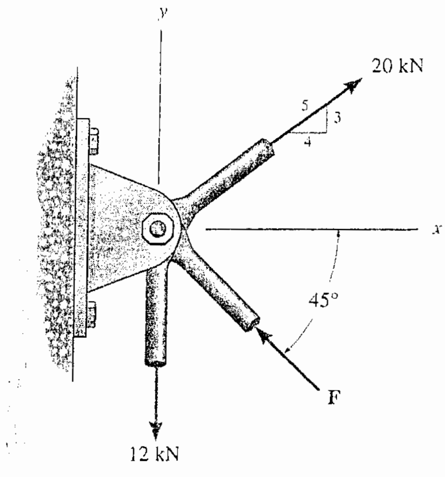
CE 201-2 (041)

H.W # 2



Prob. 2–33

Fig-1

2-33 (P-38)

Given:

The forces are shown in Fig.-1, F_R in Min^m

Req.d:

the magnitude of F.

Sol.n:

From Fig.-2

The resultant force of the two known forces, $R_1 = \sqrt{(12)^2 + (20)^2 - 2(12)(20)\underbrace{\cos 53.12}_{3/5}}$

$= 16\ kN$

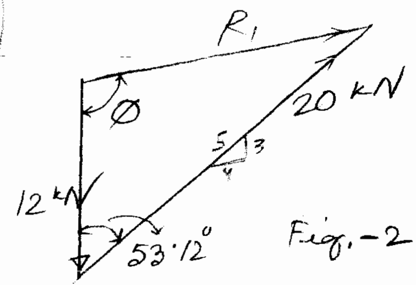


Fig.-2

or $R_{1_x} = 20(\frac{4}{5}) = 16\ kN$

$R_{1_y} = 20(\frac{3}{5}) - 12$
$= 12 - 12 = 0$

$\Rightarrow R_1 = 16\ kN$ along x-axis

To make the resultant force F_R min^m, $R \perp F$

From Fig. 2

$\frac{20}{\sin \emptyset} = \frac{16}{\sin 53.12}$

$\therefore \emptyset = 90°$

From Fig. 3

$\frac{16}{\sin 90} = \frac{F}{\sin 45} \Rightarrow$

$\therefore \boxed{F = 11.31}\ kN$

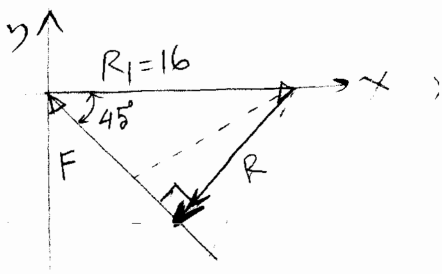


Fig-3

⊛ Another method for the solution

1- Write $R = f(F)$.
2- Take $\frac{dR}{dF}$ & set it equal to zero to get max or min.
3- From $\frac{dR}{dF} = 0$, find F & check F_{max} or F_{min}. (($\frac{d^2R}{dF^2} \lesseqgtr 0$?))

Prob. 2-77 (P. 54)

Given:
Forces shown in Fig-1
Resultant force given

Req.d:
The magnitude and the coordinate direction angles of forces $\vec{F_3}$

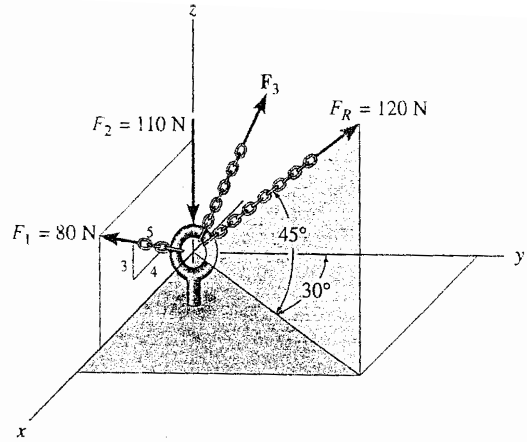


Fig-1

Sol.n:

$\vec{F_1} = \frac{80}{5} * 4\vec{i} + \frac{80}{5} * 3\vec{k}$

$\therefore \vec{F_1} = 64\vec{i} + 48\vec{k}$

$\vec{F_2} = -110\vec{k}$.

