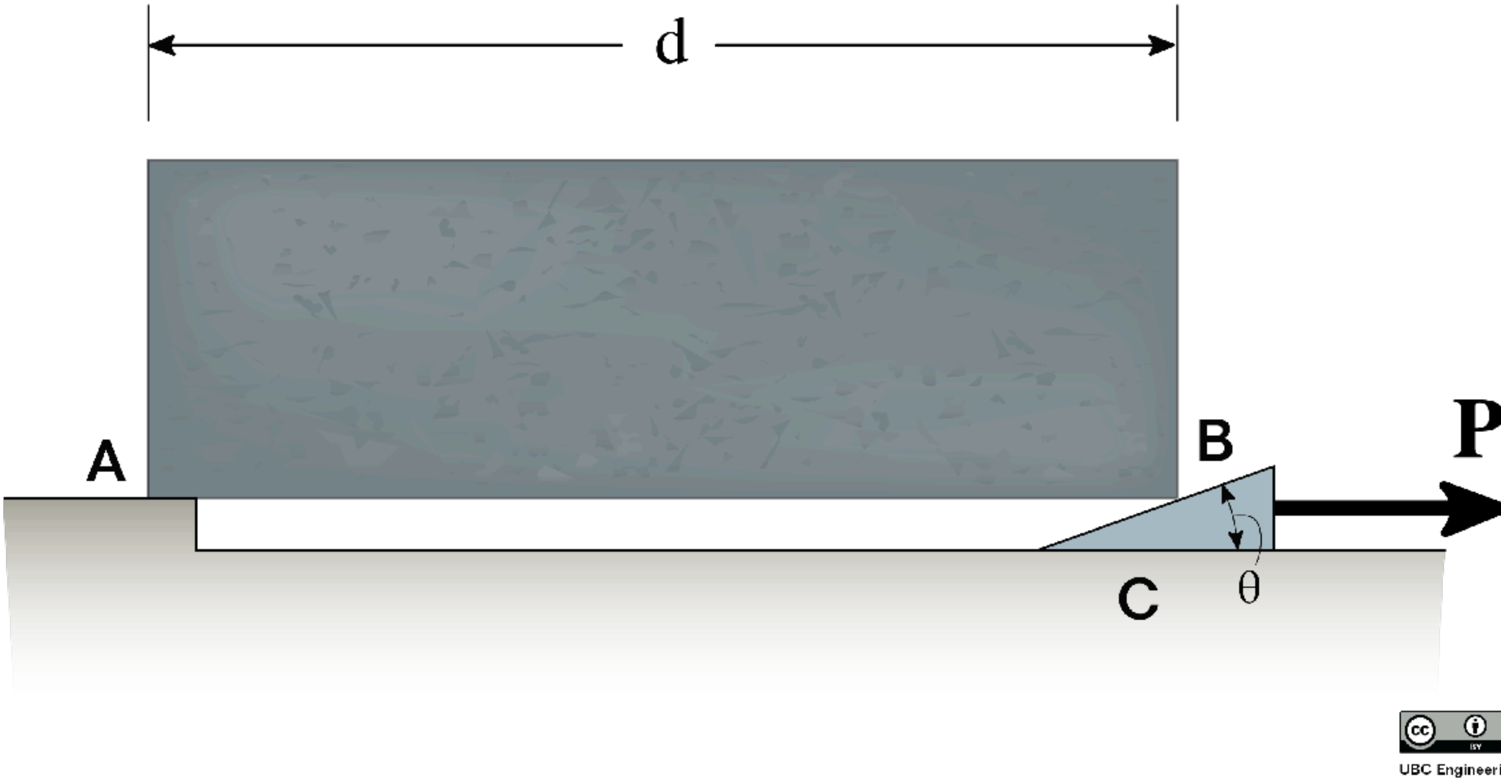
21-S-8.3-RP-01



A stone block with uniform density has a total mass of $m\,\text{kg}$ and is held in the horizontal position using the wedge at point B. If the static coefficient of friction at all surfaces of contact is μ_s, find the minimum force P required to remove the wedge. Assume that the stone does not slip at A and that the wedge has negligible mass. Use $g = 9.81\ \text{N/kg}$.

Find the normal forces acting on the wedge.

Minimum implies that the friction forces on the wedge are at maximum:

$$F_B = \mu_s N_B$$

$$\Sigma M_A = 0 \rightarrow d \cdot N_B(\cos(\theta) + \mu_s \sin(\theta)) - \frac{d}{2} mg = 0$$

$$\Rightarrow N_B = \frac{mg}{2(\cos(\theta) + \mu_s \sin(\theta))}$$

$$+\uparrow \Sigma F_y = 0 \rightarrow N_C - N_B(\cos(\theta) + \mu_s \sin(\theta)) = 0$$

$$\Rightarrow N_C = \frac{mg}{2}$$

Find the minimum force P required to remove the wedge.

$F_C = \mu_s N_C$

$+ \rightarrow \Sigma F_x = 0 \rightarrow P - \mu_s N_C + N_B(\sin(\theta) - \mu_s \cos(\theta)) = 0 \rightarrow P = \dfrac{\mu_s \cdot mg}{2} - mg\dfrac{\sin(\theta) - \mu_s \cos(\theta)}{2(\cos(\theta) + \mu_s \sin(\theta))}$

$\Rightarrow P = \dfrac{mg}{2}\left(\mu_s - \dfrac{\sin(\theta) - \mu_s \cos(\theta)}{\cos(\theta) + \mu_s \sin(\theta)}\right)$