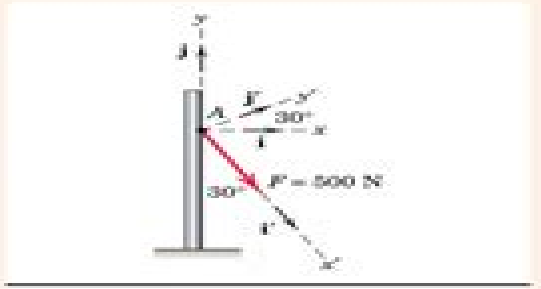
Sample Problem 2/3

The 500-N force **F** is applied to the vertical pole as shown. (1) Write **F** in terms of the unit vectors **i** and **j** and identify both its vector and scalar components. (2) Determine the scalar components of the force vector **F** along the x'- and y'-axes. (3) Determine the scalar components of **F** along the x- and y'-axes.



Solution. ***Part (1).*** From Fig. *a* we may write **F** as

$$\mathbf{F} = (F\cos\theta)\mathbf{i} - (F\sin\theta)\mathbf{j}$$
$$= (500\cos 60^\circ)\mathbf{i} - (500\sin 60^\circ)\mathbf{j}$$
$$= (250\mathbf{i} - 433\mathbf{j})\ \text{N} \qquad \text{Ans.}$$

The scalar components are $F_x = 250$ N and $F_y = -433$ N. The vector components are $\mathbf{F}_x = 250\mathbf{i}$ N and $\mathbf{F}_y = -433\mathbf{j}$ N.

Part (2). From Fig. *b* we may write **F** as $\mathbf{F} = 500\mathbf{i}'$ N, so that the required scalar components are

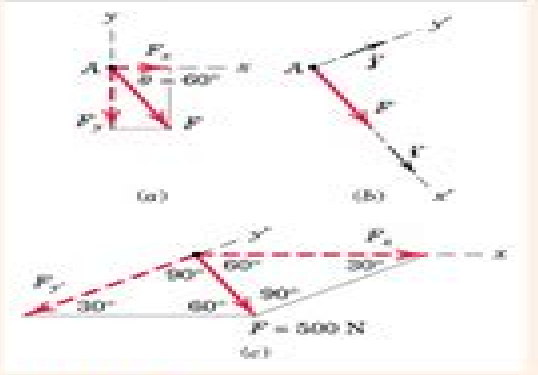
$$F_{x'} = 500\ \text{N} \qquad F_{y'} = 0 \qquad \text{Ans.}$$

Part (3). The components of **F** in the x- and y'-directions are nonrectangular and are obtained by completing the parallelogram as shown in Fig. *c*. The magnitudes of the components may be calculated by the law of sines. Thus,

① $$\frac{|F_x|}{\sin 90^\circ} = \frac{500}{\sin 30^\circ} \qquad |F_x| = 1000\ \text{N}$$
$$\frac{|F_{y'}|}{\sin 60^\circ} = \frac{500}{\sin 30^\circ} \qquad |F_{y'}| = 866\ \text{N}$$

The required scalar components are then

$$F_x = 1000\ \text{N} \qquad F_{y'} = -866\ \text{N} \qquad \text{Ans.}$$

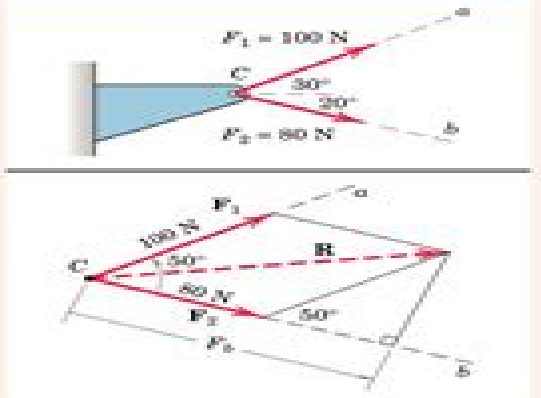


Helpful Hint

① Obtain F_x and $F_{y'}$ graphically and compare your results with the calculated values.

Sample Problem 2/4

Forces $\mathbf{F}_1$ and $\mathbf{F}_2$ act on the bracket as shown. Determine the projection P_b of their resultant **R** onto the b-axis.



Solution. The parallelogram addition of $\mathbf{F}_1$ and $\mathbf{F}_2$ is shown in the figure. Using the law of cosines gives us

$$R^2 = (80)^2 + (100)^2 - 2(80)(100)\cos 130^\circ \qquad R = 163.4\ \text{N}$$

The figure also shows the orthogonal projection $\mathbf{P}_b$ of **R** onto the b-axis. Its length is

$$P_b = 80 + 100\cos 50^\circ = 144.3\ \text{N} \qquad \text{Ans.}$$

Note that the components of a vector are in general not equal to the projections of the vector onto the same axes. If the a-axis had been perpendicular to the b-axis, then the projections and components of **R** would have been equal.

Meriam Statics Chapter Chapter 3 Solutions

Yijin Wang

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