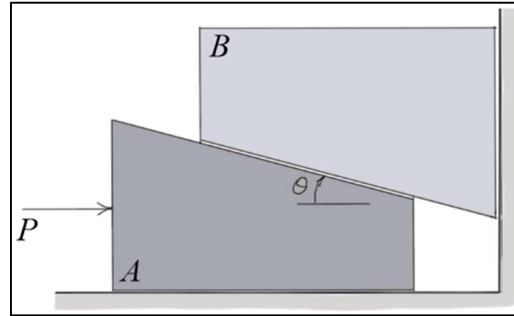
Given: $W_A = 8 \text{ (lb)}$, $W_B = 15 \text{ (lb)}$, $P = 12 \text{ (lb)}$

$\theta = 15 \text{ (deg)}$

all surfaces are **smooth**

Find: a_B the acceleration of block B

Solution:



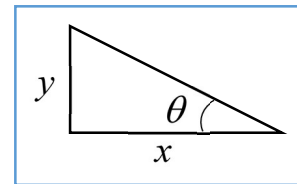
Free body diagrams

$$A: \rightarrow \sum F = P - N_{AB} \sin(\theta) = \left(\frac{W_A}{g}\right) a_A \quad \text{and} \quad \uparrow \sum F = N_A - W_A - N_{AB} \cos(\theta) = 0$$

$$B: \rightarrow \sum F = N_{AB} \sin(\theta) - N_B = 0 \quad \text{and} \quad \uparrow \sum F = N_{AB} \cos(\theta) - W_B = \left(\frac{W_B}{g}\right) a_B$$

Kinematics:

$$\tan(\theta) = \frac{y}{x} \Rightarrow a_B = \ddot{y} = \ddot{x} \tan(\theta) = a_A \tan(\theta)$$



Simultaneous Equations:

$$\left(\frac{W_A}{g}\right) \left(\frac{a_B}{\tan(\theta)}\right) + \sin(\theta) N_{AB} = P = 12$$

$$\left(\frac{W_B}{g}\right) a_B - \cos(\theta) N_{AB} = -W_B = -15$$

$$\Rightarrow a_B \approx 7.586 \approx 7.59 \text{ (ft/s}^2\text{)}$$

$$N_{AB} \approx 19.1877 \approx 19.2 \text{ (lb)}$$

$$\Rightarrow a_A \approx 28.3113 \approx 28.3 \text{ (ft/s}^2\text{)}, \quad N_A \approx 26.5 \text{ (lb)} \quad \text{and} \quad N_B \approx 5.00 \text{ (lb)}$$