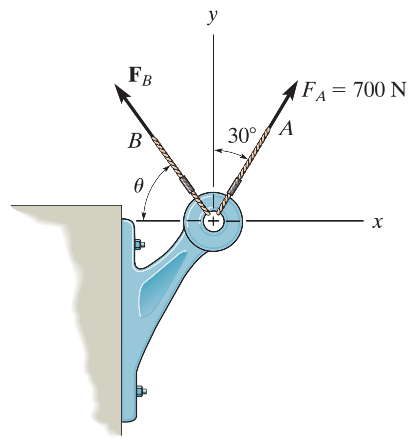
***2–52.**

Determine the magnitude and orientation, measured counterclockwise from the positive y axis, of the resultant force acting on the bracket, if $F_B = 600$ N and $\theta = 20°$.



SOLUTION

Scalar Notation: Suming the force components algebraically, we have

$$\overset{+}{\rightarrow} F_{R_x} = \Sigma F_x; \quad F_{R_x} = 700 \sin 30° - 600 \cos 20°$$

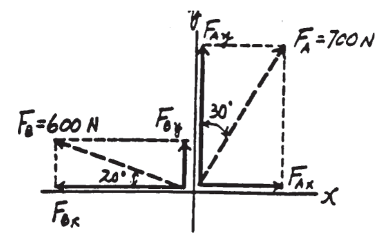
$$= -213.8 \text{ N} = 213.8 \text{ N} \leftarrow$$

$$+\uparrow F_{R_y} = \Sigma F_y; \quad F_{R_y} = 700 \cos 30° + 600 \sin 20°$$

$$= 811.4 \text{ N} \uparrow$$

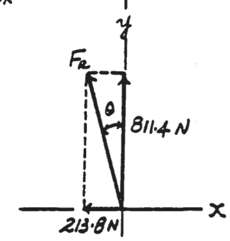
The magnitude of the resultant force $\mathbf{F}_R$ is

$$F_R = \sqrt{F_{R_x}^2 + F_{R_y}^2} = \sqrt{213.8^2 + 811.4^2} = 839 \text{ N} \qquad \textbf{Ans.}$$



The directional angle θ measured counterclockwise from positive y axis is

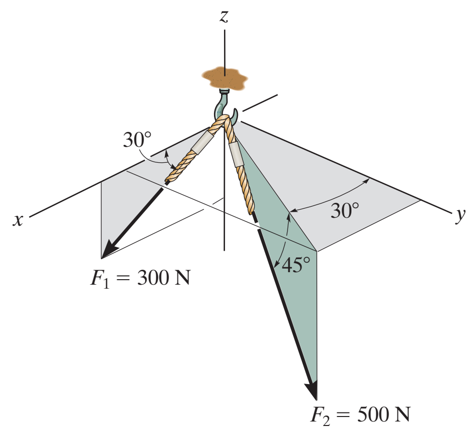
$$\theta = \tan^{-1}\frac{F_{R_x}}{F_{R_y}} = \tan^{-1}\left(\frac{213.8}{811.4}\right) = 14.8° \qquad \textbf{Ans.}$$



Ans:
$F_R = 839$ N
$\theta = 14.8°$

***2–80.**

Express each force as a Cartesian vector.



SOLUTION

Rectangular Components: By referring to Figs. *a* and *b*, the *x*, *y*, and *z* components of $\mathbf{F}_1$ and $\mathbf{F}_2$ can be written as

$(F_1)_x = 300 \cos 30° = 259.8$ N $\qquad (F_2)_x = 500 \cos 45° \sin 30° = 176.78$ N

$(F_1)_y = 0 \qquad (F_2)_y = 500 \cos 45° \cos 30° = 306.19$ N

$(F_1)_t = 300 \sin 30° = 150$ N $\qquad (F_2)_z = 500 \sin 45° = 353.55$ N

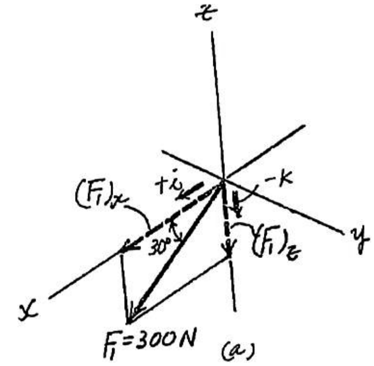
Thus, $\mathbf{F}_1$ and $\mathbf{F}_2$ can be written in Cartesian vector form as

