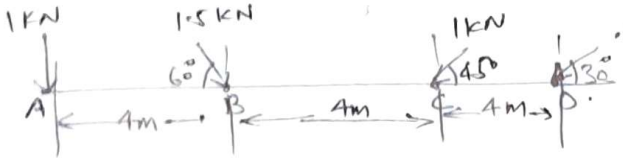
Q. A horizontal beam AD of length 12 m is acted upon (2) (80) by a set of forces as shown in fig



Soln

$\Sigma F_x = 0 + 1.5\cos 60 - 1\cos 45^\circ - .5\cos 30 = -0.39$ KN

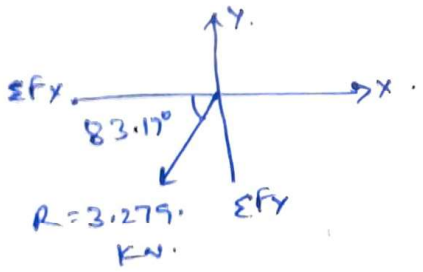
$\Sigma F_y = -1 - 1.5\sin 60 - 1\sin 45 - 0.5\sin 30^\circ = -3.256$ KN.

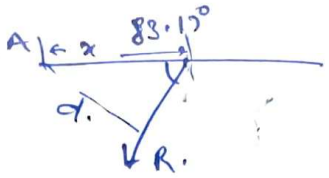
$R = \sqrt{(-.39)^2 + (3.256)^2} = 3.279$ KN.

$\tan\alpha = \frac{\Sigma F_y}{\Sigma F_x} = 8.333$, $\alpha = 83.17^\circ$. (lie in 3rd quadrant).

taking moment of all forces about point A. (clock +ve)

$\Sigma M_A = 1.5\sin 60 \times 4 + 1\sin 45 \times 8 + .5\sin 30 \times 12 = 13.853$ KN-m





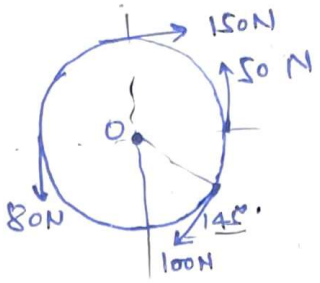
$R \times d = \Sigma M_A$

$d = \frac{13.853}{3.279} = 4.22$ m.

horizontal distance $x = ?$

$\sin 83.17 = \frac{d}{x} \Rightarrow x = \frac{4.22}{\sin 83.17^\circ} = 4.25$ m.

Q. Determine the resultant of the four forces acting tangentially to a circle of radius 3 m as shown in fig. What will be the location of the resultant with respect to centre of the circle.



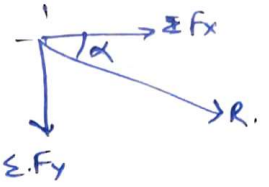
Soln —

$$\Sigma F_x = 150 - 100 \cos 45^\circ = 79.29\ N$$

$$\Sigma F_y = 50 - 80 - 100 \sin 45^\circ = -100.71\ N.$$

$$R = \sqrt{(79.29)^2 + (-100.71)^2} = 128.18\ N.$$

$$\alpha = \tan^{-1}\left(\frac{100.71}{79.29}\right) \Rightarrow \alpha = 51.8^\circ.$$



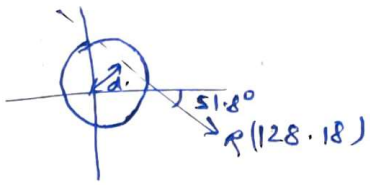
taking Moment about O' (clock +)

$$M_O = 150 \times 3 - 50 \times 3 + 100 \times 3 - 80 \times 3 = 360 \text{ (clockwise) N-m}$$

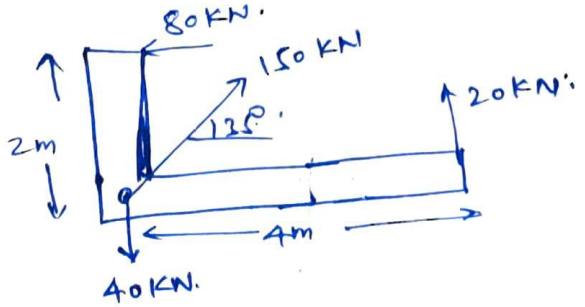
$$R \times d = \Sigma M_O$$

$$= \frac{360}{128.18} = 2.795\ m.$$

from the centre



Q → For the force system applied to an angle bracket as shown in fig. determine the magnitude and direction of the resultant. what would be the distance of line of action of the resultant from point O.

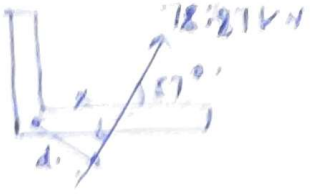


$\Sigma F_x = 150\cos 35° - 80 = 42.87\ KN$ { First quadrant }

$\Sigma F_y = 150\sin 35° + 20 - 40 = 66\ KN$

$R = 78.7\ KN.$

$\alpha = \tan^{-1}\left(\frac{66}{42.87}\right) \Rightarrow \underline{57°}$



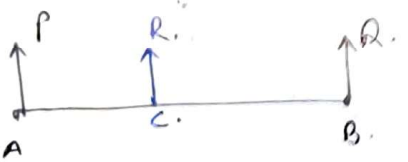
$\Sigma M_O = -80 \times 2 - 20 \times 4 = -240\ KN.$ (Anticlockwise)

$R \times d = \Sigma M_O$

$d = \frac{240}{78.7} = 3.049m$

$\sin\alpha = \frac{d}{x} \Rightarrow x = \frac{3.049}{\sin 57°} = 3.635m.$

* Resultant of like parallel forces:-



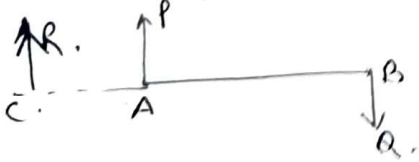
$\Rightarrow R = P + Q$

Take Moment about C point

$P \times AC = Q \times BC$ (x)

$$\boxed{\frac{P}{Q} = \frac{BC}{AC}}$$

* Resultant of unlike parallel forces:-



$R = P - Q.$

$P \times AC = Q \times BC$

$$\boxed{\frac{P}{Q} = \frac{BC}{AC}}$$