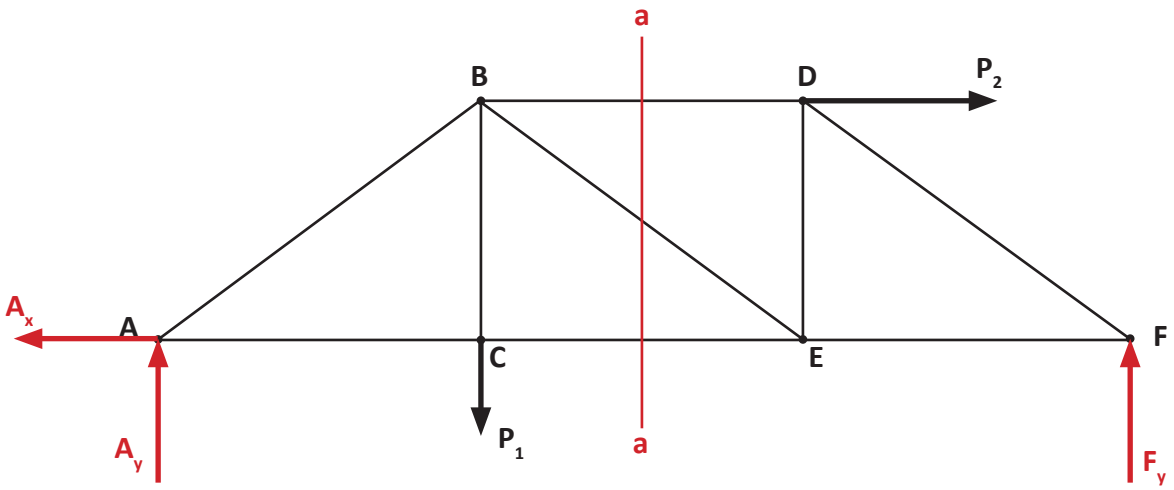
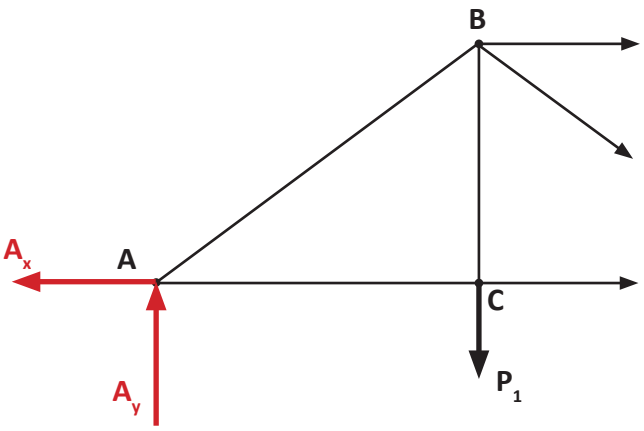
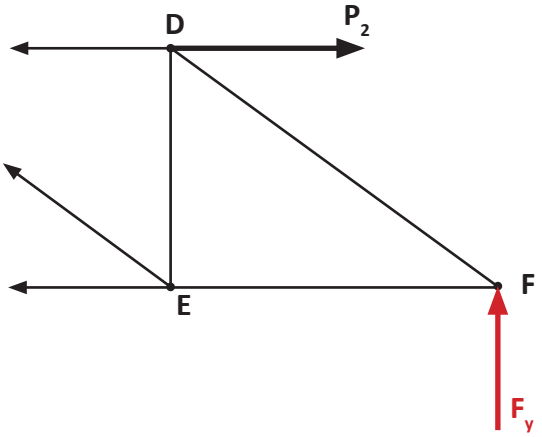
The Method of Sections

- Cut a section through the truss
- Draw a Free-Body Diagram of either portion of the truss
- Forces in the members cut become external forces
- The forces are nonconcurrent. The three independent equations of equilibrium can be used to solve for no more than three unknown member forces.





