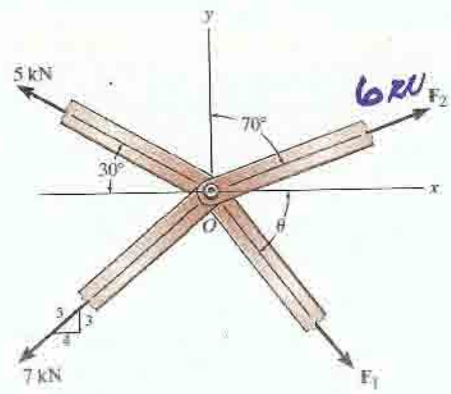
3–2.

The members of a truss are pin connected at joint O. Determine the magnitude of $\mathbf{F}_1$ and its angle θ for equilibrium. Set $F_2 = 6$ kN.



SOLUTION

FBD

$\rightarrow \Sigma F_x = 0$

$$6 \sin 70 + F_1 \cos\theta - 5 \cos 30 - \tfrac{4}{5}(7) = 0$$

$$F_1 \cos\theta = 4.29 \quad (1)$$

$\uparrow \Sigma F_y = 0$

$$6 \cos 70 + 5 \sin 30 - F_1 \sin\theta - \tfrac{3}{5}(7) = 0$$

$$F_1 \sin\theta = 0.3521 \quad (2)$$

SOLVING (1) + (2)

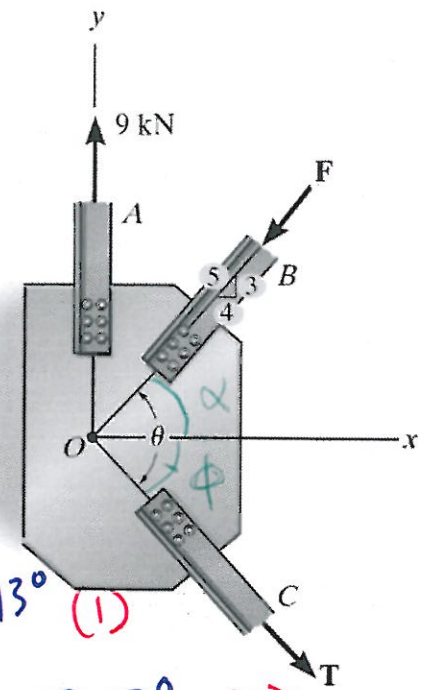
$$\frac{F_1 \sin\theta}{F_1 \cos\theta} = \frac{0.3521}{4.29} = \tan\theta$$

$$\theta = 4.69°$$

$$F_1 = 4.31 \text{ KN}$$

3-5

The members of a truss are connected to the gusset plate. If the forces are concurrent at point O, determine the magnitudes of **F** and **T** for equilibrium. Take $\theta = 90°$.



$$\alpha = \tan^{-1}\left(\frac{3}{4}\right) = 36.87°$$

$$\phi = \theta - \alpha = 90 - 36.87 = 53.13°$$

For equilibrium: $\Sigma \vec{F} = \phi$

$$\xrightarrow{+} \Sigma F_x = 0 = -F\left(\frac{4}{5}\right) + T\cos 53.13° \quad (1)$$

$$+\uparrow \Sigma F_y = 0 = 9 - F\left(\frac{3}{5}\right) - T\sin 53.13° \quad (2)$$

Solve system of equations:

