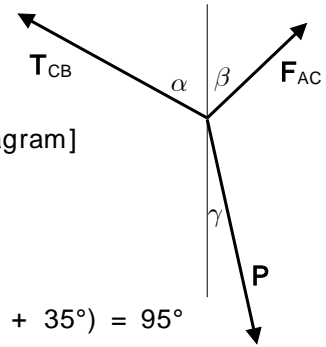


[2.9~2.11 ]

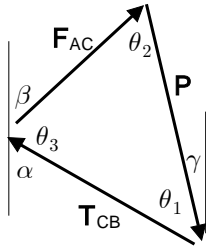
2.43 [ ]

$$\alpha = 50^\circ, \beta = 35^\circ, \gamma = 25^\circ, P = 400 \text{ N}$$

[free-body diagram]



< 1 : >



$$\theta_1 = \alpha - \gamma = 50^\circ - 25^\circ = 25^\circ$$

$$\theta_2 = \beta + \gamma = 35^\circ + 25^\circ = 60^\circ$$

$$\theta_3 = 180^\circ - (\alpha + \beta) = 180^\circ - (50^\circ + 35^\circ) = 95^\circ$$

$$\frac{F_{AC}}{\sin\theta_1} = \frac{T_{CB}}{\sin\theta_2} = \frac{P}{\sin\theta_3}$$

$$(a) F_{AC} = P \frac{\sin\theta_1}{\sin\theta_3} = (400 \text{ N}) \frac{\sin 25^\circ}{\sin 95^\circ} = 169.7 \text{ N}$$

$$(b) T_{CB} = P \frac{\sin\theta_2}{\sin\theta_3} = (400 \text{ N}) \frac{\sin 60^\circ}{\sin 95^\circ} = 348 \text{ N}$$

< 2 : >

$$F_x = F_{AC} \sin\beta - T_{CB} \sin\alpha + P \sin\gamma = 0 \quad \dots$$

$$F_y = F_{AC} \cos\beta + T_{CB} \cos\alpha - P \cos\gamma = 0 \quad \dots$$

(a)  $\times \cos\alpha + \times \sin\alpha$

$$F_{AC} (\cos\alpha \sin\beta + \sin\alpha \cos\beta) + P (\cos\alpha \sin\gamma - \sin\alpha \cos\gamma) = 0$$

$$F_{AC} = -P \frac{\cos\alpha \sin\gamma - \sin\alpha \cos\gamma}{\cos\alpha \sin\beta + \sin\alpha \cos\beta}$$

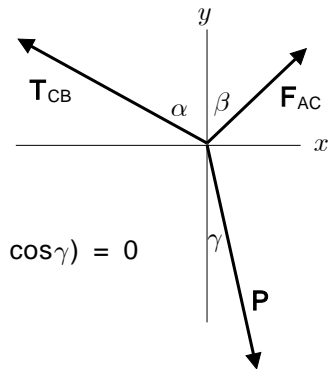
$$= -(400 \text{ N}) \frac{\cos 50^\circ \sin 25^\circ - \sin 50^\circ \cos 25^\circ}{\cos 50^\circ \sin 35^\circ + \sin 50^\circ \cos 35^\circ} = 169.7 \text{ N}$$

(b)  $\times \cos\beta - \times \sin\beta$

$$-T_{CB} (\cos\beta \sin\alpha + \sin\beta \cos\alpha) + P (\cos\beta \sin\gamma + \sin\beta \cos\gamma) = 0$$

$$T_{CB} = P \frac{\cos\beta \sin\gamma + \sin\beta \cos\gamma}{\cos\beta \sin\alpha + \sin\beta \cos\alpha}$$

$$= (400 \text{ N}) \frac{\cos 35^\circ \sin 25^\circ + \sin 35^\circ \cos 25^\circ}{\cos 35^\circ \sin 50^\circ + \sin 35^\circ \cos 50^\circ} = 348 \text{ N}$$



2.57 [ , ]

$$T_{AC} = 3W, \quad T_{AD} = W, \quad P = 400 \text{ N}$$

$$F_x = \frac{12}{37} T_{AB} - \frac{4}{5} T_{AC} + \frac{35}{37} T_{AD} = 0 \quad \dots$$

$$F_y = \frac{35}{37} T_{AB} + \frac{3}{5} T_{AC} + \frac{12}{37} T_{AD} - P = 0 \quad \dots$$

