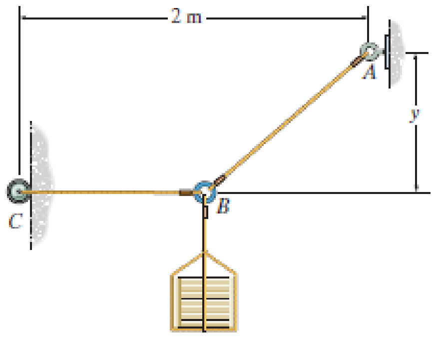
•3–1. Determine the force in each cord for equilibrium of the 200-kg crate. Cord remains horizontal due to the roller at C, and AB has a length of 1.5 m. Set y = 0.75 m.BC

•3–1. Determine the force in each cord for equilibrium of the 200-kg crate. Cord *BC* remains horizontal due to the roller at *C*, and *AB* has a length of 1.5 m. Set $y = 0.75$ m.



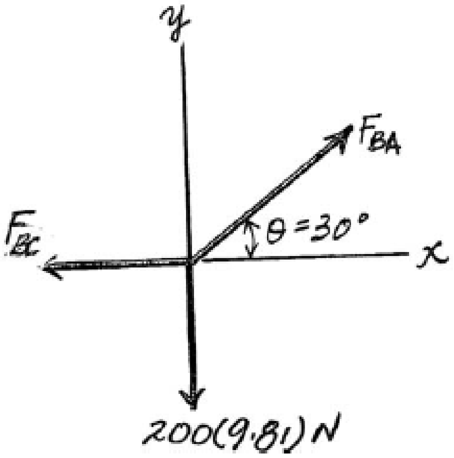
Geometry: From the geometry of the figure,

$$\theta = \sin^{-1}\left(\frac{0.75}{1.5}\right) = 30°$$

Equations of Equilibrium: Applying the equations of equilibrium to the free - body diagram in Fig. (*a*),

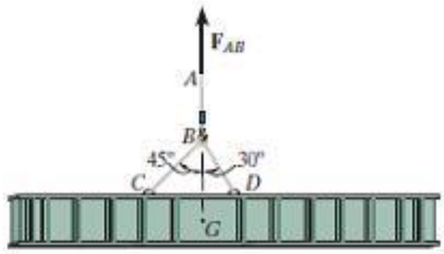
$+\uparrow \Sigma F_y = 0;$ $\quad F_{BA}\sin 30° - 200(9.81) = 0 \quad F_{BA} = 3924\text{ N} = 3.92\text{ kN}$ **Ans.**

$\overset{+}{\rightarrow} \Sigma F_x = 0;$ $\quad 3924\cos 30° - F_{BC} = 0 \quad F_{BC} = 3398.28\text{ N} = 3.40\text{ kN}$ **Ans.**



3–3. If the mass of the girder is and its center of mass is located at point *G*, determine the tension developed in cables AB, BC, and BD for equilibrium. 3 Mg

3–3. If the mass of the girder is 3 Mg and its center of mass is located at point *G*, determine the tension developed in cables *AB*, *BC*, and *BD* for equilibrium.



Equations of Equilibrium: The girder is suspended from cable *AB*. In order to meet the conditions of equilibrium the tensile force developed in cable *AB* must be equal to the weight of the girder. Thus,

$F_{AB} = 3000(9.81) = 29\,430\text{ N} = 29.43\text{ kN} = 29.4\text{ kN}$ **Ans.**

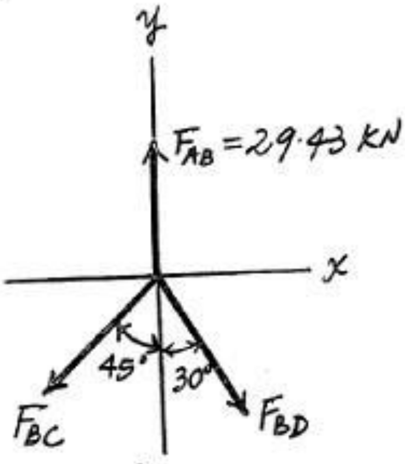
Applying the equations of equilibrium along the *x* and *y* axes to the free - body diagram in Fig. (*a*),

$\overset{+}{\rightarrow}\Sigma F_x = 0;$ $F_{BD}\sin 30° - F_{BC}\sin 45° = 0$ (1)

$+\uparrow \Sigma F_y = 0;$ $29.43 - F_{BD}\cos 30° - F_{BC}\cos 45° = 0$ (2)

