

[2.9~11절]

2.45 [ 질점의 평형 문제 ]

$$\alpha = 20^\circ, \beta = 5^\circ, W = 12 \text{ kN}$$

<방법 1 : 직각 성분>

$$\Sigma F_x = -T_{AC} \sin\beta + T_{BC} \cos\alpha = 0 \quad \dots \textcircled{1}$$

$$\Sigma F_y = T_{AC} \cos\beta - T_{BC} \sin\alpha - W = 0 \quad \dots \textcircled{2}$$

(a)  $\sin\alpha \times \textcircled{1} + \cos\alpha \times \textcircled{2}$

$$(-\sin\alpha \sin\beta + \cos\alpha \cos\beta) T_{AC} = W \cos\alpha$$

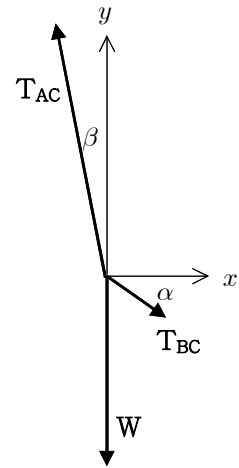
$$\Rightarrow T_{AC} = W \frac{\cos\alpha}{\cos(\alpha+\beta)} = (12 \text{ kN}) \frac{\cos 20^\circ}{\cos 25^\circ} = 12.44 \text{ kN}$$

(b)  $\cos\beta \times \textcircled{1} + \sin\beta \times \textcircled{2}$

$$(\cos\beta \cos\alpha - \sin\beta \sin\alpha) T_{BC} = W \sin\beta$$

$$\Rightarrow T_{BC} = W \frac{\sin\beta}{\cos(\alpha+\beta)} = (12 \text{ kN}) \frac{\sin 5^\circ}{\cos 25^\circ} = 1.154 \text{ kN}$$

자유물체도



<방법 2 : 힘 삼각형>

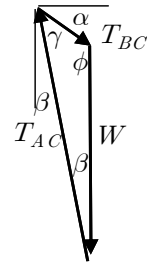
$$\gamma = 90^\circ - (\alpha + \beta) = 90^\circ - (20^\circ + 5^\circ) = 65^\circ$$

$$\phi = 90^\circ + \alpha = 90^\circ + 20^\circ = 110^\circ$$

$$\text{sine 공식 } \frac{W}{\sin\gamma} = \frac{T_{AC}}{\sin\phi} = \frac{T_{BC}}{\sin\beta}$$

$$(a) T_{AC} = W \frac{\sin\phi}{\sin\gamma} = (12 \text{ kN}) \frac{\sin 110^\circ}{\sin 65^\circ} = 12.44 \text{ kN}$$

$$(b) T_{BC} = W \frac{\sin\beta}{\sin\gamma} = (12 \text{ kN}) \frac{\sin 5^\circ}{\sin 65^\circ} = 1.154 \text{ kN}$$



2.63 [ 질점의 평형 문제 ]

$$W = 200 \text{ N}, h = 400 \text{ mm}, \text{ 줄의 장력은 동일 } T = W, \theta = \tan^{-1} \frac{h}{x}$$

<방법 1 : 직각 성분>

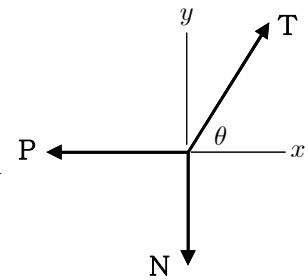
$$\Sigma F_x = 0; -P + T \cos\theta = 0 \Rightarrow P = T \cos\theta$$

$$(a) x = 90 \text{ mm}, \theta = \tan^{-1} \frac{400 \text{ mm}}{90 \text{ mm}} = 77.3^\circ$$

$$P = (200 \text{ N}) \cos 77.3^\circ = 43.90 \text{ N} \Rightarrow P = 43.9 \text{ N}$$

$$(b) x = 300 \text{ mm}, \theta = \tan^{-1} \frac{400 \text{ mm}}{300 \text{ mm}} = \tan^{-1} \frac{4}{3}$$

$$P = (200 \text{ N}) \frac{3}{5} = 120 \text{ N}$$



<방법 2 : 힘 삼각형>

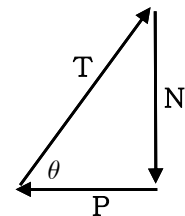
$$P = T \cos\theta$$

$$(a) x = 90 \text{ mm}, \theta = \tan^{-1} \frac{400 \text{ mm}}{90 \text{ mm}} = 77.3^\circ$$

$$P = (200 \text{ N}) \cos 77.3^\circ = 43.90 \text{ N} \Rightarrow P = 43.9 \text{ N}$$

$$(b) x = 300 \text{ mm}, \theta = \tan^{-1} \frac{400 \text{ mm}}{300 \text{ mm}} = \tan^{-1} \frac{4}{3}$$