$\vec{F_R} = 120 \cos 45 * \sin 30\, \vec{i} + 120 \cos 45° \cos 30\, \vec{j} + 120 \sin 45°\, \vec{k}$

$\vec{F_R} = 42.426\vec{i} + 73.48\vec{j} + 84.85\vec{k}$

$\vec{F_3} = F_3 \cos\alpha\, \vec{i} + F_3 \cos\beta\, \vec{j} + F_3 \cos\gamma\, \vec{k}. \quad = F_{3x}\vec{i} + F_{3y}\vec{j} + F_{3z}\vec{k}$

$\vec{F_R} = \vec{F_1} + \vec{F_2} + \vec{F_3}$

$\Rightarrow (42.426\vec{i} + 73.48\vec{j} + 84.85\vec{k}) = (64\vec{i} + 48\vec{k}) + (-110\vec{k})$
$+ (F_3 \cos\alpha\, \vec{i} + F_3 \cos\beta\, \vec{j} + F_3 \cos\gamma\, \vec{k})$

$\Rightarrow 42.426 = 64 + F_3 \cos\alpha \quad \therefore F_3 \cos\alpha = -21.574 \text{ N} = F_{3x}$

$\Rightarrow 73.48 = F_3 \cos\beta \quad \therefore F_3 \cos\beta = 73.48 \text{ N} = F_{3y}$

$\Rightarrow 84.85 = 48k - 110k + F_3 \cos\gamma \quad \therefore F_3 \cos\gamma = 146.85 \text{ N} = F_{3z}$

$F_3 = \sqrt{(-21.574)^2 + (73.48)^2 + (146.85)^2} = 166 \text{ N} \quad \therefore \boxed{F_3 = 166 \text{ N}}$

$\therefore \boxed{\alpha = 97.5°} = \theta_x$

$\boxed{\beta = 63.73} = \theta_y \quad \boxed{\gamma = 27.8°} = \theta_z$

$\Leftarrow \cos\theta_x = \frac{F_{3x}}{F_3}$

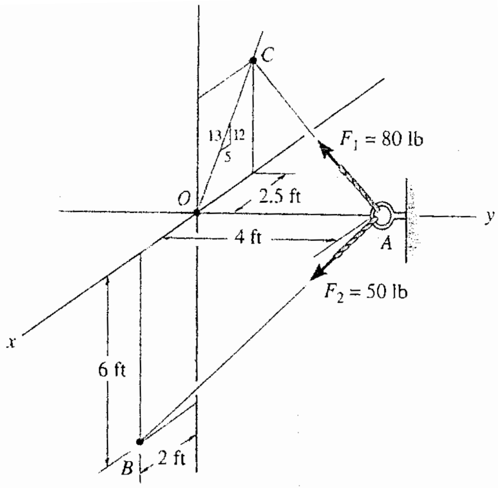
$\vdots$

etc.

Prob. 2-93 (P. 64)

Given:

The forces are shown in Fig-1



Prob. 2–93

Fig.-1

Reqd:

The magnitude and coordinate direction angles of the resultant force, R.