Solving Eqs. (1) and (2), yields

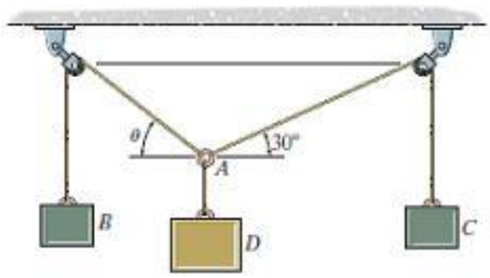
$F_{BC} = 15.2\text{ kN}$ $F_{BD} = 21.5\text{ kN}$ **Ans.**



(a)

***3–12.** If block weighs and block weighs , determine the required weight of block and the angle for equilibrium.D u B 200 lb C 100

*3–12. If block B weighs 200 lb and block C weighs 100 lb, determine the required weight of block D and the angle θ for equilibrium.



Equations of Equilibrium: Applying the equations of equilibrium along the x and y axes to the free-body diagram shown in Fig. (a),

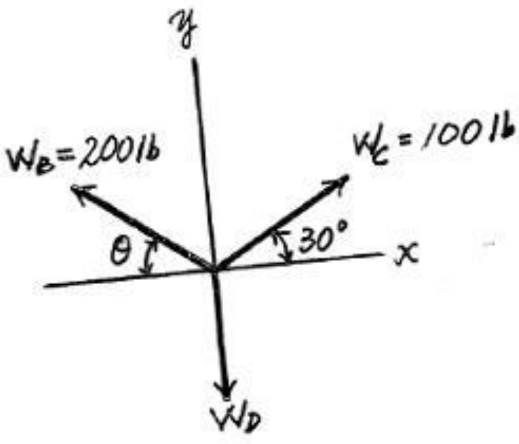
$\overset{+}{\rightarrow}\Sigma F_x = 0;$ $100\cos 30° - 200\cos\theta = 0$

$\theta = 64.34° = 64.3°$ **Ans.**

Using this result and writing the equation of equilibrium along the y axis, yields

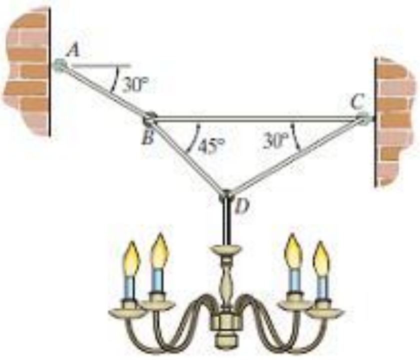
$+\uparrow \Sigma F_y = 0;$ $100\sin 30° + 200\sin 64.34° - W_D = 0$

$W_D = 230\text{ lb}$ **Ans.**



•**3–21.** If the tension developed in each of the four wires is not allowed to exceed , determine the maximum mass of the chandelier that can be supported. 600

•**3–21.** If the tension developed in each of the four wires is not allowed to exceed 600 N, determine the maximum mass of the chandelier that can be supported.



Equations of Equilibrium: First, we will apply the equation of equilibrium along the x and y axes to the free-body diagram of joint D shown in Fig. (a).

$$\xrightarrow{+} \Sigma F_x = 0; \quad F_{CD}\cos 30° - F_{BD}\cos 45° = 0 \quad (1)$$

$$+\uparrow \Sigma F_y = 0; \quad F_{CD}\sin 30° + F_{BD}\sin 45° - m(9.81) = 0 \quad (2)$$

Solving Eqs. (1) and (2), yields

$$F_{CD} = 7.1814m \qquad F_{BD} = 8.7954m$$

Using the result $F_{BD} = 8.7954m$ and applying the equation of equilibrium along the x and y axes to the free-body diagram of joint B shown in Fig. (b).

$$+\uparrow \Sigma F_y = 0; \quad F_{AB}\sin 30° - 8.7954m\sin 45° = 0$$

$$F_{AB} = 12.4386m$$

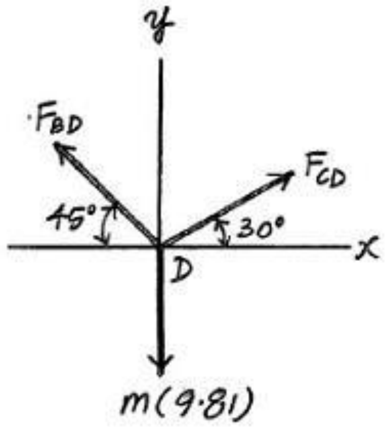
$$\xrightarrow{+} \Sigma F_x = 0; \quad F_{BC} + 8.7954m\cos 45° - 12.4386m\cos 30° = 0$$

