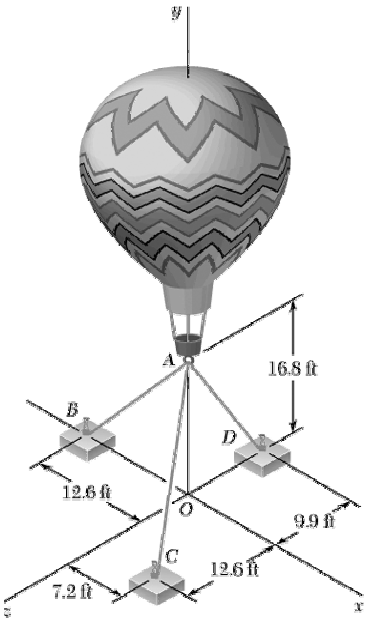
PROBLEM 2.104



Three cables are used to tether a balloon as shown. Determine the vertical force **P** exerted by the balloon at *A* knowing that the tension in cable *AC* is 100 lb.

SOLUTION

See Problem 2.103 for the figure and the analysis leading to the linear algebraic Equations (1), (2), and (3) below:

$$-0.6T_{AB} + 0.3242T_{AC} = 0 \tag{1}$$

$$-0.8T_{AB} - 0.75676T_{AC} - 0.8615T_{AD} + P = 0 \tag{2}$$

$$0.56757T_{AC} - 0.50769T_{AD} = 0 \tag{3}$$

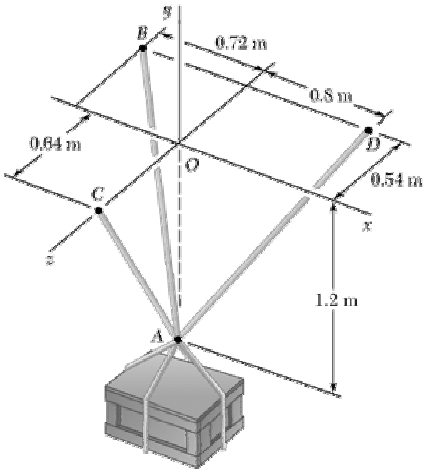
Substituting $T_{AC} = 100$ lb in Equations (1), (2), and (3) above, and solving the resulting set of equations using conventional algorithms gives

$$T_{AB} = 54 \text{ lb}$$

$$T_{AD} = 112 \text{ lb}$$

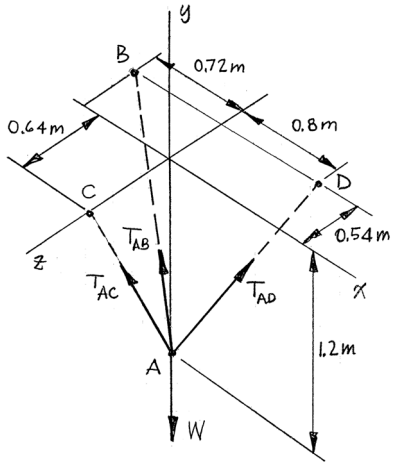
$$\mathbf{P} = 215 \text{ lb} \uparrow \blacktriangleleft$$

PROBLEM 2.105



The crate shown in Figure P2.105 and P2.108 is supported by three cables. Determine the weight of the crate knowing that the tension in cable *AB* is 3 kN.

SOLUTION



The forces applied at *A* are:

$$\mathbf{T}_{AB},\ \mathbf{T}_{AC},\ \mathbf{T}_{AD} \text{ and } \mathbf{P}$$

where $\mathbf{P} = P\mathbf{j}$. To express the other forces in terms of the unit vectors **i**, **j**, **k**, we write

$$\overrightarrow{AB} = -(0.72\text{ m})\mathbf{i} + (1.2\text{ m})\mathbf{j} - (0.54\text{ m})\mathbf{k}, \qquad AB = 1.5\text{ m}$$

$$\overrightarrow{AC} = (1.2\text{ m})\mathbf{j} + (0.64\text{ m})\mathbf{k}, \qquad AC = 1.36\text{ m}$$

$$\overrightarrow{AD} = (0.8\text{ m})\mathbf{i} + (1.2\text{ m})\mathbf{j} - (0.54\text{ m})\mathbf{k}, \qquad AD = 1.54\text{ m}$$

and $$\mathbf{T}_{AB} = T_{AB}\boldsymbol{\lambda}_{AB} = T_{AB}\frac{\overrightarrow{AB}}{AB} = (-0.48\mathbf{i} + 0.8\mathbf{j} - 0.36\mathbf{k})T_{AB}$$

$$\mathbf{T}_{AC} = T_{AC}\boldsymbol{\lambda}_{AC} = T_{AC}\frac{\overrightarrow{AC}}{AC} = (0.88235\mathbf{j} + 0.47059\mathbf{k})T_{AC}$$

$$\mathbf{T}_{AD} = T_{AD}\boldsymbol{\lambda}_{AD} = T_{AD}\frac{\overrightarrow{AD}}{AD} = (0.51948\mathbf{i} + 0.77922\mathbf{j} - 0.35065\mathbf{k})T_{AD}$$