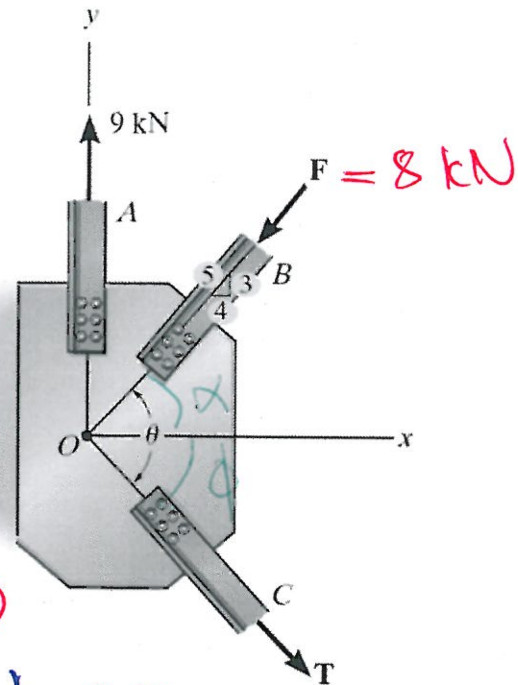
$$\begin{bmatrix} -0.8 & \cos 53.13° \\ 0.6 & \sin 53.15° \end{bmatrix} \begin{bmatrix} F \\ T \end{bmatrix} = \begin{bmatrix} 0 \\ 9 \end{bmatrix}$$

$T = 7.20$ kN Ans.

$F = 5.40$ kN Ans.

3-6

The gusset plate is subjected to the forces of three members. Determine the tension force in member C and its angle θ for equilibrium. The forces are concurrent at point O. Take $F = 8$ kN.



$\alpha = \tan^{-1}\left(\frac{3}{4}\right) = 36.87^{\circ}$

$\theta = \alpha + \phi$

For equilibrium: $\Sigma \vec{F} = \phi$

$\xrightarrow{+} \Sigma F_x = 0 = -8\left(\frac{4}{5}\right) + T\cos\phi$ (1)

$+\uparrow \Sigma F_y = 0 = 9 - 8\left(\frac{3}{5}\right) - T\sin\phi$ (2)

(1) $\Rightarrow T\cos\phi = 6.4$ (1')

(2) $\Rightarrow T\sin\phi = 4.2$ (2')

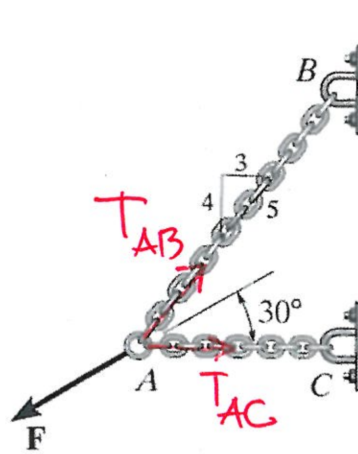
$\frac{(2')}{(1')} \Rightarrow \frac{T\sin\phi}{T\cos\phi} = \frac{4.2}{6.4} \Rightarrow \tan\phi = 0.65625$

$\phi = 33.3^{\circ}$

Substitute ϕ to (2'): $\underline{\underline{T = 7.65 \text{ kN}}}$ Ans.

$\theta = \alpha + \phi = 36.87 + 33.3 = \underline{\underline{70.2^{\circ}}}$ Ans.

3-9
Determine the maximum force **F** that can be supported in the position shown if each chain can support a maximum tension of 600 lb before it fails.



For equilibrium: $\Sigma \vec{F} = \phi$

$+\uparrow \Sigma F_y = 0 = \left(\frac{4}{5}\right)T_{AB} - F\sin 30°$

$\Rightarrow T_{AB} = 0.625\,F$

$\stackrel{+}{\rightarrow} \Sigma F_x = 0 = T_{AC} + \frac{3}{5}\underbrace{T_{AB}}_{0.625F} - F\cos 30°$

$\Rightarrow T_{AC} = 0.491\,F$

* $T_{AB} \leq T_{max}$ or $0.625F \leq 600\text{ lb} \Rightarrow F \leq 960\text{ lb}$

* $T_{AC} \leq T_{max}$ or $0.491F \leq 600\text{ lb} \Rightarrow F \leq 1222\text{ lb}$

$\Rightarrow$ Max. force $F = \underline{960\text{ lb}}$

Ans.