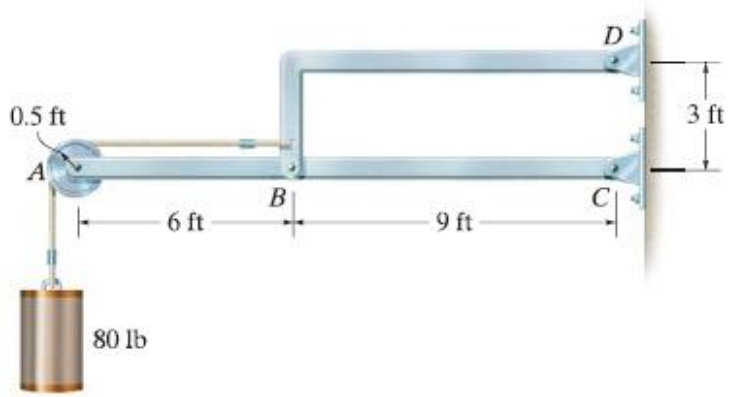
Homework # 5-(PART II)-SOLUTION

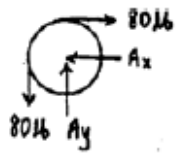
Structural Analysis-"FRAMES"

6–119. Determine the horizontal and vertical components of reaction which the pins exert on member *ABC*.



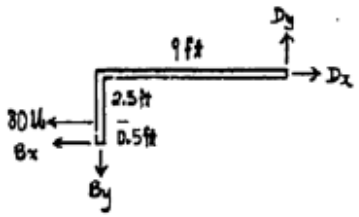
$\overset{+}{\rightarrow}\Sigma F_x = 0;$ $\quad A_x = 80\ \text{lb}$ **Ans**

$+\uparrow \Sigma F_y = 0;$ $\quad A_y = 80\ \text{lb}$ **Ans**



$\circlearrowleft +\Sigma M_C = 0;$ $\quad 80(15) - B_y(9) = 0$

$B_y = 133.3 = 133\ \text{lb}$ **Ans**

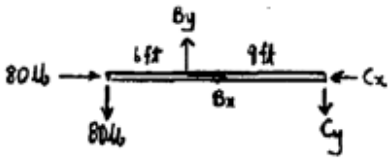


$\circlearrowleft +\Sigma M_D = 0;$ $\quad -80(2.5) + 133.3(9) - B_x(3) = 0$

$B_x = 333\ \text{lb}$ **Ans**

$\overset{+}{\rightarrow}\Sigma F_x = 0;$ $\quad 80 + 333 - C_x = 0$

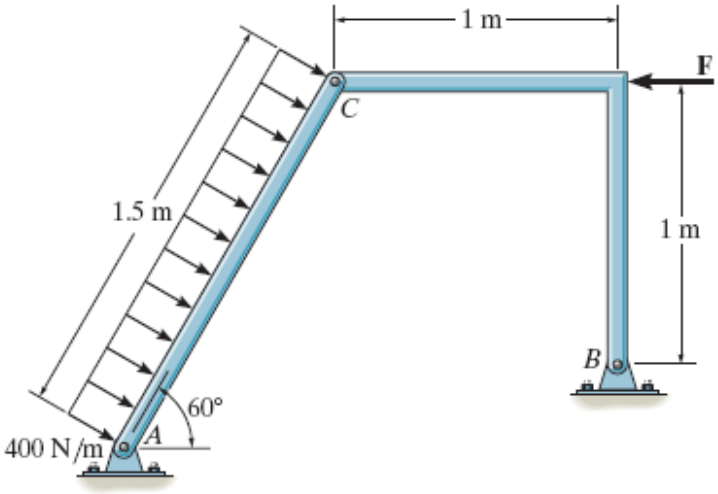
$C_x = 413\ \text{lb}$ **Ans**



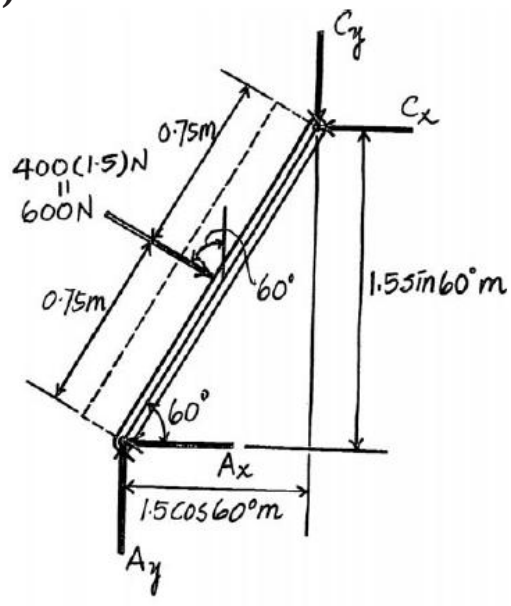
$+\uparrow \Sigma F_y = 0;$ $\quad -80 + 133.3 - C_y = 0$

