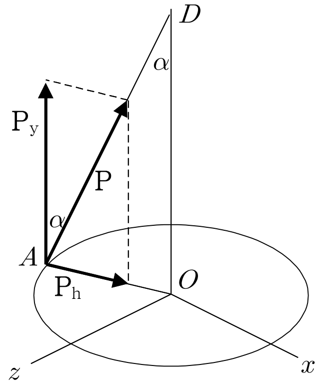
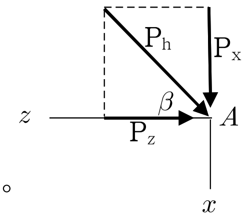
<2.12~14절>

2.73 [공간에서 힘의 직각성분]





$\alpha = 30°, \quad \beta = 50°, \quad P_x = 110.3\ \text{N}$

(a) $P_h = P\ \sin\alpha$

$P_x = P_h\ \sin\beta = (P\ \sin\alpha)\ \sin\beta$

$\Rightarrow \quad P = \dfrac{P_x}{\sin\alpha\ \sin\beta} = \dfrac{110.3\ \text{N}}{\sin30°\ \sin50°} = 287.97\ \text{N}$

$\Rightarrow \quad P = 288\ \text{N}$

(b) $\cos\theta_x = \dfrac{P_x}{P} = \sin\alpha\ \sin\beta = \sin30°\ \sin50° = 0.3830$

$\Rightarrow \quad \theta_x = \cos^{-1}(0.3830) = 67.48° \quad \Rightarrow \quad \theta_x = 67.5°$

$P_y = P\ \cos\alpha$

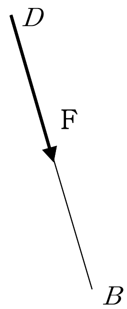
$\cos\theta_y = \dfrac{P_y}{P} = \cos\alpha \quad \Rightarrow \quad \theta_y = \alpha = 30.0°$

$P_z = -P_h\ \cos\beta = -(P\ \sin\alpha)\ \cos\beta$

$\cos\theta_z = \dfrac{P_z}{P} = -\sin\alpha\ \cos\beta = -\sin30°\ \cos50° = -0.3214$

$\Rightarrow \quad \theta_z = \cos^{-1}(-0.3214) = 108.74° \quad \Rightarrow \quad \theta_x = 108.7°$

2.87 [두 점과 힘 크기에 의해 정의되는 힘]



$F = 385\ \text{N}$

$d_x = 480\ \text{mm}, \quad d_y = -510\ \text{mm}, \quad d_z = (600 - 280)\ \text{mm} = 320\ \text{mm}$

$d = \sqrt{d_x^2 + d_y^2 + d_z^2}$

$= \sqrt{(480\ \text{mm})^2 + (-510\ \text{mm})^2 + (320\ \text{mm})^2} = 770\ \text{mm}$

$\boldsymbol{\lambda}_{DB} = \dfrac{1}{d}(d_x\mathbf{i} + d_y\mathbf{j} + d_z\mathbf{k})$

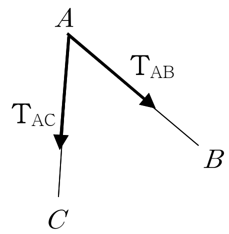
$= \dfrac{1}{770}(480\ \mathbf{i} - 510\ \mathbf{j} + 320\ \mathbf{k})$

$\mathbf{F}_{DB} = F\boldsymbol{\lambda}_{DB} = (385\ \text{N})\ \dfrac{1}{77}(48\ \mathbf{i} - 51\ \mathbf{j} + 32\ \mathbf{k})$

$= 240\ \mathbf{i} - 255\ \mathbf{j} + 160\ \mathbf{k}\ \ (\text{N})$

$\Rightarrow \quad F_x = (240\ \text{N})\ \mathbf{i}, \quad F_y = (-255\ \text{N})\ \mathbf{j}, \quad F_z = (160.0\ \text{N})\ \mathbf{k}$

2.96 [공간에서 힘의 직각성분 합성]