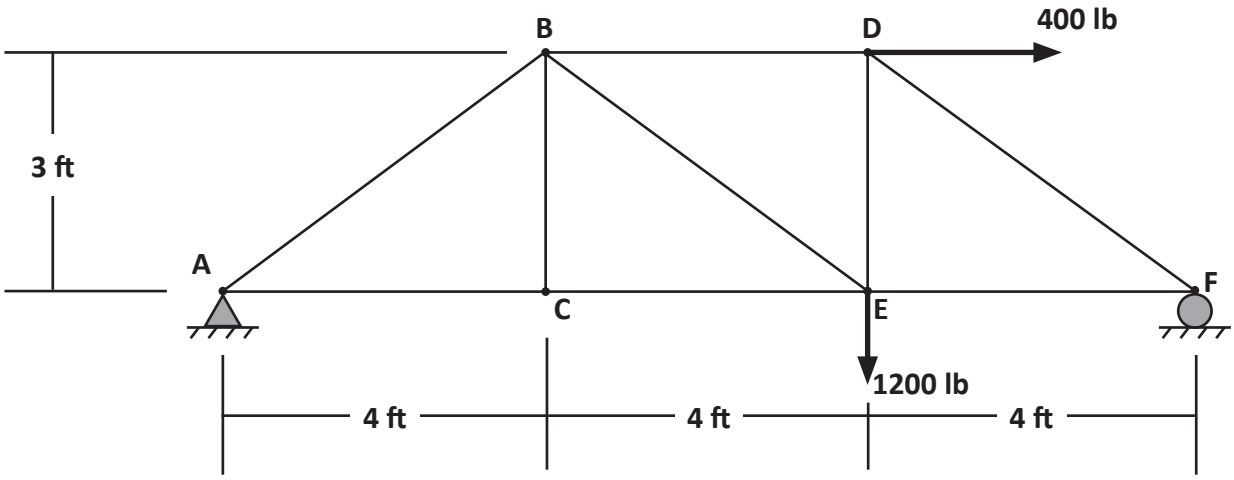
FBD
Left Portion of Section a-a



FBD
Right Portion of Section a-a

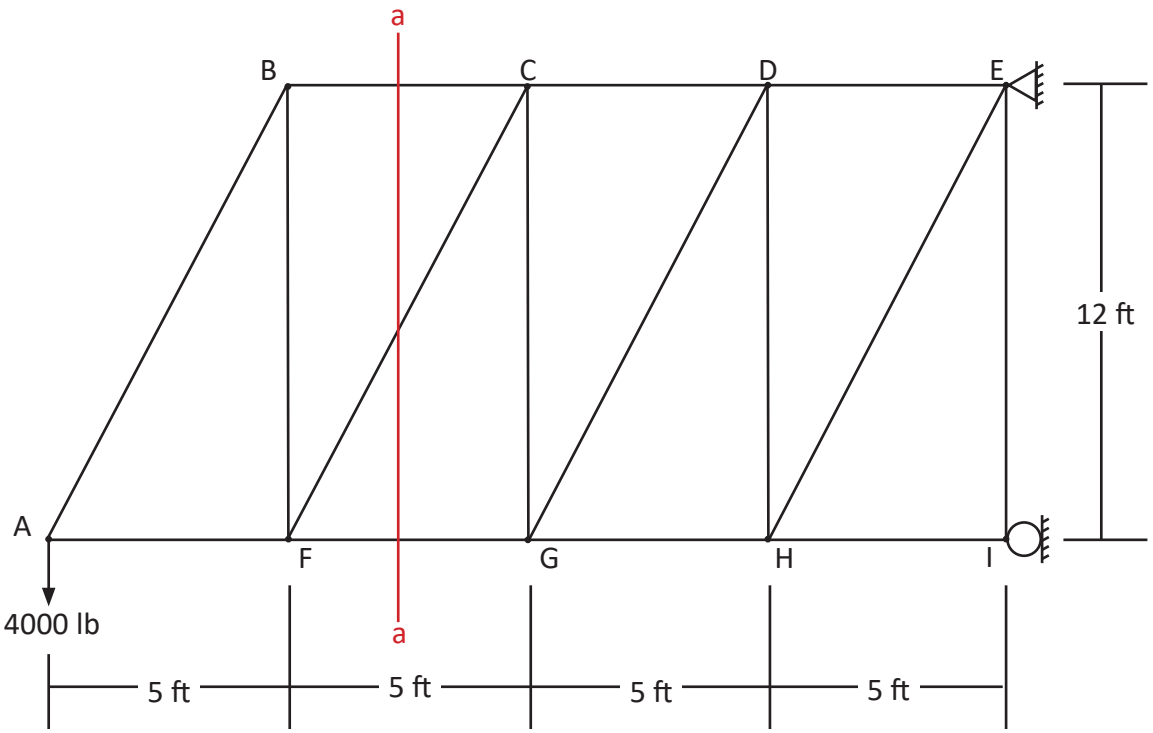
Example 1

Using the Method of Sections determine the force in members