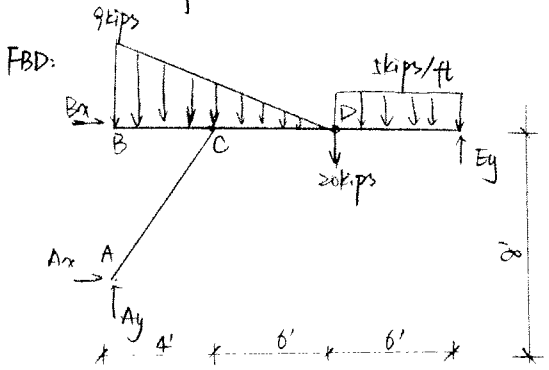
3.9 Determine the reactions of the structure. All dimensions are measured from centrelines of members.



Let ↺ ↑ → be possitive direction ⊕

The support provide 4 reactions, since 3 equations of equilibrium are available for the structures and the hinge C provide one conditional equation, the structure is determinate.

$\Sigma F(x)=0 \quad Ax+Bx=0$

$\Sigma Fy=0 \quad Ay+Ey-\frac{9\times10}{2}-20-5\times6=0$

Then compute the moment about A.

$\Sigma M(A)=0 \quad Bx\times8+\frac{9\times10}{2}\times\frac{10}{3}+20\times10+\frac{5\times6}{2}-Ey\times16=0$

There are 4 unknowns, while only 3 independent equations provided so far, we should consider the equation of condition by computing the moment about hinge D.

$\overset{DE}{\Sigma M(D)=0} \quad Ey\times6+5\times6\times3=0$

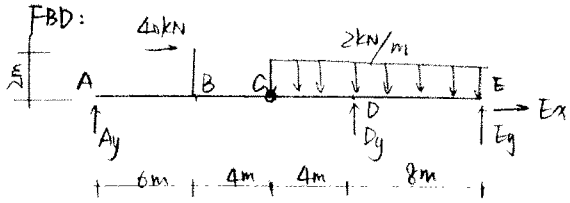
Then solve the 4 eqns:

$$\begin{cases}\Sigma F(x)=0\\ \Sigma F(y)=0\\ \Sigma M(A)=0\\ \overset{DE}{\Sigma M(D)=0}\end{cases}\Rightarrow\begin{cases}Ay=80\,kips\,(\uparrow)\\ Ax=62.5kips\,(\rightarrow)\\ Bx=-62.5kips\,(\leftarrow)\\ Ey=15kips\,(\uparrow)\end{cases}\quad \text{Ans.}$$

3.13 Determine the reactions at all supports and the force transmitted through the hinge C.

Let ↻ ↑ → be ⊕

FBD:



The structure provide 4 reactions, since 3 equations of equilibrium are available, for the entire structure, hinge C provide conditional equation.

(1) Determine the support reactions.

The structure is determinate, then we can solve 4 unknowns with 4 independent eqns.

$\Sigma F(x)=0 \quad 40+Ex=0 \Rightarrow Ex=-40\,kN\ (\leftarrow)$

$\Sigma F(y)=0 \quad Ay+Dy+Ey-2\times12=0$

$\Sigma M(E)=0 \quad Ay\times22+40\times2+Dy\times8-30-2\times12\times6=0$

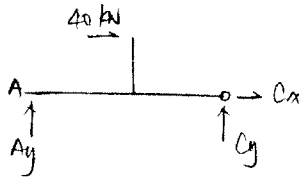
Then compute the Moment about C, taking the left part.

$\overset{ABC}{\Sigma M(C)=0} \quad Ay\times10+40\times2=0 \Rightarrow Ay=-8kN\ (\downarrow)$

$$\begin{cases} \Sigma F(x)=0 \\ \Sigma F(y)=0 \\ \Sigma M(E)=0 \\ \overset{ABC}{\Sigma M(C)=0} \end{cases} \Rightarrow \begin{cases} Ay=-8kN\ (\downarrow) \\ Dy=33.75kN\ (\uparrow) \\ Ex=-40kN\ (\leftarrow) \\ Ey=-17.5kN\ (\downarrow) \end{cases}$$ Ans.

(2) Determine the internal force transmitted through the hinge C, taking the left side.

FBD of ABC:

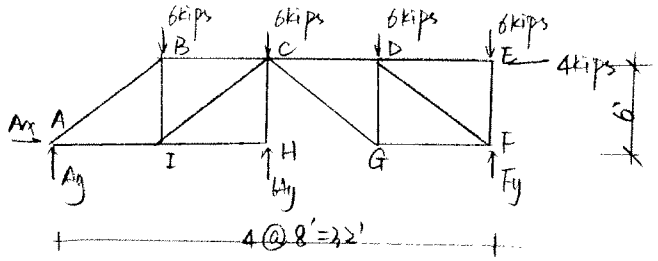


$\Sigma F(x)=0 \quad Cx+40=0 \Rightarrow \underline{Cx=-40kN\ (\leftarrow)}$ Ans.

$\Sigma M(A)=0 \quad 40\times2-Cy\times10=0 \quad \underline{Cy=8kN\ (\uparrow)}$ Ans.

3-15. Determine the reactions. Joint C can be treated as a hinge.

FBD:



The supports provide 4 reactions, we would get 3 equilibrium eqns, plus 1 conditional eqn by taking the Moment about hinge C.

$$\Sigma F(x)=0 \quad Ax-4=0 \Rightarrow Ax=4\text{kips}\ (\rightarrow)$$

$$\Sigma Fy=0 \quad Ay+Hy+Fy-6\times4=0$$

$$\Sigma M(A)=0 \quad 6\times8+6\times16+6\times24+6\times32-4\times6-Hy\times16-Fy\times32=0$$

Then conditional eqn of hinge C, taking the right part.

$$\overset{CDEFG}{\Sigma M(C)}=6\times8+6\times16-Fy\times16=0 \quad Fy=9\text{kips}\ (\uparrow)$$

Solve the 4 eqns:

$$\begin{cases} Ax=4\text{kips}\ (\rightarrow) \\ Ay=4.5\text{kips}\ (\uparrow) \\ Hy=10.5\text{kips}\ (\uparrow) \\ Fy=9\text{kips}\ (\uparrow) \end{cases}$$

Ans.