Equilibrium Condition with $\mathbf{W} = -W\mathbf{j}$

$$\Sigma F = 0: \quad \mathbf{T}_{AB} + \mathbf{T}_{AC} + \mathbf{T}_{AD} - W\mathbf{j} = 0$$

Substituting the expressions obtained for $\mathbf{T}_{AB}$, $\mathbf{T}_{AC}$, and $\mathbf{T}_{AD}$ and factoring **i**, **j**, and **k**:

$$(-0.48T_{AB} + 0.51948T_{AD})\mathbf{i} + (0.8T_{AB} + 0.88235T_{AC} + 0.77922T_{AD} - W)\mathbf{j}$$

$$+ (-0.36T_{AB} + 0.47059T_{AC} - 0.35065T_{AD})\mathbf{k} = 0$$

PROBLEM 2.105 CONTINUED

Equating to zero the coefficients of **i**, **j**, **k**:

$$-0.48T_{AB} + 0.51948T_{AD} = 0$$

$$0.8T_{AB} + 0.88235T_{AC} + 0.77922T_{AD} - W = 0$$

$$-0.36T_{AB} + 0.47059T_{AC} - 0.35065T_{AD} = 0$$

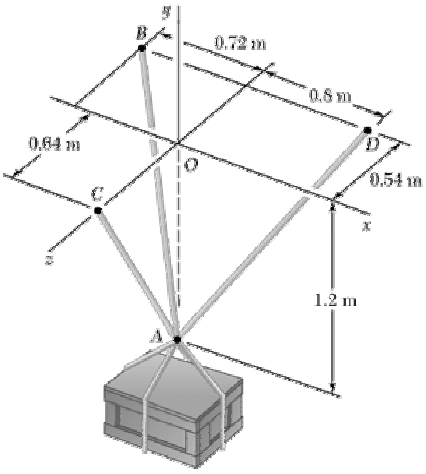
Substituting $T_{AB} = 3$ kN in Equations (1), (2) and (3) and solving the resulting set of equations, using conventional algorithms for solving linear algebraic equations, gives

$$T_{AC} = 4.3605 \text{ kN}$$

$$T_{AD} = 2.7720 \text{ kN}$$

$$W = 8.41 \text{ kN} \blacktriangleleft$$

PROBLEM 2.106



For the crate of Problem 2.105, determine the weight of the crate knowing that the tension in cable *AD* is 2.8 kN.

Problem 2.105: The crate shown in Figure P2.105 and P2.108 is supported by three cables. Determine the weight of the crate knowing that the tension in cable *AB* is 3 kN.

SOLUTION

See Problem 2.105 for the figure and the analysis leading to the linear algebraic Equations (1), (2), and (3) below:

$$-0.48T_{AB} + 0.51948T_{AD} = 0$$

$$0.8T_{AB} + 0.88235T_{AC} + 0.77922T_{AD} - W = 0$$

$$-0.36T_{AB} + 0.47059T_{AC} - 0.35065T_{AD} = 0$$

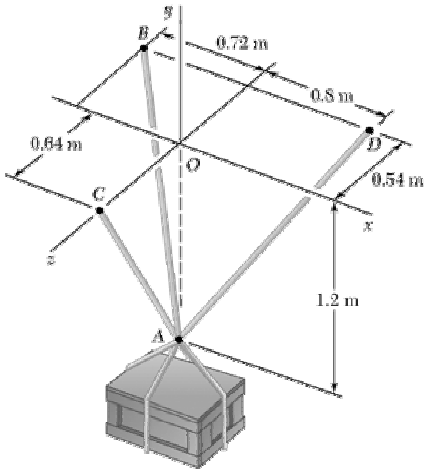
Substituting $T_{AD} = 2.8$ kN in Equations (1), (2), and (3) above, and solving the resulting set of equations using conventional algorithms, gives

$$T_{AB} = 3.03 \text{ kN}$$

$$T_{AC} = 4.40 \text{ kN}$$

$$W = 8.49 \text{ kN} \blacktriangleleft$$

PROBLEM 2.107



For the crate of Problem 2.105, determine the weight of the crate knowing that the tension in cable *AC* is 2.4 kN.

Problem 2.105: The crate shown in Figure P2.105 and P2.108 is supported by three cables. Determine the weight of the crate knowing that the tension in cable *AB* is 3 kN.

SOLUTION

See Problem 2.105 for the figure and the analysis leading to the linear algebraic Equations (1), (2), and (3) below:

$$-0.48T_{AB} + 0.51948T_{AD} = 0$$

$$0.8T_{AB} + 0.88235T_{AC} + 0.77922T_{AD} - W = 0$$

$$-0.36T_{AB} + 0.47059T_{AC} - 0.35065T_{AD} = 0$$

Substituting $T_{AC} = 2.4$ kN in Equations (1), (2), and (3) above, and solving the resulting set of equations using conventional algorithms, gives

$$T_{AB} = 1.651 \text{ kN}$$

$$T_{AD} = 1.526 \text{ kN}$$

$$W = 4.63 \text{ kN} \blacktriangleleft$$