BD, BE, and CE. Indicate whether the members are in tension or compression.

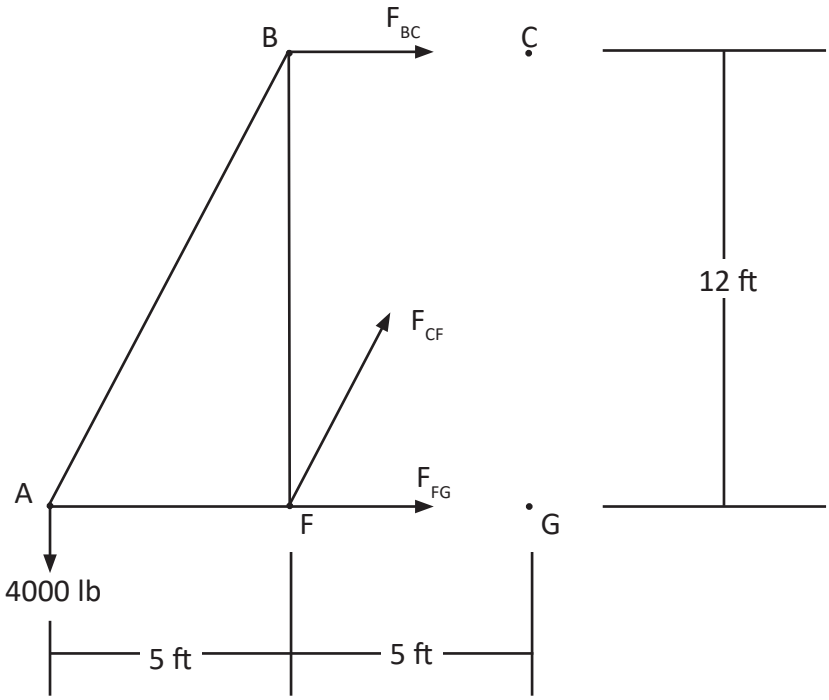


Solution.

Example 2. Use the Method of Sections to determine the force in members BC, CF, and FG.



Solution.