(a)  $\times 35 - \times 12$

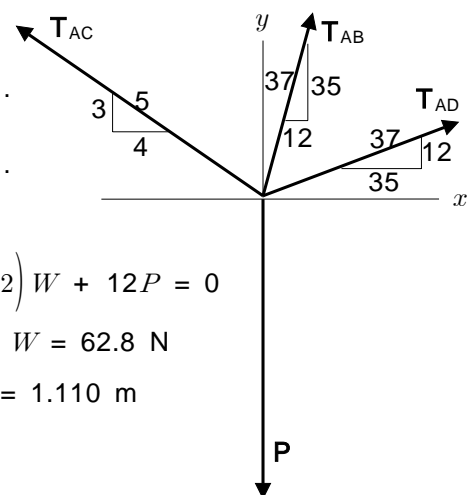
$$\left(-\frac{4}{5} \times 35 - \frac{3}{5} \times 12\right) (3W) + \left(\frac{35}{37} \times 35 - \frac{12}{37} \times 12\right) W + 12P = 0$$

$$-105.6 W + 29.2 W = -12 (400 \text{ N}) \quad W = 62.8 \text{ N}$$

(b)  $k = 800 \text{ N/m}, \quad L_{AB} = \sqrt{(0.360 \text{ m})^2 + (1.050 \text{ m})^2} = 1.110 \text{ m}$

$$T_{AB} = \frac{37}{12} \left(\frac{4}{5} T_{AC} - \frac{35}{37} T_{AD}\right)$$

[F.B.D.]



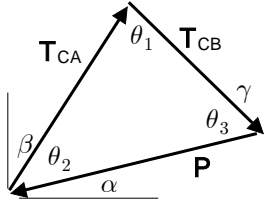
$$= \frac{37}{12} \left[ \frac{4}{5} (3 \times 62.8 \text{ N}) - \frac{35}{37} (62.8 \text{ N}) \right] = 281.6 \text{ N}$$

$$T_{AB} = k(L_{AB} - L_0)$$

$$L_0 = L_{AB} - \frac{T_{AB}}{k} = (1.110 \text{ m}) - \frac{281.6 \text{ N}}{800 \text{ N/m}} = 0.758 \text{ m} = 758 \text{ mm}$$

2.67 [ , ]  
 $T_{CA} = T_{CB} = 140 \text{ N}, \quad \beta = 30^\circ, \quad \gamma = 45^\circ$

< 1 : >



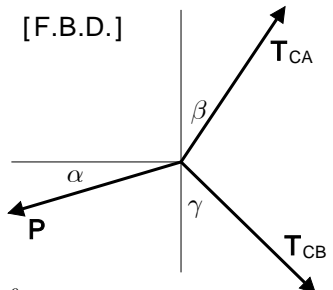
$$\theta_1 = \beta + \gamma = 30^\circ + 45^\circ = 75^\circ$$

$$P^2 = T_{CA}^2 + T_{CB}^2 - 2 T_{CA} T_{CB} \cos \theta_1 = (140 \text{ N})^2 + (140 \text{ N})^2 - 2(140 \text{ N})(140 \text{ N}) \cos 75^\circ = 29054 \text{ N}^2 \quad P = 170.5 \text{ N}$$

$$\theta_2 = \theta_3 = \frac{1}{2} (180^\circ - \theta_1) = \frac{1}{2} (180^\circ - 75^\circ) = 52.5^\circ$$

$$\alpha = 90^\circ - (\beta + \theta_2) = 90^\circ - (30^\circ + 52.5^\circ) = 7.5^\circ$$

$$P = 170.5 \text{ N} \text{ } ^{-7.5^\circ}$$



< 2 : >

$$F_x = T_{CA} \sin \beta + T_{CB} \sin \gamma - P \cos \alpha = 0 \quad \dots$$

$$F_y = T_{CA} \cos \beta - T_{CB} \cos \gamma - P \sin \alpha = 0 \quad \dots$$

$$P \cos \alpha = T_{CA} \sin \beta + T_{CB} \sin \gamma = (140 \text{ N}) (\sin 30^\circ + \sin 45^\circ) = 169.0 \text{ N} \quad \dots$$

$$P \sin \alpha = T_{CA} \cos \beta - T_{CB} \cos \gamma = (140 \text{ N}) (\cos 30^\circ - \cos 45^\circ) = 22.3 \text{ N} \quad \dots$$

$^2 + ^2$

$$(P \cos \alpha)^2 + (P \sin \alpha)^2 = P^2 = (169.0 \text{ N})^2 + (22.3 \text{ N})^2 = 29058 \text{ N}^2$$

$$P = \sqrt{29058 \text{ N}^2} = 170.5 \text{ N}$$

$\div$

$$\frac{P \sin \alpha}{P \cos \alpha} = \tan \alpha = \frac{22.3 \text{ N}}{169.0 \text{ N}} = 0.13195$$

$$\alpha = \tan^{-1}(0.13195) = 7.5^\circ$$

$$P = 170.5 \text{ N} \text{ } ^{-7.5^\circ}$$

