

1.[4 ]

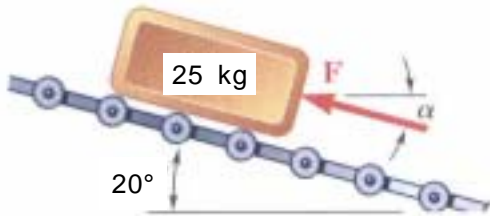
(a) (mechanical engineering)

(b) (equilibrium)

2.[2 ] ( )가

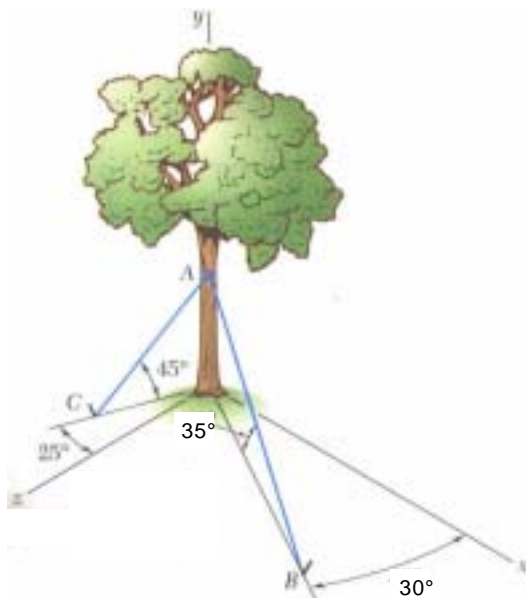
3.[6 ]

$\alpha = 20^\circ$  F 가



- (a)
- (b) F F
- F
- (c)

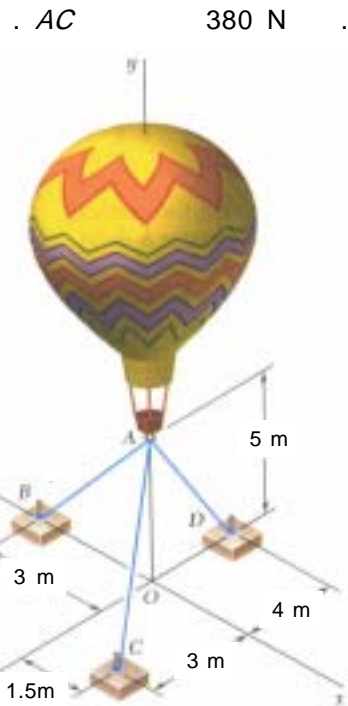
4.[4 ] Cables AB and AC are attached to the upper trunk of the tree and then are fastened to steel rods anchored in the ground. The tension in the wire AB is 2500 N.



(a) Determine the component magnitude  $F_x$ ,  $F_y$ ,  $F_z$  of the force exerted by the cable AB on the tree at A.

(b) Determine the angles  $\theta_x$ ,  $\theta_y$ ,  $\theta_z$  defining the direction of the force exerted by the cable AB on the rod at A.

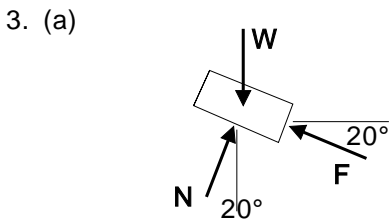
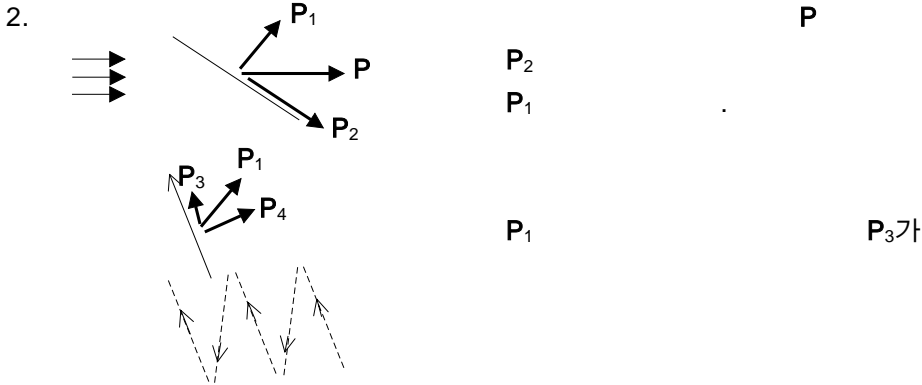
5.[4 ]



- (a) AC A
- (b) A P

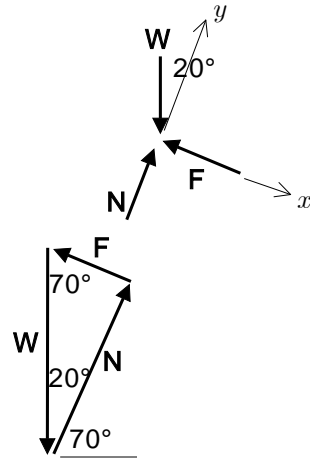
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- 3. (b)  $F = 83.9 \text{ N}$   $20^\circ$
  - (c)  $N = 230 \text{ N}$   $70^\circ$
  - 4. (a)  $F_x = 1774 \text{ N}$ ,  $F_y = -1434 \text{ N}$ ,  $F_z = 1024 \text{ N}$
  - (b)  $\theta_x = 44.8^\circ$ ,  $\theta_y = 125.0^\circ$ ,  $\theta_z = 65.8^\circ$
  - 5. (a)  $T_{AC} = 94.7 \text{ i} - 316 \text{ j} + 189.3 \text{ k}$  (N)
  - (b)  $P = 711 \text{ N}$

1. (a) ( : , , . , , )  
 (b) ( : , )