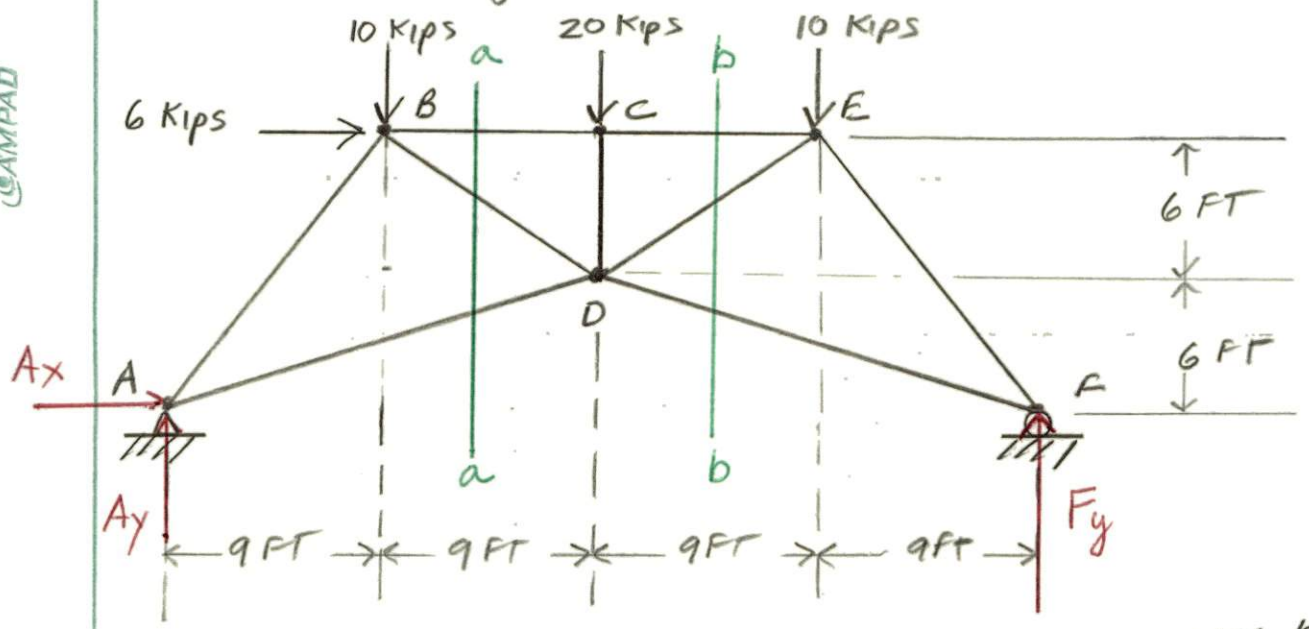


FBD - Left Portion of Section a-a

Equilibrium Equations

P-4-27

Determine the forces in all the members of the truss by <u>combined use</u> of the <u>Method of Sections</u> and the <u>method of joints</u> so that the solution of simultaneous equations can be avoided.



Solution.

Step 1. Solve for the reactions at A and F

$\Sigma F_x = 0$ $\quad A_x + 6\ \text{Kips} = 0$

$A_x = -6\ \text{Kips} \rightarrow$

or

$\boxed{A_x = 6\ \text{Kips} \leftarrow}$

$\Sigma M_A = 0$

$-6\text{Kips}(12\text{FT}) - 10\text{Kips}(9\text{FT}) - 20\text{Kips}(18\text{FT}) - 10\text{Kips}(27\text{FT}) + F_y(36\text{FT}) = 0$

$F_y(36\text{FT}) = (72 + 90 + 360 + 270)\ \text{Kips}\cdot\text{FT}$

$F_y = \dfrac{792\ \text{Kips}\cdot\text{FT}}{36\ \text{FT}} = \underline{\underline{22\ \text{Kips} \uparrow}}$