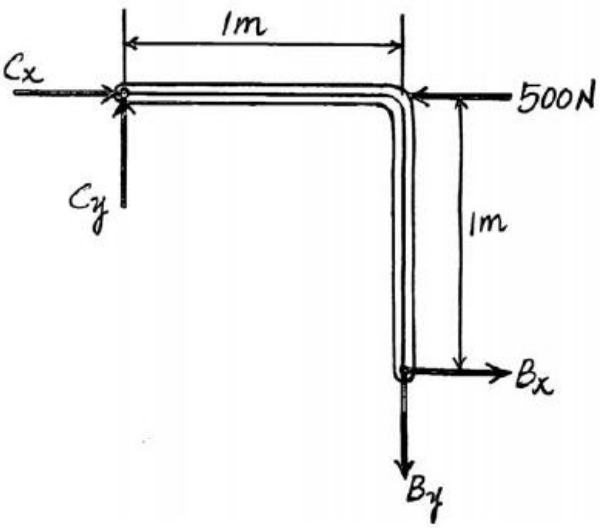
$C_y = 53.3\ \text{lb}$ **Ans**

•**6–133.** Determine the horizontal and vertical components of reaction that pins A and B exert on the two-member frame. (a) Set F = 500 N. (b) set F=0 N



a) F= 500 N





Member *AC*:

$\zeta + \Sigma M_A = 0;$ $\quad -600\,(0.75) - C_y\,(1.5\cos 60°) + C_x\,(1.5\sin 60°) = 0$

Member *CB*:

$\zeta + \Sigma M_B = 0;$ $\quad -C_x\,(1) - C_y\,(1) + 500\,(1) = 0$

Solving,

$$C_x = 402.6\ \text{N}$$

$$C_y = 97.4\ \text{N}$$

Member *AC*:

$\overset{+}{\rightarrow} \Sigma F_x = 0;$ $\quad -A_x + 600\sin 60° - 402.6 = 0$

$$A_x = 117\ \text{N} \quad \text{Ans}$$

$+\uparrow \Sigma F_y = 0;$ $\quad A_y - 600\cos 60° - 97.4 = 0$

$$A_y = 397\ \text{N} \quad \text{Ans}$$

Member *CB*:

$\overset{+}{\rightarrow} \Sigma F_x = 0;$ $\quad 402.6 - 500 + B_x = 0$

$$B_x = 97.4\ \text{N} \quad \text{Ans}$$

$+\uparrow \Sigma F_y = 0;$ $\quad -B_y + 97.4 = 0$

$$B_y = 97.4\ \text{N} \quad \text{Ans}$$

b) F= 0

CB **is a two-force member.**

Member *AC*:

$$(+\Sigma M_A = 0; \quad -600\,(0.75) + 1.5\,(F_{CB} \sin 75°) = 0$$

$$\boxed{F_{CB} = 310.6}$$

Thus,

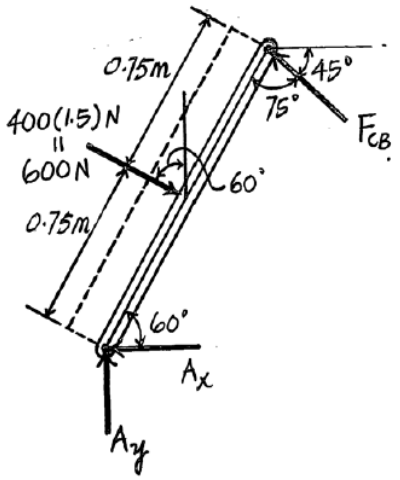
$$\boxed{B_x = B_y} = 310.6\left(\frac{1}{\sqrt{2}}\right) = \boxed{220\ \text{N}} \quad \text{Ans}$$

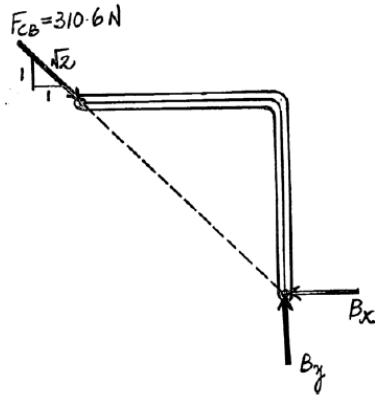
$$\stackrel{+}{\rightarrow} \Sigma F_x = 0; \quad -A_x + 600 \sin 60° - 310.6 \cos 45° = 0$$

$$\boxed{A_x = 300\ \text{N}} \quad \text{Ans}$$

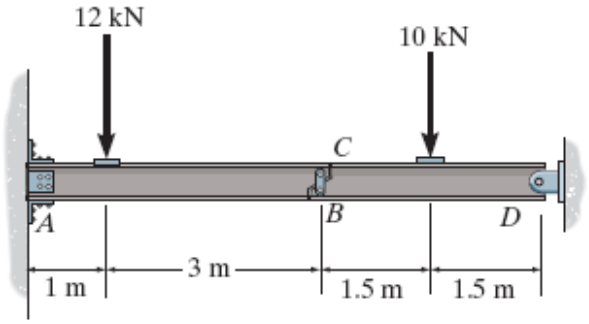
$$+\uparrow \Sigma F_y = 0; \quad A_y - 600 \cos 60° + 310.6 \sin 45° = 0$$

$$\boxed{A_y = 80.4\ \text{N}} \quad \text{Ans}$$





***6–80.** Two beams are connected together by a pin at *BC*. Determine the components of reaction at the fixed support *A* and at pin *D*.



