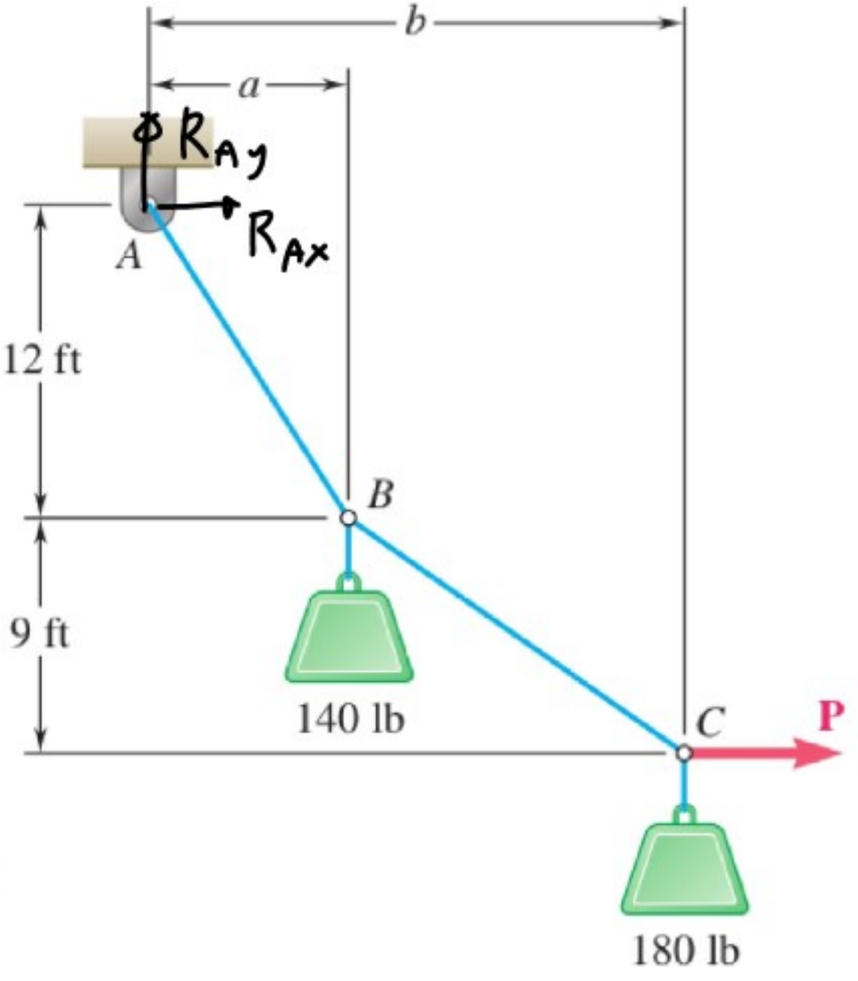
7.103 Cable ABC supports two loads as shown. Knowing that $b = 21$ ft, determine (a) the required magnitude of the horizontal force **P**, (b) the corresponding distance a.