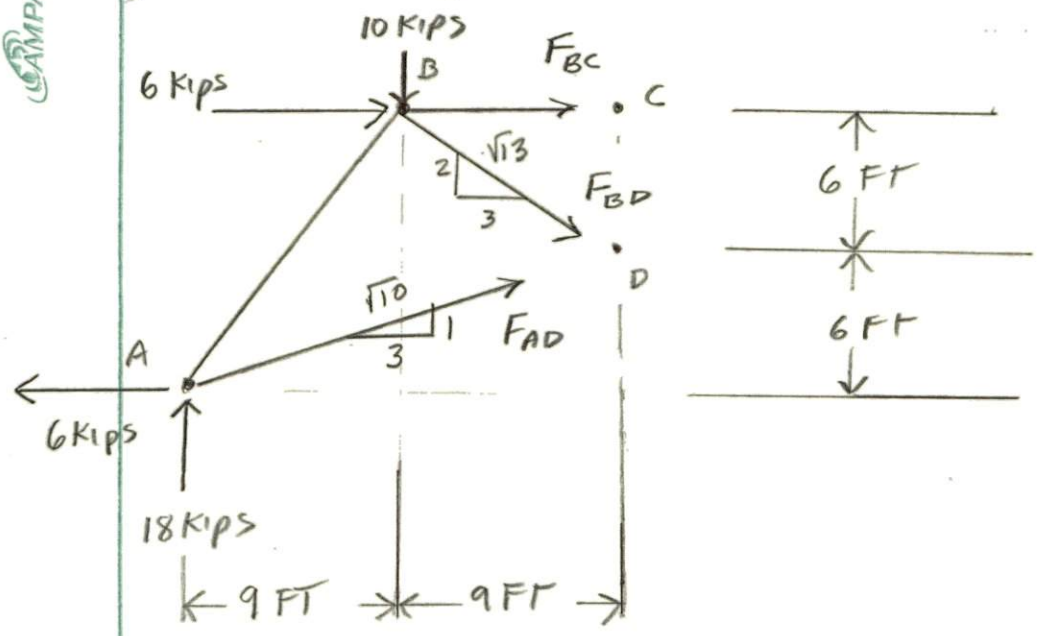
$\Sigma F_y = 0$

$$A_y - 10\,\text{Kips} - 20\,\text{Kips} - 10\,\text{Kips} + 22\,\text{Kips} = 0$$

$$A_y = (40 - 22)\,\text{Kips}$$

$$A_y = \underline{18\ \text{Kips}}\ \uparrow$$

Step 2. use Method of Sections AND METHOD of Joints



ccw +M ↺
cw -M ↻

FBD- Left Portion of Section a-a

Equilibrium Equations

$\Sigma M_B = 0$

$$-6\,\text{Kips}(12\,\text{FT}) - 18\,\text{Kips}(9\,\text{FT}) - \frac{1}{\sqrt{10}} F_{AD}(9\,\text{FT}) + \frac{3}{\sqrt{10}} F_{AD}(12\,\text{FT}) = 0$$

$$2.846\,F_{AD} - 11.384\,F_{AD} = -234\ \text{kips}\cdot\text{FT}$$

$$F_{AD} = \frac{-234\ \text{Kips}\cdot\text{FT}}{-8.538\ \text{FT}}$$

$$F_{AD} = \underline{27.4\ \text{Kips (T)}}$$

$\Sigma M_D = 0$

$-18\text{Kips}(18\text{FT}) - 6\text{Kips}(6\text{FT}) - 6\text{Kips}(6\text{FT}) + 10\text{Kips}(9\text{FT}) - F_{BC}(6\text{FT}) = 0$

