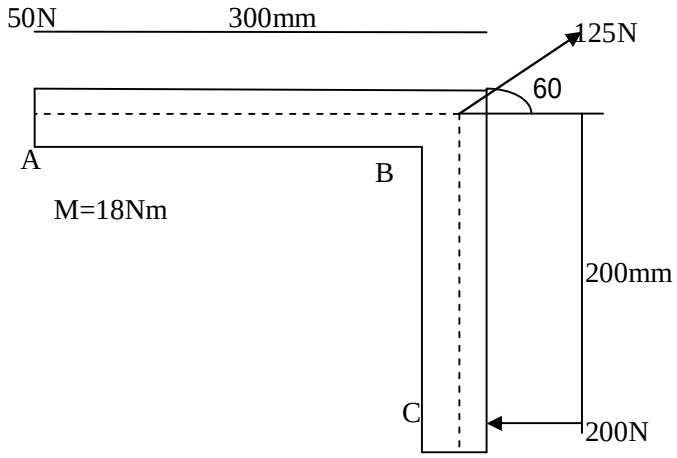
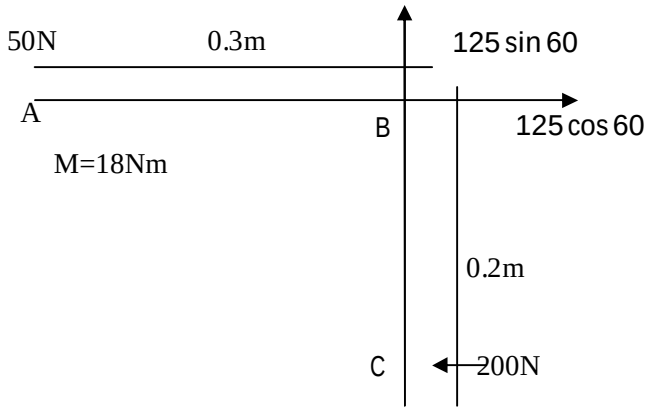
Problem 10:

The three forces and a couple of magnitude m = 18 Nm are applied to an angled bracket as shown in fig. (i) Find the resultant of this system of forces (ii) Locate the points where the line of action of the resultant intersects line AB and line BC.





Solution:

(i) Resultant force

Algebric sum of Horizontal forces,

$$\sum H = 125\cos 60 - 200 = -137.5\ N$$

Algebric sum of Vertical forces

$$\sum V = 125\sin 60 - 50 = 58.25\ N$$

Magnitude of resultant force

$$R = \sqrt{(\sum H)^2 + (\sum V)^2} = \sqrt{(137.5)^2 + (58.25)^2} = 149.32\ N$$

Direction of the resultant force

$$\propto = tan^{-1}\left(\frac{\sum V}{\sum H}\right) = tan^{-1}\left(\frac{58.25}{137.5}\right) = 22.95$$

Location of the resultant force

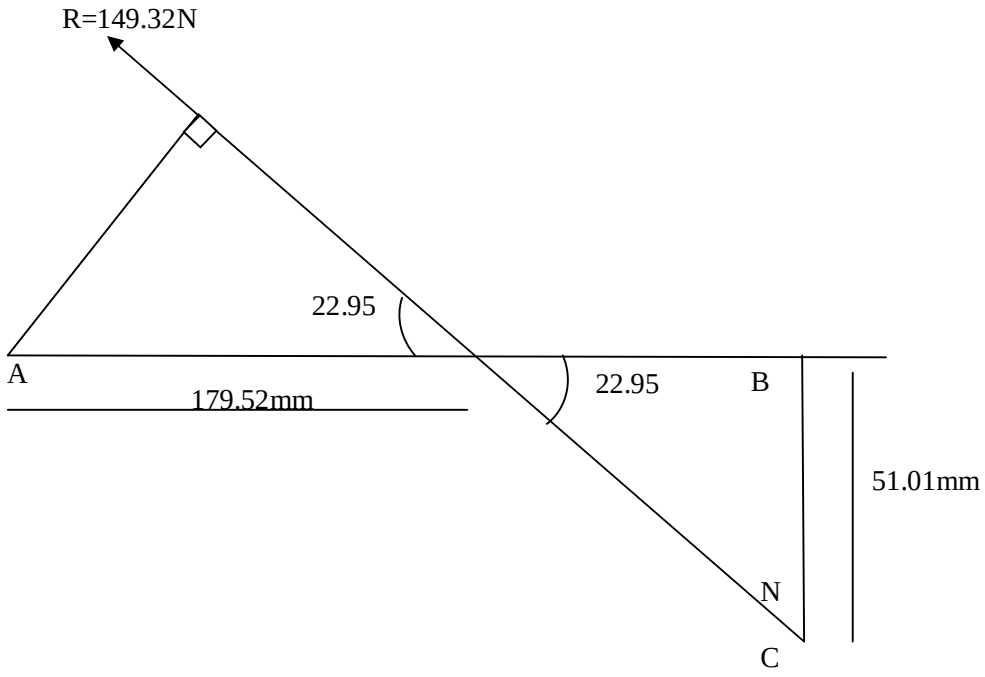
Sum of moments $\sum m_A = -(125 \sin 60 \times 0.3) - 18 + (200 \times 0.2)$

$$= -10.475\ Nm\ (Anticlockwise\ moment)$$

Let x be the perpendicular distance of the resultant from A.

$$\sum m_A = R \times x$$

$$x = \frac{10.475}{149.32} = 0.07\ m = 70\ mm$$



(ii) Intersection of resultant force with line AB and BC

To find AM

In right triangle APM $< APM = 90^{\circ}$; $< PMA = 22.95^{\circ}$; $AP = 70\ mm$

$$\sin 22.95 = \frac{AP}{AM} = \frac{70}{AM}$$

$$AM = \frac{70}{\sin 22.95} = 179.52\ mm$$

To find BN

In right angled triangle BMN

$$BM = AB - AM = 300 - 179.52 = 120.48\ mm$$

$$\tan 22.95 = \frac{BN}{BM} = \frac{BN}{120.48}$$

$$BN = 51.01\ mm$$

EQILIBRIUM OF RIGIDBODIES – SUPPORT REACTIONS

Beam:

A beam is a horizontal structural member which carries a load, transverse (perpendicular) to its axis and transfers the load through support reactions to supporting columns or walls.

Frame:

A structure made up of several members, riveted or welded together is known as frame.

Support reactions of Beam:

The force of resistance exerted by the support on the beam is called as support reactions.

- Support reaction of beam depends upon the type of loading and type of support.

Types of Supports

1. Roller support
2. Hinged support
3. Fixed support

1. Roller support: