CE 201 (091)
Sections 3&4
Solution of H.W # 1

Problem #1 :-

- Given Data

The figure shown

Fig P1

$F_{BA} = F_{BC} = 800\,N$.

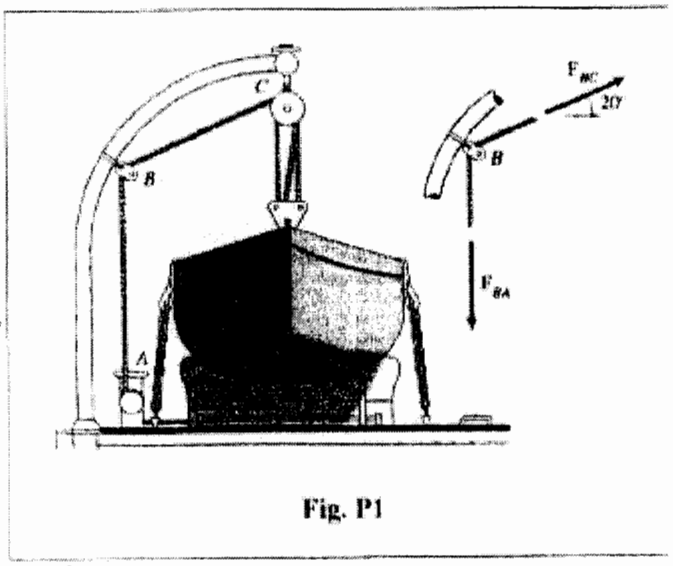

Fig. P1

- Required :-

the magnitude and the direction of the resultant of the two forces.

- solution :-

In the fig. 1, using the sine and cosine laws:

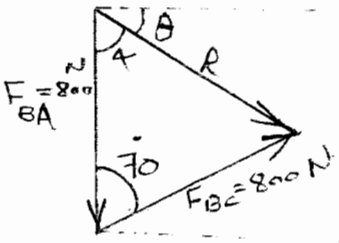

Fig. 1

$$R^2 = F_{BA}^2 + F_{BC}^2 - 2 * F_{BA} * F_{BC} * \cos 70$$

$$\Rightarrow R^2 = (800)^2 + (800)^2 - 2*800*800*0.3420$$

$$= 842214.216$$

$$\Rightarrow R = 917.72$$ #

* To find the direction of R:

$$\frac{\sin\alpha}{F_{BC}} = \frac{\sin 70}{R} \Rightarrow \frac{\sin\alpha}{800} = \frac{0.93969}{917.72}$$

$$\Rightarrow \sin\alpha = 0.81915 \Rightarrow \alpha = 55^\circ$$

$\theta = 90 - 55 = 35^\circ$ #

Thus, R is directed 55° from F_{BA} (vertical) or 35° from the horizontal

Note that sin law can be used to calculate R instead of ~~#~~

Problem #2:

* Given Data:

. The figure shown, Fig. P2

- Rocket engine exerts an upward force of 4 MN.

* Required:

· Resolve the force into two components parallel to the bars AB and CD.

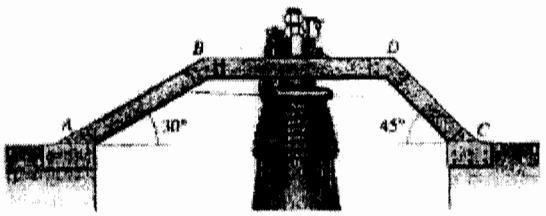

Fig. P2

* Solution:

In the Fig. 1,

$\alpha = 90 - 30 = 60^\circ$

$\beta = 90 - 45 = 45^\circ$

$\gamma = 45^\circ$ (Why ?!)

$\phi = 90 - 45 = 45^\circ$

$\theta = 30 + \gamma = 75^\circ$

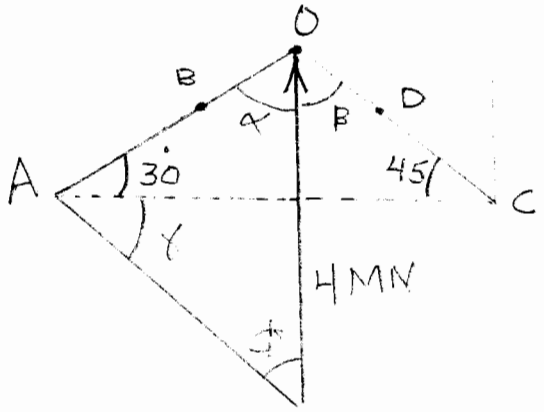

Fig. 1.

Using the sine laws,

$$\frac{4}{\sin 75} = \frac{F_{AB}}{\sin 45^\circ} \Rightarrow F_{AB} = 2.928 \text{ MN} \quad \#$$

$$\frac{4}{\sin 75} = \frac{F_{CD}}{\sin 60} \Rightarrow F_{CD} = 3.586 \text{ MN} \quad \#$$

Problem # 3:

* **Given Data:**
  - The figure shown, Fig P3.
  - $F_A = 1000$ lb, the resultant is directed along Line L.

* **Required:**
  - The magnitude of F_B
  - the resultant of the two forces.

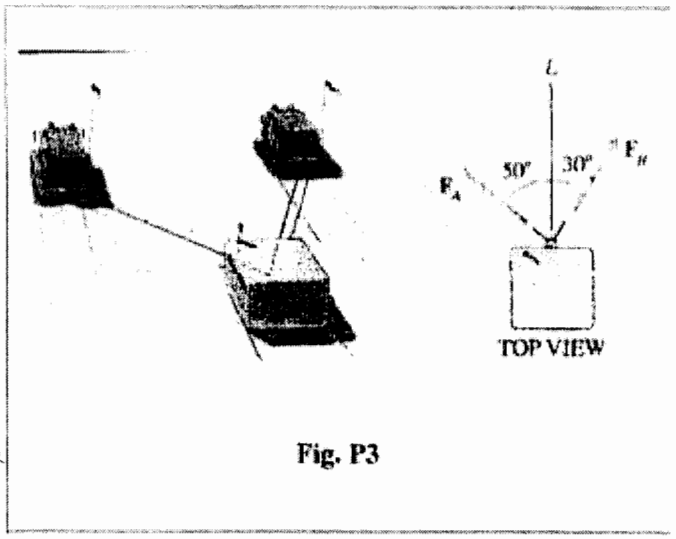

Fig. P3

* **Solution:**

From Fig. 1.

$\theta = 180 - (50 + 30)$

$= 100^\circ$

$\alpha = 180 - 50 - 100 = 30^\circ$

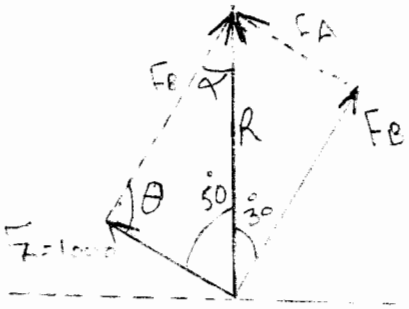

Fig. 1

Using the sine laws,

$$\frac{F_A}{\sin\alpha} = \frac{F_B}{\sin 50} = \frac{R}{\sin\theta}$$

$$\Rightarrow F_B = \frac{1000}{\sin 30} \times (\sin 50)$$

$$\Rightarrow F_B = 1532.09 \text{ lb} \quad \#$$

$$R = \frac{1000}{\sin 30} \times (\sin 100)$$

$$\Rightarrow R = 1969.6 \text{ lb} \quad \#$$

Problem # 4 :

* Given Data :

- The figure shown, Fig. P4
- The resultant forces = 0.0
- W = 600 kN.

* Required :

- F_A & F_B

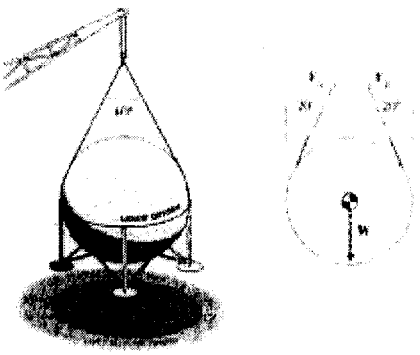

Fig. P4

* Solution :

From Fig. 1,

$\pm\rightarrow \sum F_x = F_A \sin 20 - F_B \sin 20 = R_x$

$+\uparrow \sum F_y = F_A \cos 20 + F_B \cos 20 - W = R_y$

Since the resultant is zero, both R_x and R_y must be zero (each one separately : Why ?!))

