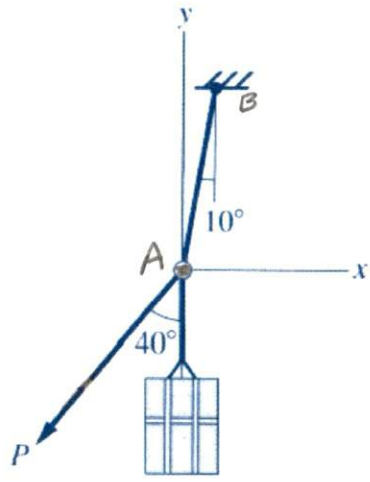
3-12

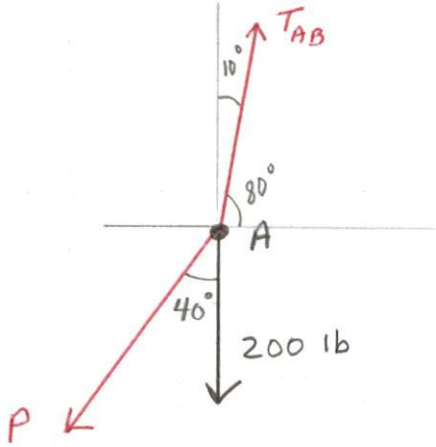
Determine the force P required to suspend the 200-lb crate in the position shown in Fig. P3-12. Solve the problem by using (a) the force triangle and (b) the equilibrium equations along the x and y axes.

Solution.

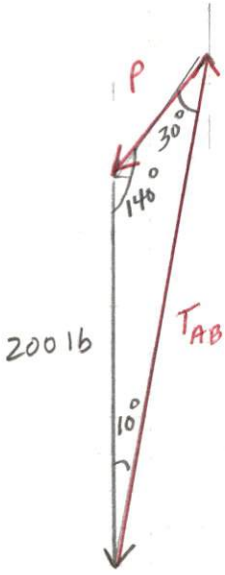


(a) Force - Triangle

Step 1. Draw the FBD!



FBD



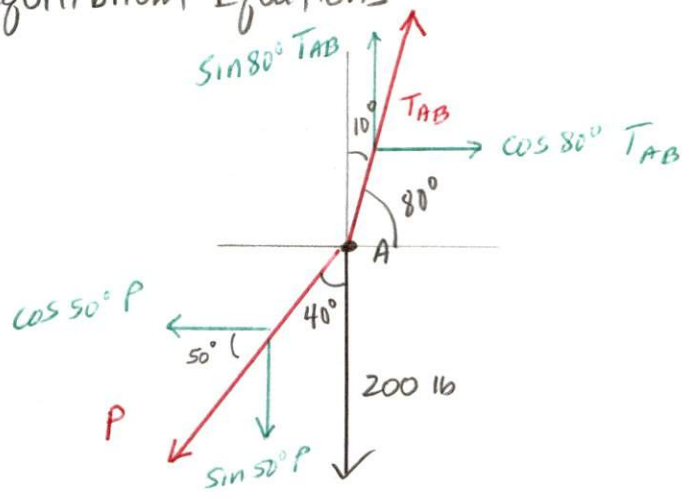
Force - Triangle

Law of Sines

$$\frac{P}{\sin 10^\circ} = \frac{T_{AB}}{\sin 140^\circ} = \frac{200\ \text{lb}}{\sin 30^\circ}$$

$$P = \frac{\sin 10^\circ\,(200\ \text{lb})}{\sin 30^\circ} = 69.5\ \text{lb}$$

(b) Equilibrium Equations



FBD

Equilibrium Equations

$[\Sigma F_x = 0]$ $\quad -\cos 50^\circ P + \cos 80^\circ T_{AB} = 0 \qquad (1)$

$[\Sigma F_y = 0]$ $\quad -\sin 50^\circ P + \sin 80^\circ T_{AB} - 200\ \text{lb} = 0 \qquad (2)$

From (1) $\quad T_{AB} = \dfrac{\cos 50^\circ P}{\cos 80^\circ} \qquad (3)$

Subst. (3) into (2)

$$-\sin 50^\circ P + \sin 80^\circ \left[\frac{\cos 50^\circ P}{\cos 80^\circ}\right] = 200\ \text{lb}$$

$$P = \frac{200\ \text{lb}}{\left[-\sin 50^\circ + \dfrac{\sin 80^\circ \cos 50^\circ}{\cos 80^\circ}\right]}$$

$$= \frac{200\ \text{lb}}{2.88}$$

$$= 69.5\ \text{lb}$$