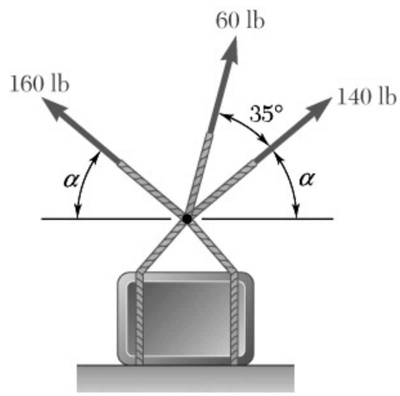
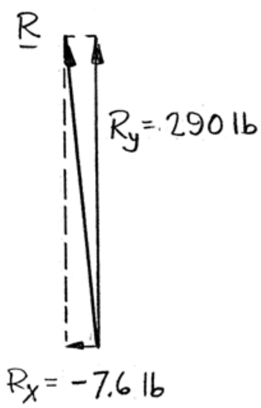
PROBLEM 2.38



Knowing that $\alpha = 50°$, determine the resultant of the three forces shown.

SOLUTION



The resultant force *R* has the *x*- and *y*-components:

$$R_x = \Sigma F_x = (140\text{ lb})\cos 50° + (60\text{ lb})\cos 85° - (160\text{ lb})\cos 50°$$

$$R_x = -7.6264\text{ lb}$$

and

$$R_y = \Sigma F_y = (140\text{ lb})\sin 50° + (60\text{ lb})\sin 85° + (160\text{ lb})\sin 50°$$

$$R_y = 289.59\text{ lb}$$

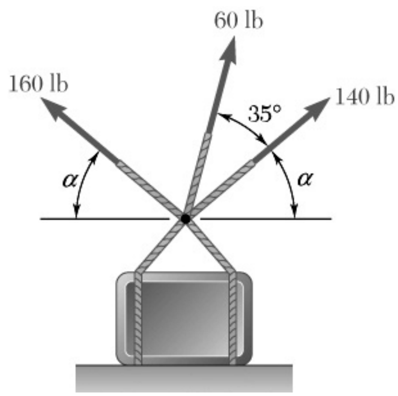
Further:

$$\tan\alpha = \frac{290}{7.6}$$

$$\alpha = \tan^{-1}\frac{290}{7.6} = 88.5°$$

Thus: $\mathbf{R} = 290\text{ lb}$ 88.5° ◀

PROBLEM 2.39



Determine (*a*) the required value of α if the resultant of the three forces shown is to be vertical, (*b*) the corresponding magnitude of the resultant.

SOLUTION

For an arbitrary angle α, we have:

$$R_x = \Sigma F_x = (140 \text{ lb})\cos\alpha + (60 \text{ lb})\cos(\alpha + 35°) - (160 \text{ lb})\cos\alpha$$

(*a*) So, for *R* to be vertical:

$$R_x = \Sigma F_x = (140 \text{ lb})\cos\alpha + (60 \text{ lb})\cos(\alpha + 35°) - (160 \text{ lb})\cos\alpha = 0$$

Expanding,

$$-\cos\alpha + 3(\cos\alpha\cos 35° - \sin\alpha\sin 35°) = 0$$

Then:

$$\tan\alpha = \frac{\cos 35° - \frac{1}{3}}{\sin 35°}$$

or

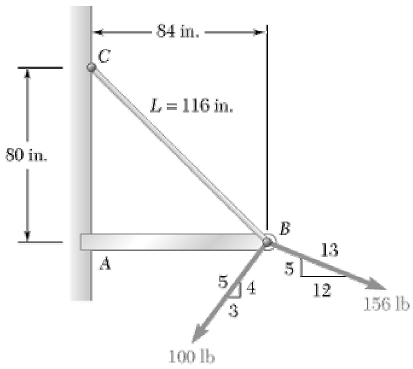
$$\alpha = \tan^{-1}\left(\frac{\cos 35° - \frac{1}{3}}{\sin 35°}\right) = 40.265° \qquad \alpha = 40.3° \blacktriangleleft$$

(*b*) Now:

$$R = R_y = \Sigma F_y = (140 \text{ lb})\sin 40.265° + (60 \text{ lb})\sin 75.265° + (160 \text{ lb})\sin 40.265°$$

$$R = |R| = 252 \text{ lb} \blacktriangleleft$$

PROBLEM 2.40



For the beam of Problem 2.37, determine (*a*) the required tension in cable *BC* if the resultant of the three forces exerted at point *B* is to be vertical, (*b*) the corresponding magnitude of the resultant.