Equations of Equilibrium: First, we will consider the free-body diagram of member *BD* in Fig. *a*.

$(+\Sigma M_D = 0;$ $\quad 10(1.5) - F_{BC}(3) = 0$

$F_{BC} = 5\,\text{kN}$

$\overset{+}{\rightarrow}\Sigma F_x = 0;$ $\quad D_x = 0$ **Ans.**

$(+\Sigma M_B = 0;$ $\quad D_y(3) - 10(1.5) = 0$

$D_y = 5\,\text{kN}$ **Ans.**

Subsequently, the free-body diagram of member *AC* in Fig. *b* will be considered using the result $F_{BC} = 5\,\text{kN}$.

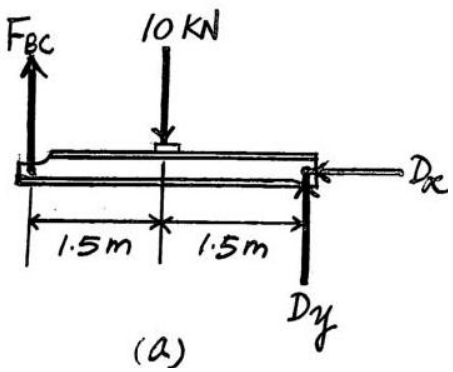
$\overset{+}{\rightarrow}\Sigma F_x = 0;$ $\quad A_x = 0$ **Ans.**

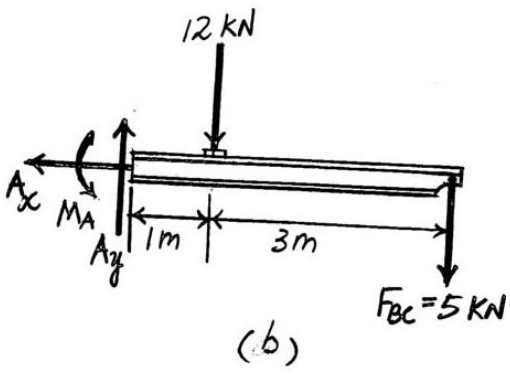
$+\uparrow \Sigma F_y = 0;$ $\quad A_y - 12 - 5 = 0$

$A_y = 17\,\text{kN}$ **Ans.**

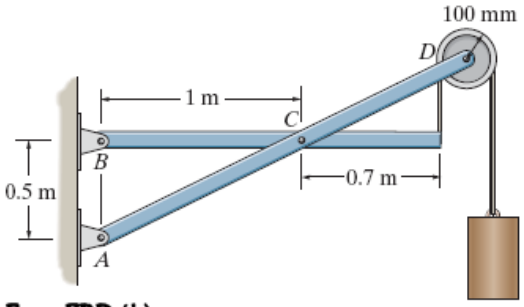
$(+\Sigma M_A = 0;$ $\quad M_A - 12(1) - 5(4) = 0$

$M_A = 32\,\text{kN}\cdot\text{m}$ **Ans.**





•**6–105.** Determine the horizontal and vertical components of reaction that the pins at *A*, *B*, and *C* exert on the frame. The cylinder has a mass of 80 kg.



Equations of Equilibrium : **From FBD (b),**

$$\zeta + \Sigma M_B = 0; \quad 784.8(1.7) - C_y(1) = 0$$
$$C_y = 1334.16\ \text{N} = 1.33\ \text{kN} \quad \textbf{Ans}$$

$$+\uparrow \Sigma F_y = 0; \quad B_y + 784.8 - 1334.16 = 0$$
$$B_y = 549\ \text{N} \quad \textbf{Ans}$$

$$\overset{+}{\rightarrow} \Sigma F_x = 0; \quad C_x - B_x = 0 \quad [1]$$

From FBD (a),

$$\zeta + \Sigma M_A = 0; \quad C_x(0.5) + 1334.16(1) - 784.8(1.7) - 784.8(1.9) = 0$$
$$C_x = 2982.24\ \text{N} = 2.98\ \text{kN} \quad \textbf{Ans}$$

$$+\uparrow \Sigma F_y = 0; \quad A_y + 1334.16 - 784.8 - 784.8 = 0$$
$$A_y = 235\ \text{N} \quad \textbf{Ans}$$

$$\overset{+}{\rightarrow} \Sigma F_x = 0; \quad A_x - 2982.24 = 0$$
$$A_x = 2982.24\ \text{N} = 2.98\ \text{kN} \quad \textbf{Ans}$$

Substitute $C_x = 2982.24$ N into Eq. [1] yields,

$$B_x = 2982.24\ \text{N} = 2.98\ \text{kN} \quad \textbf{Ans}$$