T_{AB} = 1425 N, T_{AC} = 2130 N

$(d_{AB})_x$ = 900 mm, $(d_{AB})_y$ = -600 mm, $(d_{AB})_z$ = -360 mm

$$d_{AB} = \sqrt{(d_{AB})_x^2 + (d_{AB})_y^2 + (d_{AB})_z^2}$$

$$= \sqrt{(900\,\text{mm})^2 + (-600\,\text{mm})^2 + (-360\,\text{mm})^2} = 1140\ \text{mm}$$

$$\boldsymbol{\lambda}_{AB} = \frac{1}{d_{AB}}\,[(d_{AB})_x\ \mathbf{i} + (d_{AB})_y\ \mathbf{j} + (d_{AB})_z\ \mathbf{k}] = \frac{1}{114}[(90)\ \mathbf{i} + (-60)\ \mathbf{j} + (-36)\ \mathbf{k}]$$

$$\mathbf{T}_{AB} = T_{AB}\ \boldsymbol{\lambda}_{AB} = (1425\ \text{N})\ \frac{1}{114}[(90)\ \mathbf{i} + (-60)\ \mathbf{j} + (-36)\ \mathbf{k}]$$

$$= 1125\ \mathbf{i} - 750\ \mathbf{j} - 450\ \mathbf{k}\ \ (\text{N})$$

$(d_{AC})_x$ = 900 mm, $(d_{AC})_y$ = -600 mm, $(d_{AC})_z$ = 920 mm

$$d_{AC} = \sqrt{(d_{AC})_x^2 + (d_{AC})_y^2 + (d_{AC})_z^2}$$

$$= \sqrt{(900\,\text{mm})^2 + (-600\,\text{mm})^2 + (920\,\text{mm})^2} = 1420\ \text{mm}$$

$$\boldsymbol{\lambda}_{AC} = \frac{1}{d_{AC}}\,[(d_{AC})_x\ \mathbf{i} + (d_{AC})_y\ \mathbf{j} + (d_{AC})_z\ \mathbf{k}] = \frac{1}{142}[(90)\ \mathbf{i} + (-60)\ \mathbf{j} + (92)\ \mathbf{k}]$$

$$\mathbf{T}_{AC} = T_{AC}\ \boldsymbol{\lambda}_{AC} = (2130\ \text{N})\ \frac{1}{142}[(90)\ \mathbf{i} + (-60)\ \mathbf{j} + (92)\ \mathbf{k}]$$

$$= 1350\ \mathbf{i} - 900\ \mathbf{j} + 1380\ \mathbf{k}\ \ (\text{N})$$

$$\mathbf{R} = \mathbf{T}_{AB} + \mathbf{T}_{AC}$$

$$= [1125\ \mathbf{i} - 750\ \mathbf{j} - 450\ \mathbf{k}\ \ (\text{N})] + [1350\ \mathbf{i} - 900\ \mathbf{j} + 1380\ \mathbf{k}\ \ (\text{N})]$$

$$= 2475\ \mathbf{i} - 1650\ \mathbf{j} + 930\ \mathbf{k}\ \ (\text{N})$$

합력의 크기

$$R = \sqrt{R_x^{\,2} + R_y^{\,2} + R_z^{\,2}} = \sqrt{(2475\ \text{N})^2 + (-1650\ \text{N})^2 + (930\ \text{N})^2} = 3117\ \text{N}$$

$$\Rightarrow \quad R = 3120\ \text{N}$$

합력의 방향

$$\cos\theta_x = \frac{R_x}{R} = \frac{2475}{3120} = 0.7933 \quad \Rightarrow \quad \theta_x = \cos^{-1}(0.7933) = 37.5°$$

$$\cos\theta_y = \frac{R_y}{R} = \frac{-1650}{3120} = -0.5288 \quad \Rightarrow \quad \theta_x = \cos^{-1}(-0.5288) = 121.9°$$

$$\cos\theta_z = \frac{R_z}{R} = \frac{930}{3120} = 0.2981 \quad \Rightarrow \quad \theta_x = \cos^{-1}(0.2981) = 72.7°$$