5-29 Determine the support reactions on the beam.

5-30 Determine the support reactions on the beam.

5-29

$+\sum M_A = 0;$ $N_B \cos 60^o\,(24) - 60(12) - 600 = 0$

$N_B = 110$ kip Ans

$\xrightarrow{+}\sum F_x = 0;$ $A_x - 110 \sin 60^o = 0$ $A_x = 95.3$ kip Ans

$+\uparrow \sum F_y = 0;$ $A_y + 110 \cos 60^o - 60 = 0$ $A_y = 5.0$ kip Ans

5-30

$+\sum M_A = 0;$ $B_y\,(9) - 20(3) - 20(6) - 20(9) - 20(12) - \sin 60^o(15) = 0$

$B_y = 78.2$ kN Ans

$\xrightarrow{+}\sum F_x = 0;$ $-A_x + 8 \cos 60^o = 0$ $A_x = 4.00$ kN Ans

$+\uparrow \sum F_y = 0;$ $A_y + 78.2 - 20 - 20 - 20 - 20 - 8 \sin 60^o = 0$

$A_y = 8.71$ kN Ans

5-53 Determine the magnitude of force at the pin *A* and in the cable *BC* needed to support the 500-lb load. Neglect the weight of the boom *AB*.

5-53

$+\sum M_A = 0;$ $T_{BC}\sin 22^o\,(8\cos 35^o) + T_{BC}\cos 22^o\,(8\sin 35^o) - 500\,(8\sin 35^o) = 0$

$T_{BC} = 341.96 \text{ lb} = 342 \text{ lb}$ Ans

$\xrightarrow{+}\sum F_x = 0;$ $A_x = 341.96\sin 22^o = 0$ $A_x = 128.10 \text{ lb}$

$+\uparrow \sum F_y = 0;$ $A_y + 341.96\cos 22^o - 500 = 0$ $A_y = 182.94 \text{ lb}$

$F_A = \sqrt{A_x^2 + A_y^2} = \sqrt{128.10^2 + 182.94^2} = 223 \text{ lb}$ Ans

5-44 The davit is used to suspend the lifeboat over the side of a ship. If the boat exerts a force of 800 lb on the cable at *D*, determine the force acting along the hydraulic cylinder *BC* (two-force member) and the horizontal and vertical components of reaction at the pin *A*.

5-44

$+\sum M_A = 0;$ $F_{BC}\cos 10^o\,(14) - F_{BC}\sin 10^o\,(12) - 800(6) = 0$

$F_{BC} = 410.13 \text{ lb} = 410 \text{ lb}$ Ans

$\xrightarrow{+}\sum F_x = 0;$ $410.13\sin 10^o - A_x = 0$ $A_x = 71.2 \text{ lb}$ Ans

$+\uparrow \sum F_y = 0;$ $A_y + 410.13\cos 10^o - 800 = 0$

$A_y = 391 \text{ lb}$ Ans

5-64 Determine the x, y, z components of reaction at the fixed wall A.

5-84 Member AB is supported by a cable BC and at A by a smooth fixed *square* rod which fits loosely through the square hole of the collar. If the force $\mathbf{F} = -\{45\mathbf{k}\}$ lb, determine the tension in cable BC and the x, y, z components of reaction at A.

5-64

$\sum \mathbf{F} = \mathbf{0}; \qquad \mathbf{F}_1 + \mathbf{F}_2 + \mathbf{F}_A = \mathbf{0}$

$$(60\mathbf{i} + 50\mathbf{j} - 20\mathbf{k}) + (40\mathbf{i} - 30\mathbf{j} - 25\mathbf{k}) + (A_x\mathbf{i} + A_y\mathbf{j} + A_z\mathbf{k}) = \mathbf{0}$$

$$(100 + A_x)\mathbf{i} + (20 + A_y)\mathbf{j} + (-45 + A_z)\mathbf{k} = \mathbf{0}$$

Equating **i**, **j**, **k** components

$\sum F_x = 0;$ $\quad 100 + A_x = 0$ $\quad A_x = 100$ N $\quad$ Ans

$\sum F_y = 0;$ $\quad 20 + A_y = 0$ $\quad A_y = -20$ N $\quad$ Ans

$\sum F_z = 0;$ $\quad -45 + A_z = 0$ $\quad A_z = 45$ N $\quad$ Ans

$\sum \mathbf{M} = \mathbf{0}; \qquad \sum \mathbf{r} \times \mathbf{F} + \mathbf{M}_A = \mathbf{0}$

$$(3\mathbf{i} + 3\mathbf{j}) \times (40\mathbf{i} - 30\mathbf{j} - 25\mathbf{k}) + (3\mathbf{i} + 3\mathbf{j} - 2\mathbf{k}) \times (60\mathbf{i} + 50\mathbf{j} - 20\mathbf{k})$$
$$+ (M_{Ax}\mathbf{i} + M_{Ay}\mathbf{j} + M_{Az}\mathbf{k}) = \mathbf{0}$$
$$(M_{Ax} - 35)\mathbf{i} + (M_{Ay} + 15)\mathbf{j} + (M_{Az} - 240)\mathbf{k} = \mathbf{0}$$

Equating **i**, **j**, **k** components

$\sum M_x = 0;$ $\quad M_{Ax} - 35 = 0$ $\quad M_{Ax} = 35$ N · m $\quad$ Ans

$\sum M_y = 0;$ $\quad M_{Ay} + 15 = 0$ $\quad M_{Ay} = -15$ N · m $\quad$ Ans

$\sum M_z = 0;$ $\quad M_{Az} - 240 = 0$ $\quad M_{Az} = 240$ N · m $\quad$ Ans

Negative signs indicate that the forces and moments act in the opposite sense of those shown on FBD.

5-84

Force Vector:

$$\mathbf{F}_{BC} = F_{BC}\left(\frac{-12\mathbf{i} + 4\mathbf{j} + 6\mathbf{k}}{\sqrt{(-12)^2 + 4^2 + 6^2}}\right) = -\tfrac{6}{7}F_{BC}\mathbf{i} + \tfrac{3}{7}F_{BC}\mathbf{k}$$

Equilibrium:

$$\sum F_z = 0; \quad \tfrac{3}{7}F_{BC} - 45 = 0 \quad F_{BC} = 105 \text{ lb} \quad \text{Ans}$$

$$\sum F_x = 0; \quad A_x - \tfrac{6}{7}(105) = 0 \quad A_x = 90 \text{ lb} \quad \text{Ans}$$

$$\sum F_y = 0; \quad A_y + \tfrac{2}{7}(105) = 0 \quad A_y = -30 \text{ lb} \quad \text{Ans}$$

$$\sum M_x = 0; \quad M_{Ax} + \tfrac{3}{7}(105)(4) = 0 \quad M_{Ax} = -180 \text{ lb} \cdot \text{ft} \quad \text{Ans}$$

$$\sum M_y = 0; \quad M_{Ay} + 45(12) - \tfrac{3}{7}(105)(12) = 0 \quad M_{Ay} = 0 \quad \text{Ans}$$

$$\sum M_z = 0; \quad M_{Az} + \tfrac{2}{7}(105)(12) + \tfrac{6}{7}(105)(4) = 0$$

$$M_{Az} = -720 \text{ lb} \cdot \text{ft} \quad \text{Ans}$$

Negative signs indicate that the reaction components act in the opposite sense of those shown on FBD.