$\Rightarrow R_y = F_A \sin 20 - F_B \sin 20 = 0$

$\Rightarrow F_A = F_B$

$R_y = F_A \cos 20 + F_B \cos 20 - 600 = 0$

$\Rightarrow F_A \cos 20 + F_A \cos 20 - 600 = 0$

$\Rightarrow F_A = 319.25$ kN

$F_B = 319.25$ kN,

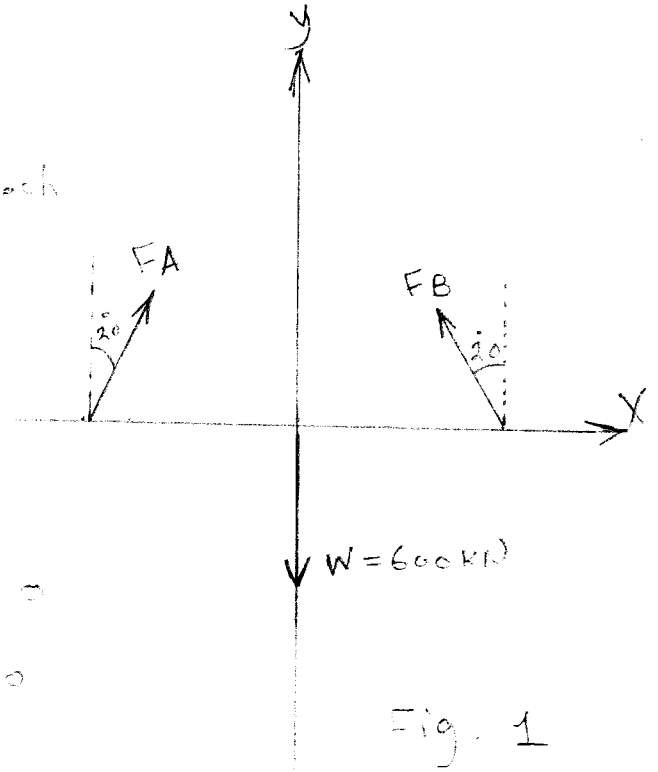

Fig. 1

Problem # 5

* Given Data:
  - The figure shown, Fig. P5
  - $F_B = 800\ N$
  - $F_C = 1000\ N$
  - $F_D = 900\ N$
  - $R = zero$

* Required :-
  - FA
  - The direction α of F_A

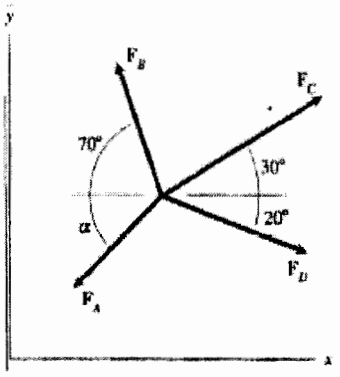

Fig. P5

* Solution :

since the resultant is zero, $R_x = F_y = 0$

$\therefore \Sigma F_x = 0$ and $\Sigma F_y = 0 \Rightarrow$

$\pm\rightarrow \Sigma F_x = 900\cos 20 + 1000\cos 30 - 800\cos 70 - F_A\cos\alpha = 0$ .... (1)

$\Rightarrow F_A\cos\alpha = 1432.125$ .... (1)

$+\uparrow \Sigma F_y = 800\sin 70 + 1000\sin 30 - 900\sin 20 - F_A\sin\alpha = 0$ .... (2)

$\Rightarrow F_A\sin\alpha = 943.932$ .... (2)

Divide equation (2) by (1), $\Rightarrow \frac{F_A\sin\alpha}{F_A\cos\alpha} = \frac{943.932}{1432.125}$

$\Rightarrow \tan\alpha = 0.65936$

$\Rightarrow \alpha = 33.28^\circ$ #

Using equation (2) $\Rightarrow F_A * \sin 33.28 = 943.932$

$\Rightarrow F_A = 1720.2\ N$ #