$$P = (200 \text{ N}) \frac{3}{5} = 120 \text{ N}$$



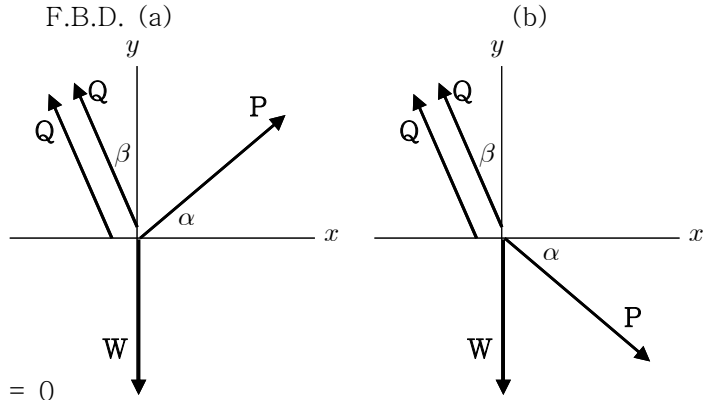
2.66 [ 질점의 평형 문제 ]

$$W = (200 \text{ kg})(9.806 \text{ m/s}^2) = 1961.2 \text{ N}$$

$$\tan\beta = \frac{0.75}{2.4} = 0.3125$$

$$\beta = \tan^{-1}(0.3125) = 17.35^\circ$$

$$P = Q$$



<방법 1 : 직각 성분>

$$\Sigma F_x = 0 ; P \cos\alpha - 2Q \sin\beta = 0$$

$$\Rightarrow \cos\alpha = 2 \sin\beta = 2 \sin 17.35^\circ = 0.5965$$

$$\alpha = \cos^{-1}(0.5965) = \pm 53.38^\circ$$

(a)  $\alpha = +53.38^\circ$

$$\Sigma F_y = 0 ; P \sin\alpha + 2Q \cos\beta - W = 0$$

$$\Rightarrow P = \frac{W}{\sin\alpha + 2\cos\beta} = \frac{1961.2 \text{ N}}{\sin 53.38^\circ + 2\cos 17.35^\circ} = 723.3 \text{ N} \Rightarrow \mathbf{P = 723 \text{ N } \nearrow 53.4^\circ}$$

(b)  $\alpha = -53.38^\circ$

$$\Sigma F_y = 0 ; P \sin\alpha + 2Q \cos\beta - W = 0$$

$$\Rightarrow P = \frac{W}{\sin\alpha + 2\cos\beta} = \frac{1961.2 \text{ N}}{\sin(-53.38^\circ) + 2\cos 17.35^\circ} = 1772.6 \text{ N}$$

$$\Rightarrow \mathbf{P = 1773 \text{ N } \searrow 53.4^\circ}$$

<방법 2 : 힘 삼각형>

$$\frac{2Q}{\sin\theta} = \frac{P}{\sin\beta}$$

$$\Rightarrow \sin\theta = 2 \sin\beta = 2 \sin 17.35^\circ = 0.5964$$

$$\Rightarrow \theta = \sin^{-1}(0.5964) = 36.61^\circ, 143.39^\circ$$

(a)  $\theta = 36.61^\circ$

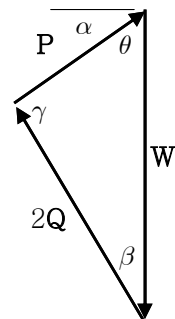
$$\alpha = 90^\circ - \theta = 90^\circ - 36.61^\circ = 53.39^\circ$$

$$\gamma = 180^\circ - (\beta + \theta) = 180^\circ - (17.35^\circ + 36.61^\circ) = 126.04^\circ$$

$$\frac{P}{\sin\beta} = \frac{W}{\sin\gamma}$$

$$\Rightarrow P = W \frac{\sin\beta}{\sin\gamma} = (1961.2 \text{ N}) \frac{\sin 17.35^\circ}{\sin 126.04^\circ} = 723.3 \text{ N}$$

$$\Rightarrow \mathbf{P = 723 \text{ N } \nearrow 53.4^\circ}$$



(b)  $\theta = 143.39^\circ$

$$\alpha = \theta - 90^\circ = 143.39^\circ - 90^\circ = 53.39^\circ$$

$$\gamma = 180^\circ - (\beta + \theta) = 180^\circ - (17.35^\circ + 143.39^\circ) = 19.26^\circ$$

$$\frac{P}{\sin\beta} = \frac{W}{\sin\gamma}$$

$$\Rightarrow P = W \frac{\sin\beta}{\sin\gamma} = (1961.2 \text{ N}) \frac{\sin 17.35^\circ}{\sin 19.26^\circ} = 1773.0 \text{ N}$$

$$\Rightarrow \mathbf{P = 1773 \text{ N } \searrow 53.4^\circ}$$