Problem 2.37: Knowing that the tension in cable *BC* is 145 lb, determine the resultant of the three forces exerted at point *B* of beam *AB*.

SOLUTION

We have:

$$R_x = \Sigma F_x = -\frac{84}{116}T_{BC} + \frac{12}{13}(156 \text{ lb}) - \frac{3}{5}(100 \text{ lb})$$

or

$$R_x = -0.724T_{BC} + 84 \text{ lb}$$

and

$$R_y = \Sigma F_y = \frac{80}{116}T_{BC} - \frac{5}{13}(156 \text{ lb}) - \frac{4}{5}(100 \text{ lb})$$

$$R_y = 0.6897T_{BC} - 140 \text{ lb}$$

(*a*) So, for *R* to be vertical,

$$R_x = -0.724T_{BC} + 84 \text{ lb} = 0$$

$$T_{BC} = 116.0 \text{ lb} \blacktriangleleft$$

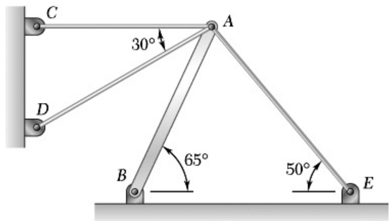
(*b*) Using

$$T_{BC} = 116.0 \text{ lb}$$

$$R = R_y = 0.6897(116.0 \text{ lb}) - 140 \text{ lb} = -60 \text{ lb}$$

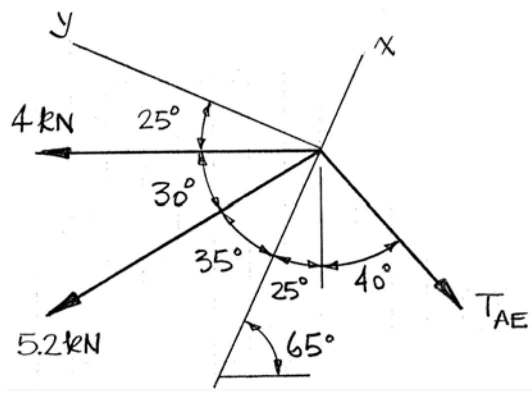
$$R = |R| = 60.0 \text{ lb} \blacktriangleleft$$

PROBLEM 2.41



Boom AB is held in the position shown by three cables. Knowing that the tensions in cables AC and AD are 4 kN and 5.2 kN, respectively, determine (*a*) the tension in cable AE if the resultant of the tensions exerted at point A of the boom must be directed along AB, (*b*) the corresponding magnitude of the resultant.

SOLUTION



Choose x-axis along bar AB.

Then

(*a*) Require

$$R_y = \Sigma F_y = 0: \quad (4\text{ kN})\cos 25° + (5.2\text{ kN})\sin 35° - T_{AE}\sin 65° = 0$$

or

$$T_{AE} = 7.2909\text{ kN}$$

$$T_{AE} = 7.29\text{ kN} \blacktriangleleft$$

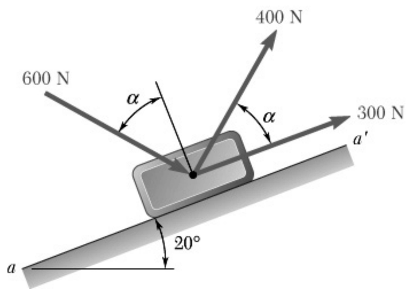
(*b*)

$$R = \Sigma F_x$$

$$= -(4\text{ kN})\sin 25° - (5.2\text{ kN})\cos 35° - (7.2909\text{ kN})\cos 65°$$