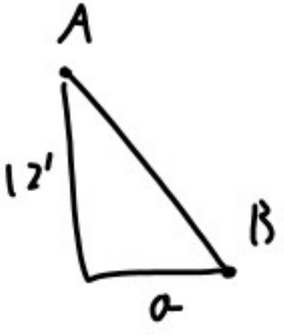
$$\sum F_x = R_{Ax} + P = 0$$

$$R_{Ax} = -P$$

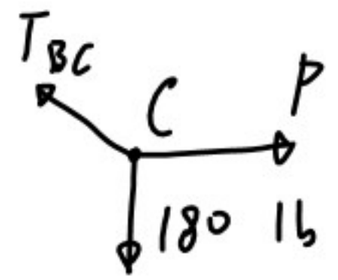
$$\sum F_y = R_{Ay} - 190 - 180 = 0$$

$$R_{Ay} = 190 + 180$$

$$= 320$$



$$\frac{a}{12} = \frac{R_{Ax}}{R_{Ay}} = \frac{P}{320}$$

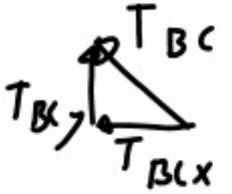


$$\sum F_x = 0$$

$$P + T_{BCx} = 0$$

$$T_{BCx} = -P$$

$$\sum F_y = 0$$



$$T_{BCy} - 180 = 0$$

$$T_{BCy} = 180$$

$$\frac{21-a}{9} = \frac{T_{BCx}}{T_{BCy}} = \frac{P}{180}$$

$$\frac{a}{12} = \frac{P}{320}$$

$$a = \frac{12}{320} P$$

$$\frac{21-a}{9} = \frac{P}{180}$$

$$21 - a = \frac{9}{180} P$$

$$21 - \frac{9}{180} P = a$$

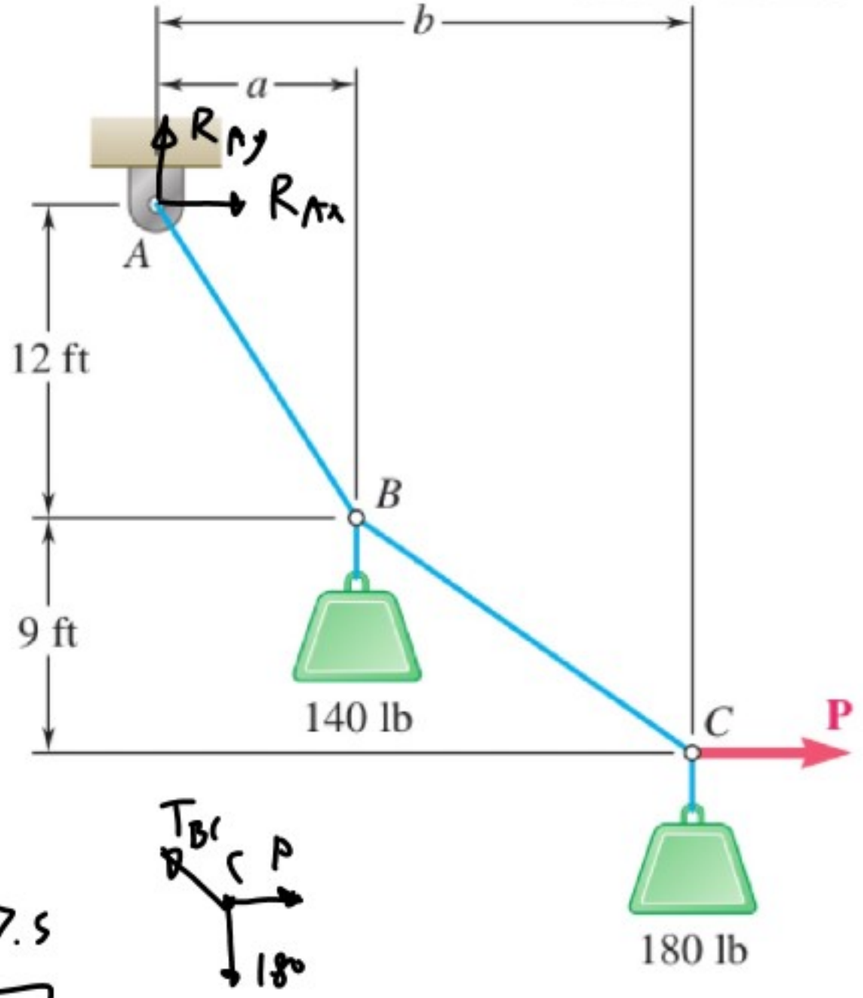
$$\frac{12}{320} P = 21 - \frac{9}{180} P$$

$$\left(\frac{12}{320} + \frac{9}{180}\right) P = 21$$

$$P = \frac{21}{\left(\frac{12}{320} + \frac{9}{180}\right)} = \boxed{240\ lb = P}$$

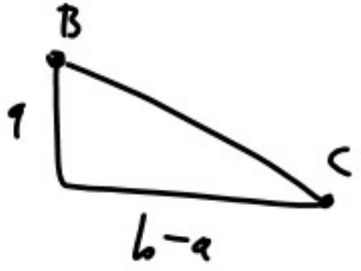
$$a = \frac{12}{320} P = \frac{12}{320} 240 = \boxed{9\ ft = a}$$

7.104 Cable ABC supports two loads as shown. Determine the distances a and b when a horizontal force **P** of magnitude 200 lb is applied at C.