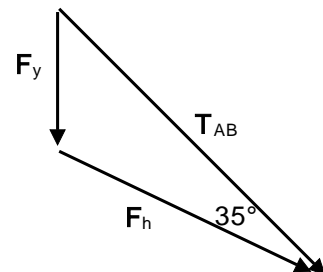


(b)  $W = m g = (25 \text{ kg})(9.81 \text{ m/s}^2) = 245.2 \text{ N}$   
 $F_x = 0 \quad -F + W \sin 20^\circ = 0$   
 $F = W \sin 20^\circ = (245.2 \text{ N}) \sin 20^\circ = 83.88 \text{ N}$   
 $F = 83.9 \text{ N} \quad \underline{20^\circ}$

(c)  $\frac{\sin 70^\circ}{N} = \frac{\sin 90^\circ}{W} = \frac{\sin 20^\circ}{F}$   
 $N = W \frac{\sin 70^\circ}{\sin 90^\circ} = (245.2 \text{ N}) \sin 70^\circ = 230.4 \text{ N}$   
 $N = 230 \text{ N} \quad \underline{70^\circ}$



4. (a)  $F_h = T_{AB} \cos 35^\circ = (2500 \text{ N}) \cos 35^\circ = 2048 \text{ N}$   
 $F_x = F_h \cos 30^\circ = (2048 \text{ N}) \cos 30^\circ = 1774 \text{ N}$   
 $F_y = -T_{AB} \sin 35^\circ = -(2500 \text{ N}) \sin 35^\circ = -1434 \text{ N}$   
 $F_z = F_h \sin 30^\circ = (2048 \text{ N}) \sin 30^\circ = 1024 \text{ N}$



(b)  $\theta_x = \cos^{-1} \frac{F_x}{T_{AB}} = \cos^{-1} \frac{1774}{2500} = \cos^{-1}(0.7096) = 44.8^\circ$   
 $\theta_y = \cos^{-1} \frac{F_y}{T_{AB}} = \cos^{-1} \frac{-1434}{2500} = \cos^{-1}(-0.5736) = 125.0^\circ$   
 $\theta_z = \cos^{-1} \frac{F_z}{T_{AB}} = \cos^{-1} \frac{1024}{2500} = \cos^{-1}(0.4096) = 65.8^\circ$

5. (a)  $T_{AC} = 380 \text{ N}$ ,  $dx = 1.5 \text{ m}$ ,  $dy = -5 \text{ m}$ ,  $dz = 3 \text{ m}$

$$d = \sqrt{d_x^2 + d_y^2 + d_z^2} = \sqrt{(1.5 \text{ m})^2 + (-5 \text{ m})^2 + (3 \text{ m})^2} = 6.021 \text{ m}$$

$$\lambda_{AC} = \frac{1}{d} [d_x \mathbf{i} + d_y \mathbf{j} + d_z \mathbf{k}] = \frac{1}{6.021 \text{ m}} [(1.5 \text{ m}) \mathbf{i} + (-5 \text{ m}) \mathbf{j} + (3 \text{ m}) \mathbf{k}]$$

$$= 0.2491 \mathbf{i} - 0.8305 \mathbf{j} + 0.4983 \mathbf{k}$$

$$\mathbf{T}_{AC} = \lambda_{AC} T_{AC} = (0.2491 \mathbf{i} - 0.8305 \mathbf{j} + 0.4983 \mathbf{k}) (380 \text{ N})$$

$$= 94.7 \mathbf{i} - 316 \mathbf{j} + 189.3 \mathbf{k} \text{ (N)}$$

(b)  $\lambda_{AB} = \frac{(-3 \text{ m})\mathbf{i} + (-5 \text{ m})\mathbf{j} + (0)\mathbf{k}}{\sqrt{(-3 \text{ m})^2 + (-5 \text{ m})^2 + 0}} = \frac{(-3)\mathbf{i} + (-5)\mathbf{j}}{5.831} = -0.514 \mathbf{i} - 0.857 \mathbf{j}$

$$\mathbf{T}_{AB} = \lambda_{AB} T_{AB} = (-0.514 \mathbf{i} - 0.857 \mathbf{j}) T_{AB}$$

$$\lambda_{AD} = \frac{0 \mathbf{i} + (-5 \text{ m})\mathbf{j} + (-4 \text{ m})\mathbf{k}}{\sqrt{0 + (-5 \text{ m})^2 + (-4 \text{ m})^2}} = \frac{(-5)\mathbf{j} + (-4)\mathbf{k}}{6.403} = -0.7809 \mathbf{j} - 0.6247 \mathbf{k}$$

$$\mathbf{T}_{AD} = \lambda_{AD} T_{AD} = (-0.7809 \mathbf{j} - 0.6247 \mathbf{k}) T_{AD}$$

$$\mathbf{P} = P \mathbf{j}$$

$$\mathbf{F} = 0 \quad \mathbf{T}_{AB} + \mathbf{T}_{AC} + \mathbf{T}_{AD} + \mathbf{P} = 0$$

$$\mathbf{i}; \quad -0.514 T_{AB} + (94.7 \text{ N}) + 0 + 0 = 0 \quad \dots \quad T_{AB} = 184.2 \text{ N}$$

$$\mathbf{j}; \quad -0.857 T_{AB} + (-316 \text{ N}) - 0.781 T_{AD} + P = 0 \dots$$

$$\mathbf{k}; \quad 0 + (189.3 \text{ N}) - 0.624 T_{AD} + 0 = 0 \quad \dots \quad T_{AD} = 303.4 \text{ N}$$

$$P = 0.857 (184.2 \text{ N}) + (316 \text{ N}) + 0.781 (303.4 \text{ N}) = 710.8 \text{ N}$$

$$\mathbf{P} = 711 \text{ N}$$