$$= -9.03\text{ kN}$$

$$|R| = 9.03\text{ kN} \blacktriangleleft$$



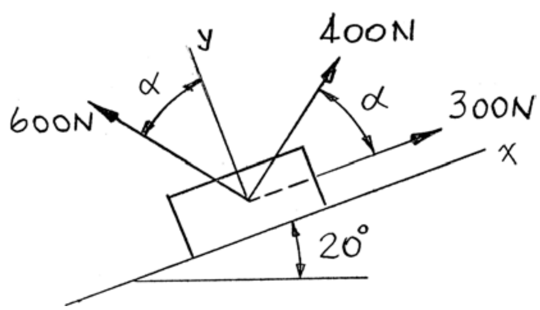
PROBLEM 2.42

For the block of Problems 2.35 and 2.36, determine (*a*) the required value of α of the resultant of the three forces shown is to be parallel to the incline, (*b*) the corresponding magnitude of the resultant.

Problem 2.35: Knowing that $\alpha = 35°$, determine the resultant of the three forces shown.

Problem 2.36: Knowing that $\alpha = 65°$, determine the resultant of the three forces shown.

SOLUTION



Selecting the x axis along aa', we write

$$R_x = \Sigma F_x = 300\text{ N} + (400\text{ N})\cos\alpha + (600\text{ N})\sin\alpha \tag{1}$$

$$R_y = \Sigma F_y = (400\text{ N})\sin\alpha - (600\text{ N})\cos\alpha \tag{2}$$

(*a*) Setting $R_y = 0$ in Equation (2):

Thus $$\tan\alpha = \frac{600}{400} = 1.5$$

$$\alpha = 56.3° \blacktriangleleft$$

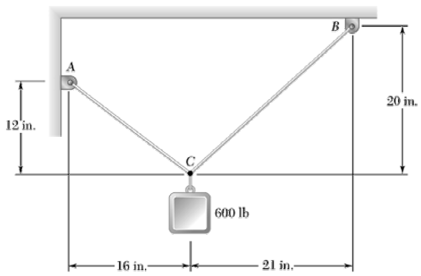
(*b*) Substituting for α in Equation (1):

$$R_x = 300\text{ N} + (400\text{ N})\cos 56.3° + (600\text{ N})\sin 56.3°$$

$$R_x = 1021.1\text{ N}$$

$$R = R_x = 1021\text{ N} \blacktriangleleft$$

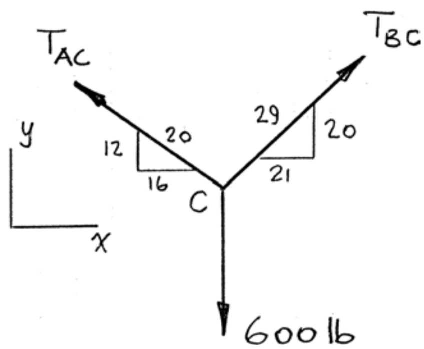
PROBLEM 2.43



Two cables are tied together at C and are loaded as shown. Determine the tension (a) in cable AC, (b) in cable BC.

SOLUTION

Free-Body Diagram



From the geometry, we calculate the distances:

$$AC = \sqrt{(16 \text{ in.})^2 + (12 \text{ in.})^2} = 20 \text{ in.}$$

$$BC = \sqrt{(20 \text{ in.})^2 + (21 \text{ in.})^2} = 29 \text{ in.}$$

Then, from the Free Body Diagram of point C:

$$\xrightarrow{+} \Sigma F_x = 0: \quad -\frac{16}{20}T_{AC} + \frac{21}{29}T_{BC} = 0$$

or

$$T_{BC} = \frac{29}{21} \times \frac{4}{5} T_{AC}$$

and

$$+\uparrow \Sigma F_y = 0: \quad \frac{12}{20}T_{AC} + \frac{20}{29}T_{BC} - 600 \text{ lb} = 0$$

or

$$\frac{12}{20}T_{AC} + \frac{20}{29}\left(\frac{29}{21} \times \frac{4}{5}T_{AC}\right) - 600 \text{ lb} = 0$$

Hence:

$$T_{AC} = 440.56 \text{ lb}$$

(a) $T_{AC} = 441 \text{ lb}$ ◀

(b) $T_{BC} = 487 \text{ lb}$ ◀