$F_{BC}(6\text{FT}) = (-324 - 36 - 36 + 90)\ \text{Kips}\cdot\text{FT}$

$$F_{BC} = \frac{-306\ \text{Kips}\cdot\text{FT}}{6\ \text{FT}}$$

$F_{BC} = -51\ \text{Kips}\ (T)$

or

$\boxed{F_{BC} = 51\ \text{Kips}\ (C)}$

$\Sigma F_y = 0$

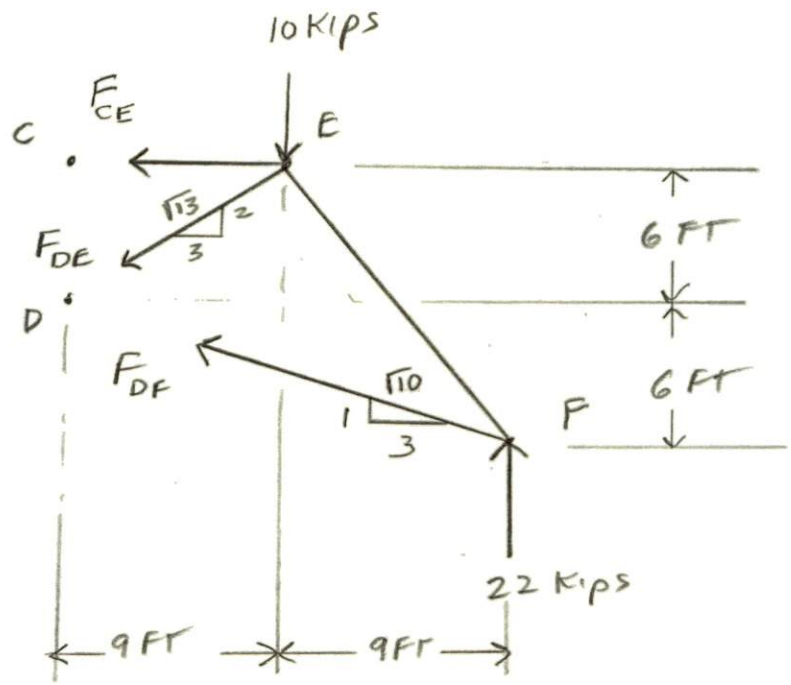
$$18\text{ Kips} - 10\text{ Kips} - \frac{2}{\sqrt{13}} F_{BD} + \frac{1}{\sqrt{10}} F_{AD} = 0$$

$$\frac{2}{\sqrt{13}} F_{BD} = 8\text{ Kips} + \frac{1}{\sqrt{10}}(27.4\text{ Kips})$$

$$F_{BD} = \frac{(8\text{ Kips} + 8.6646\text{ Kips})\sqrt{13}}{2}$$

$F_{BD} = 30\ \text{Kips}\ (T)$

Use Section b-b



FBD - Right Portion of Section b-b

Equilibrium Equations

ccw +M ↺
cw -M ↻

$\Sigma M_E = 0$

$$22 \text{ Kips}(9\text{Ft}) + \frac{1}{\sqrt{10}} F_{DF}(9\text{FT}) - \frac{3}{\sqrt{10}} F_{DF}(12\text{Ft}) = 0$$

$$(8.5381\text{ Ft}) F_{DF} = 198 \text{ Kips} \cdot \text{Ft}$$

$$F_{DF} = \frac{198 \text{ Kips} \cdot \text{FT}}{8.5381 \text{ FT}}$$

$$F_{DF} = 23.2 \text{ Kips (T)}$$

$\Sigma M_D = 0$

$22 \text{ kips}(18 \text{ FT}) - 10 \text{ kips}(9 \text{ FT}) + F_{CE}(6 \text{ FT}) = 0$

$F_{CE}(6 \text{ FT}) = -396 \text{ kips} \cdot \text{FT} + 90 \text{ kips} \cdot \text{FT}$

$F_{CE} = \frac{-306 \text{ kips} \cdot \text{FT}}{6 \text{ FT}}$

$F_{CE} = -51 \text{ kips (T)}$

OR

$\boxed{F_{CE} = 51 \text{ kips (C)}}$

$\Sigma F_x = 0$

$-F_{CE} - \frac{3}{\sqrt{13}} F_{DE} - \frac{3}{\sqrt{10}} F_{DF} = 0$

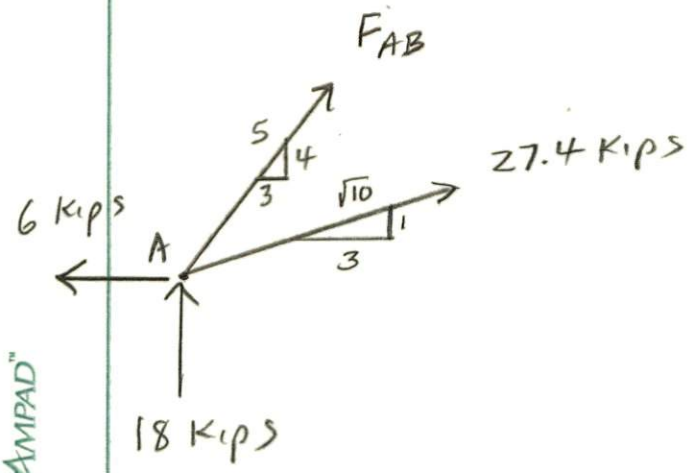
$-\frac{3}{\sqrt{13}} F_{DE} = F_{CE} + \frac{3}{\sqrt{10}} F_{DF}$