$R_{Ax} = -200$

$R_{Ay} = 320$

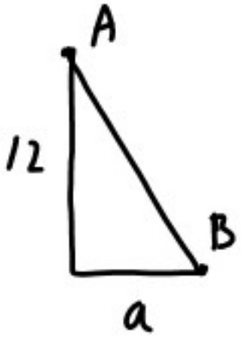


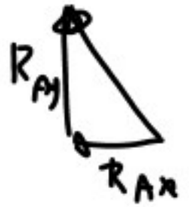
$$\frac{b-a}{9} = \frac{P}{180} = \frac{200}{180}$$

$$b-a = 9\,\frac{200}{180}$$

$$b = 9\,\frac{200}{180} + a = 9\,\frac{200}{180} + 7.5$$

$$\boxed{b = 17.5 \text{ ft}}$$

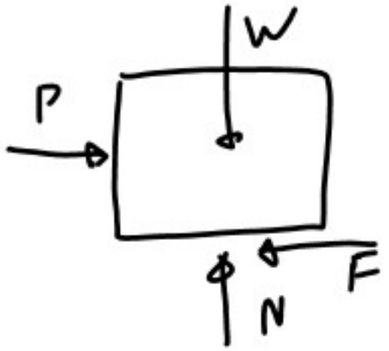




$$\frac{9}{12} = \frac{R_{Ax}}{R_{Ay}} = \frac{200}{320}$$

$$a = 12\,\frac{200}{320} = \boxed{7.5 \text{ ft} = a}$$

Friction



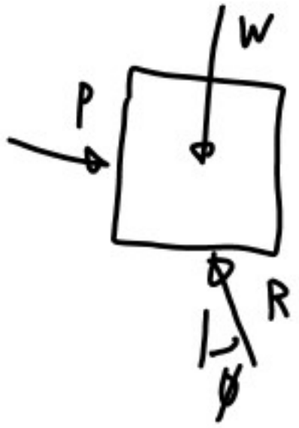
Static

$F = \mu_s N$

$P \leq \mu_s W$

Kinetic

$F = \mu_K N$

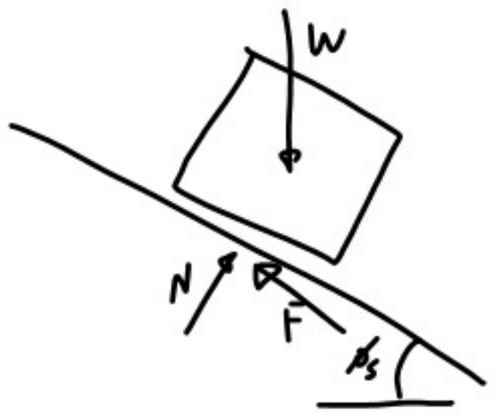


ϕ Friction angle

$$\tan \phi_s = \frac{F}{N} = \frac{\mu_s N}{N} = \mu_s$$

$\phi_s = \tan^{-1}(\mu_s)$

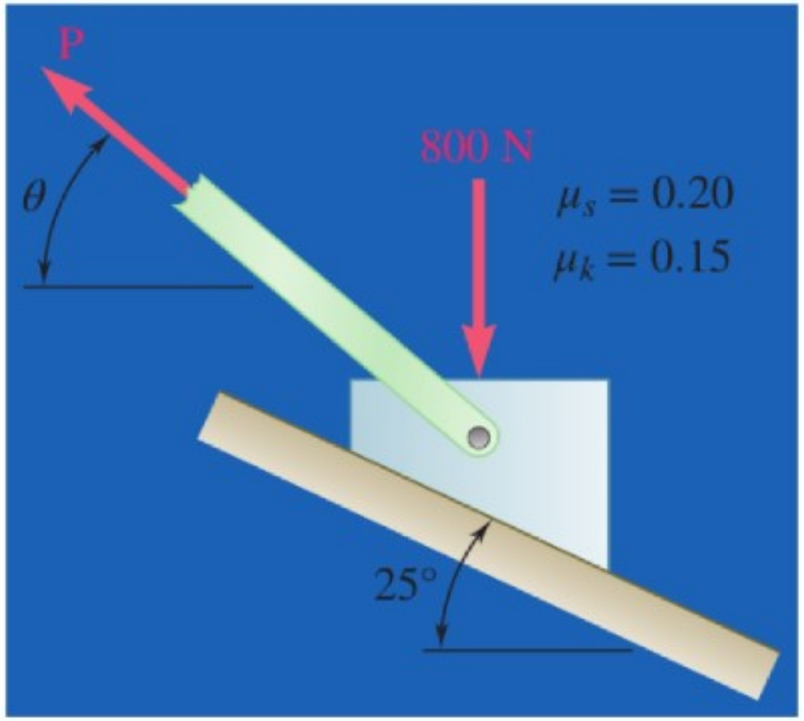
$\phi_K = \tan^{-1}(\mu_K)$



Steeper than ϕ_s slides down

less than ϕ_s stationary

Determine whether the block shown is in equilibrium and find the magnitude and direction of the friction force when $\theta = 40°$ and $P = 400$ N.



Determine whether the block shown is in equilibrium and find the magnitude and direction of the friction force when $\theta = 30°$ and $P = 50$ lb.