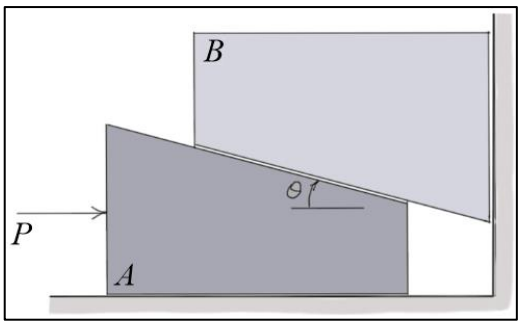
Elementary Dynamics Example #14: (Newton's Laws, Rectangular Components)

Given: $W_A = 8$ (lb), $W_B = 15$ (lb), $P = 12$ (lb)

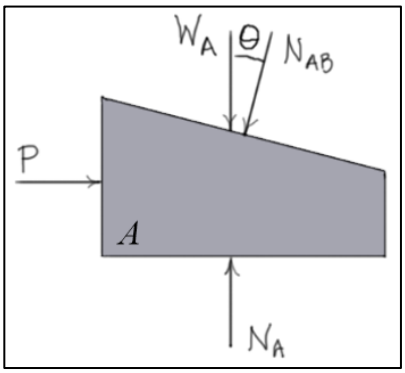
$\theta = 15$ (deg)

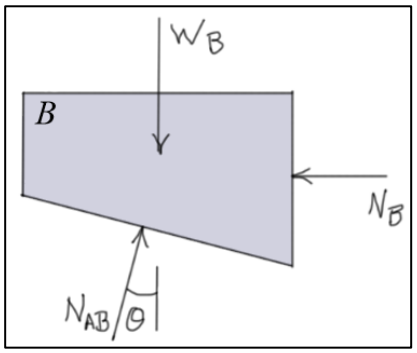
all surfaces are ***smooth***



Find: a_B the acceleration of block B

Solution:





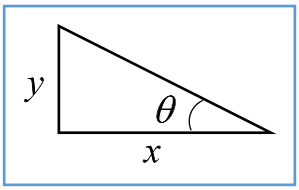
Free body diagrams

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

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

Kinematics:

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



Simultaneous Equations:

$$\left(\frac{W_A}{g}\right)\left(\frac{a_B}{\tan(\theta)}\right) + \sin(\theta)N_{AB} = P = 12$$
$$\left(\frac{W_B}{g}\right)a_B - \cos(\theta)N_{AB} = -W_B = -15$$

$$\Rightarrow \quad \boxed{\begin{aligned} a_B &\approx 7.586 \approx 7.59 \text{ (ft/s}^2\text{)} \\ N_{AB} &\approx 19.1877 \approx 19.2 \text{ (lb)} \end{aligned}}$$

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