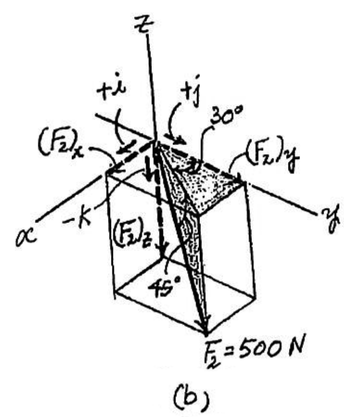
$$\mathbf{F}_1 = 259.81(+\mathbf{i}) + 0\mathbf{j} + 150(-\mathbf{k})$$

$$= \{260\mathbf{i} - 150\mathbf{k}\} \text{ N} \qquad \textbf{Ans.}$$

$$\mathbf{F}_2 = 176.78(+\mathbf{i}) + 306.19(+\mathbf{j}) + 353.55(-\mathbf{k})$$

$$= \{177\mathbf{i} + 306\mathbf{j} - 354\mathbf{k}\} \text{ N} \qquad \textbf{Ans.}$$

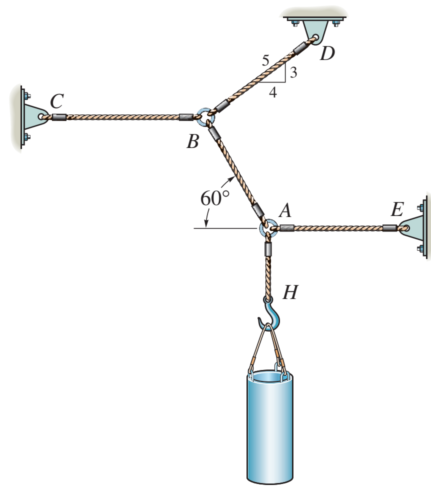




Ans:
$\mathbf{F}_1 = \{260\mathbf{i} - 150\mathbf{k}\}$ N
$\mathbf{F}_2 = 2\{177\mathbf{i} + 306\mathbf{j} - 354\mathbf{k}\}$ N

3–34.

The 30-kg pipe is supported at A by a system of five cords. Determine the force in each cord for equilibrium.



SOLUTION

At *H*:

$+\uparrow \Sigma F_y = 0; \qquad T_{HA} - 30(9.81) = 0$

$T_{HA} = 294 \text{ N}$ **Ans.**

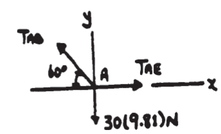
At *A*:

$+\uparrow \Sigma F_y = 0; \qquad T_{AB} \sin 60° - 30(9.81) = 0$

$T_{AB} = 339.83 = 340 \text{ N}$ **Ans.**

$\overset{+}{\rightarrow} \Sigma F_x = 0; \qquad T_{AE} - 339.83 \cos 60° = 0$

$T_{AE} = 170 \text{ N}$ **Ans.**



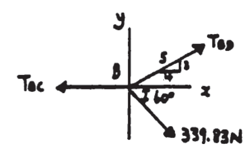
At *B*:

$+\uparrow \Sigma F_y = 0; \qquad T_{BD}\left(\frac{3}{5}\right) - 339.83 \sin 60° = 0$

$T_{BD} = 490.50 = 490 \text{ N}$ **Ans.**

$\overset{+}{\rightarrow} \Sigma F_x = 0; \qquad 490.50\left(\frac{4}{5}\right) + 339.83 \cos 60° - T_{BC} = 0$

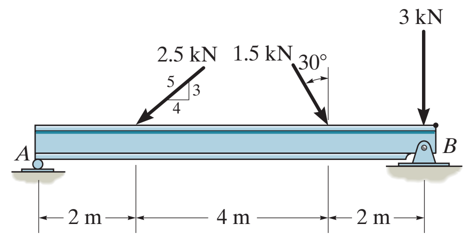
$T_{BC} = 562 \text{ N}$ **Ans.**



Ans:
$T_{HA} = 294 \text{ N}$
$T_{AB} = 340 \text{ N}$
$T_{AE} = 170 \text{ N}$
$T_{BD} = 490 \text{ N}$
$T_{BC} = 562 \text{ N}$

***4–104.**

Replace the force system acting on the beam by an equivalent force and couple moment at point B.