$$F_{BC} = 4.5528m$$

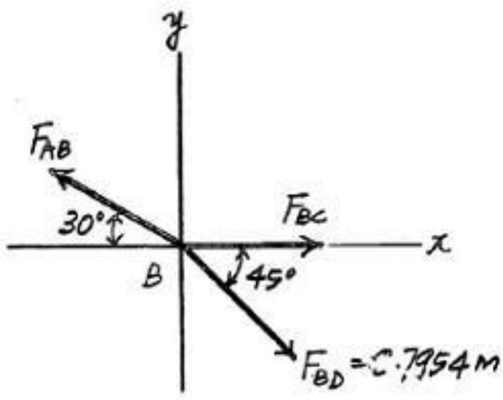
From this result, notice that cable AB is subjected to the greatest tensile force. Thus, it will achieve the maximum allowable tensile force first.

$$F_{AB} = 600 = 12.4386m$$

$$m = 48.2 \text{ kg} \qquad \textbf{Ans.}$$



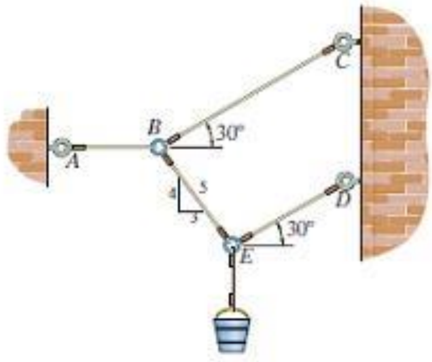
(a)



(b)

*__3–24.__ If the bucket weighs 50 lb, determine the tension developed in each of the wires.

*3–24. If the bucket weighs 50 lb, determine the tension developed in each of the wires.



Equations of Equilibrium: First, we will apply the equation of equilibrium along the x and y axes to the free-body diagram of joint E shown in Fig. (a).

$$\overset{+}{\rightarrow}\Sigma F_x = 0; \qquad F_{ED}\cos 30^\circ - F_{EB}\left(\frac{3}{5}\right) = 0 \qquad (1)$$

$$+\uparrow \Sigma F_y = 0; \qquad F_{ED}\sin 30^\circ + F_{EB}\left(\frac{4}{5}\right) - 50 = 0 \qquad (2)$$

Solving Eqs. (1) and (2), yields

$F_{ED} = 30.2\text{ lb}$ $\qquad F_{EB} = 43.61\text{ lb} = 43.6\text{ lb}$ **Ans.**

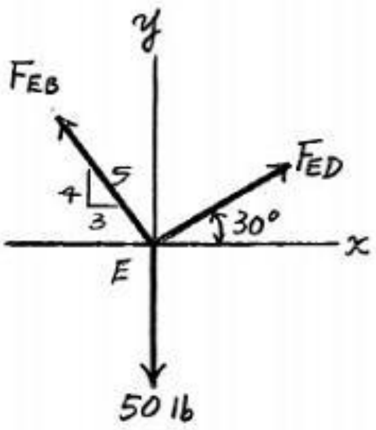
Using the result $F_{EB} = 43.61$ lb and applying the equation of equilibrium to the free-body diagram of joint B shown in Fig. (b),

$$+\uparrow \Sigma F_y = 0; \qquad F_{BC}\sin 30^\circ - 43.61\left(\frac{4}{5}\right) = 0$$

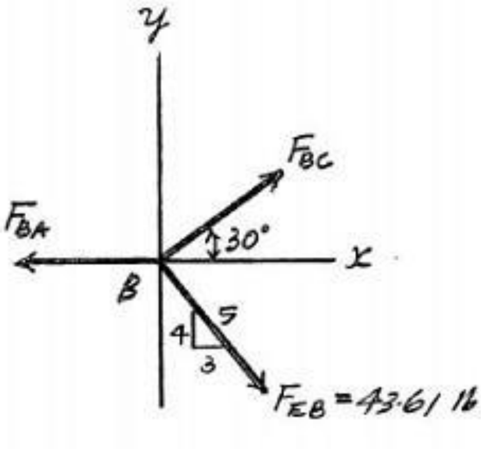
$F_{BC} = 69.78\text{ lb} = 69.8\text{ lb}$ **Ans.**

$$\overset{+}{\rightarrow}\Sigma F_x = 0; \qquad 69.78\cos 30^\circ + 43.61\left(\frac{3}{5}\right) - F_{BA} = 0$$

$F_{BA} = 86.6\text{ lb}$ **Ans.**



(a)



(b)