$-\frac{3}{\sqrt{13}} F_{DE} = -51 \text{ kips} + \frac{3}{\sqrt{10}}(23.2 \text{ kips})$

$-\frac{3}{\sqrt{13}} F_{DE} = -28.99 \text{ kips}$

$F_{DE} = 34.8 \text{ kips (T)}$

Joint A



FBD

Equilibrium Equations

$\Sigma F_x = 0$

$$-6\,\text{Kips} + \frac{3}{5} F_{AB} + \frac{3}{\sqrt{10}}(27.4\,\text{Kips}) = 0$$

$$\frac{3}{5} F_{AB} = 6\,\text{Kips} - 26\,\text{Kips}$$

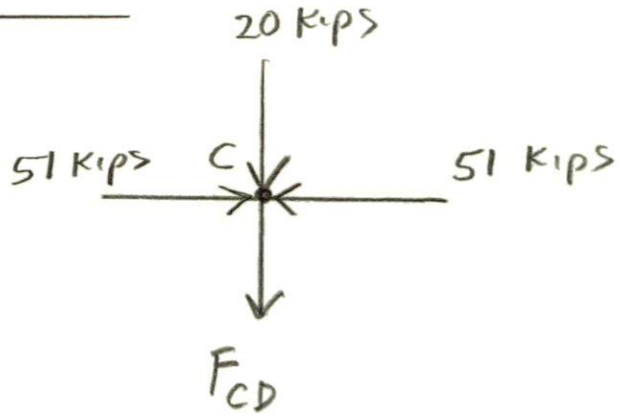
$$F_{AB} = \frac{-20\,\text{Kips}\,(5)}{3}$$

$$F_{AB} = -33.3\,\text{Kips}\,(T)$$

OR

$$\boxed{F_{AB} = 33.3\,\text{Kips}\,(C)}$$

Joint C



FBD

Equilibrium Equations

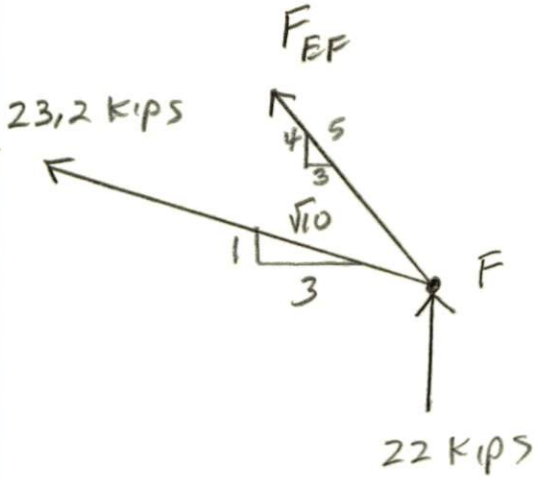
$\Sigma F_y = 0$ $\quad -20 \text{ kips} - F_{CD} = 0$

$F_{CD} = -20 \text{ kips (T)}$

OR

$\boxed{F_{CD} = 20 \text{ kips (C)}}$

Joint F:



FBD

Equilibrium Equations

$$\Sigma F_x = 0$$

$$-\frac{3}{\sqrt{10}}(23.2 \text{ kips}) - \frac{3}{5} F_{EF} = 0$$

$$\frac{3}{5} F_{EF} = -22 \text{ kips}$$

$$F_{EF} = -22 \text{ kips} \left(\frac{5}{3}\right)$$

$$F_{EF} = -36.7 \text{ kips (T)}$$

OR

$$\boxed{F_{EF} = 36.7 \text{ kips (C)}}$$