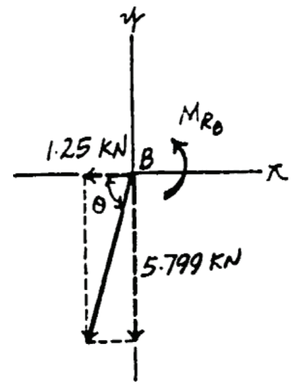
SOLUTION

$$\xrightarrow{+} F_{R_x} = \Sigma F_x; \qquad F_{R_x} = 1.5 \sin 30° - 2.5\left(\frac{4}{5}\right)$$

$$= -1.25 \text{ kN} = 1.25 \text{ kN} \leftarrow$$

$$+\uparrow F_{R_y} = \Sigma F_y; \qquad F_{R_y} = -1.5 \cos 30° - 2.5\left(\frac{3}{5}\right) - 3$$

$$= -5.799 \text{ kN} = 5.799 \text{ kN} \downarrow$$



Thus,

$$F_R = \sqrt{F_{R_x}^2 + F_{R_y}^2} = \sqrt{1.25^2 + 5.799^2} = 5.93 \text{ kN}$$ **Ans.**

and

$$\theta = \tan^{-1}\left(\frac{F_{R_y}}{F_{R_x}}\right) = \tan^{-1}\left(\frac{5.799}{1.25}\right) = 77.8° \;\measuredangle$$ **Ans.**

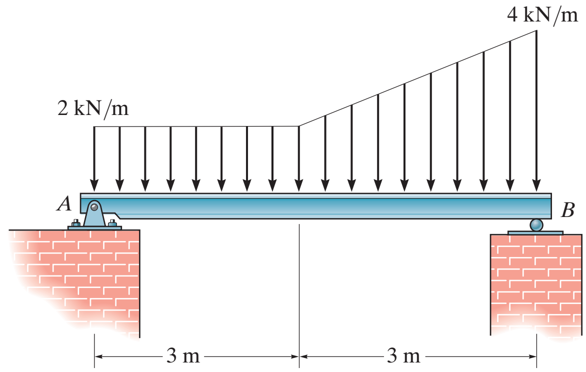
$$\circlearrowleft + M_{R_B} = \Sigma M_{R_B}; \qquad M_B = 1.5\cos 30°(2) + 2.5\left(\frac{3}{5}\right)(6)$$

$$= 11.6 \text{ kN}\cdot\text{m} \quad \textbf{(\textit{Counterclockwise})}$$ **Ans.**

Ans:
$F_R = 5.93$ kN
$\theta = 77.8° \;\measuredangle$
$\circlearrowleft + M_{R_B} = 11.6$ kN·m **(*Counterclockwise*)**

4–147.

Replace the distributed loading by an equivalent resultant force, and specify its location on the beam, measured from the pin at A.



SOLUTION

Equivalent Resultant Force. Summing the forces along the y axis by referring to Fig. a,

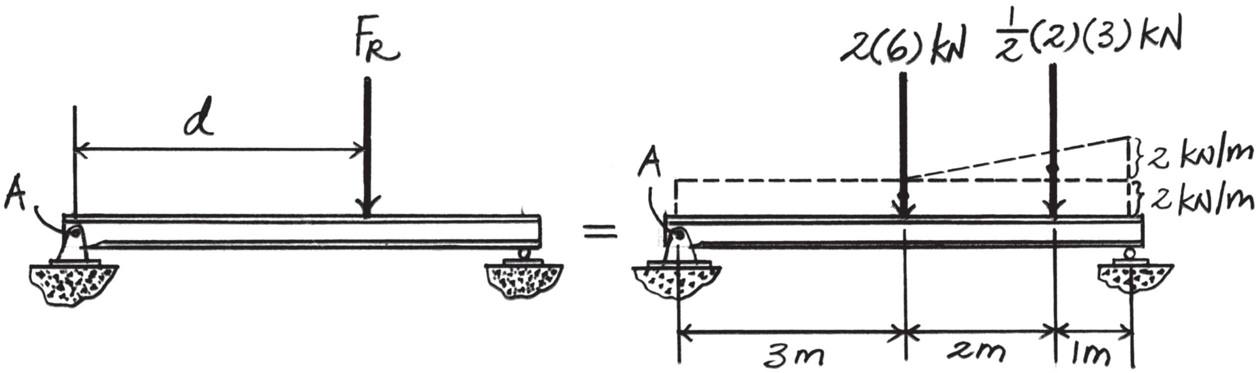
$$+\uparrow (F_R)_y = \Sigma F_y; \quad -F_R = -2(6) - \frac{1}{2}(2)(3)$$

$$F_R = 15.0 \text{ kN} \downarrow \qquad \textbf{Ans.}$$

Location of the Resultant Force. Summing the Moments about point A,

$$\circlearrowleft + (M_R)_A = \Sigma M_A; \quad -15.0(d) = -2(6)(3) - \frac{1}{2}(2)(3)(5)$$

$$d = 3.40 \text{ m} \qquad \textbf{Ans.}$$



(a)

Ans:
$F_R = 15.0$ kN
$d = 3.40$ m