Sol.n:

A(0, 4, 0)

B(2, 0, -6)

C(-2.5, 0, 6)

$\vec{AC} = -2.5\vec{i} - 4\vec{j} + 6\vec{k}$

$\vec{AB} = 2\vec{i} - 4\vec{j} - 6\vec{k}$

$AC = 7.63$

$AB = 7.48$

$\vec{F}_{AB} = 13.37\vec{i} - 26.73\vec{j} - 40\vec{k}$

$\vec{F}_{AC} = -26.21\vec{i} - 41.94\vec{j} + 62.9\vec{k}$

$\vec{R} = \vec{F}_{AB} + \vec{F}_{AC}$

$\vec{R} = -12.84\vec{i} - 68.67\vec{j} + 22.9\vec{k}$ $\boxed{R = 73.51 \text{ lb}}$

$\boxed{\alpha = 100°} = \theta_x$

$\boxed{\beta = 159°} = \theta_y$

$\boxed{\gamma = 71.85°} = \theta_z$

Prob. 2-111 (P. 73)

Given:

The forces are shown in Fig-1

Req.d:

The angle θ between two cable

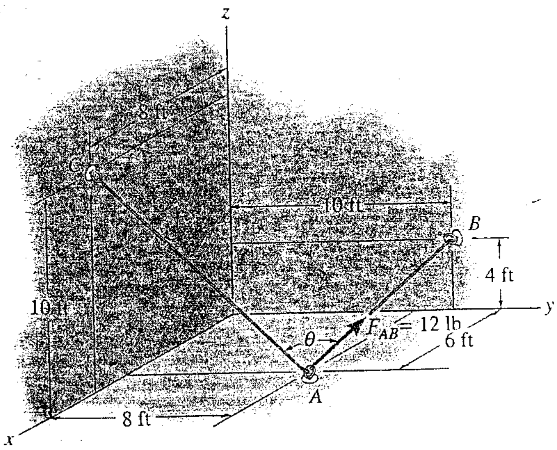


Fig-1

Sol.n:

A(6, 8, 0)
B(0, 10, 4)
C(8, 0, 10)

$\vec{AB} = -6\vec{i} + 2\vec{j} + 4\vec{k}$. $\quad AB = 7.483$

$\vec{AC} = 2\vec{i} - 8\vec{j} + 10\vec{k}$. $\quad AC = 12.96$

$\vec{AB} \cdot \vec{AC} = AB \cdot AC \cdot \cos\theta$

$$\theta = \cos^{-1}\left\{\frac{\vec{AB} \cdot \vec{AC}}{AB \cdot AC}\right\} = 82.89^\circ.$$

$\boxed{\theta \doteq 82.9^\circ}$

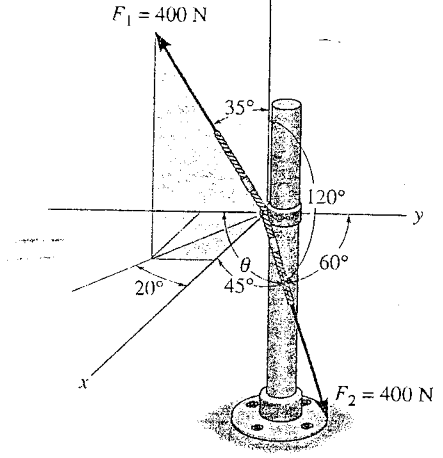
Prob 2-130 (P. 76)

Given:

Forces are shown in Fig.-1

Reqd:

The magnitude of the projected component of F_1 along the line of action of F_2, $(F_1)_{F_2}$



Prob. 2–130

Fig.-1

$$\vec{F_1} = 400\{\sin 35 \times \cos 20 \vec{i} - \sin 35 \times \sin 20 \vec{j} + \cos 35 \vec{k}\}$$

$$= 215.594 \vec{i} - 78.47 \vec{j} + 327.66 \vec{k}$$

$$\vec{u}_{F_2} = \cos 45 \vec{i} + \cos 60 \vec{j} + \cos 120 \vec{k}$$

$$= 0.707 \vec{i} + 0.5 \vec{j} - 0.5 \vec{k}.$$

$$(F_1)_{F_2} = \vec{F_1} \cdot \vec{U}_{F_2} = \underline{50.6 \text{ N}}$$