Solution

$$Magnitude\ of\ the\ resultant\ force\ R = 10 - 15 - 20 + 35 = 10N$$

Direction of the resultant; upwards (R is positive)

Location of the resultant force

From Varignon's theorem

$$\sum m_A = R \times x (moment\ of\ the\ resultant\ force)$$

Algebric sum of the moments about A

$$\therefore \sum m_A = (10 \times 0) + (15 \times 1) + (20 \times 3) - (35 \times 4)$$

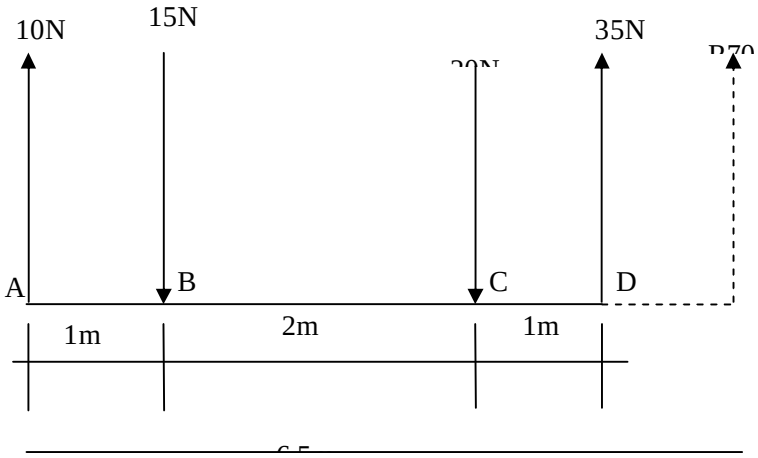
$$= 15 + 60 - 140 = -65Nm(satisfied)$$

Since

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

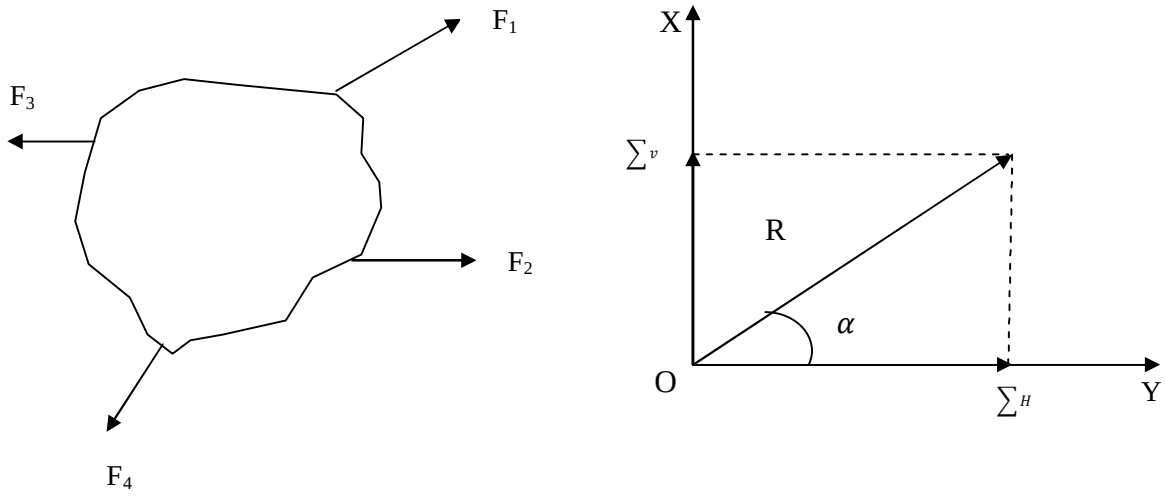
$$65 = 10 \times x$$

$$x = 6.5m$$



Resultant force of Nm –concurrent & non parallel forces

The magnitude and direction of resultant force can be determined by analytical method as same for concurrent force system. But, the location of resultant force of non concurrent and non parallel force system is determined by the concept of moment and Varignon's principle.



Magnitude of resultant force

$$R = \sqrt{\left(\sum H\right)^2 + \left(\sum v\right)^2}$$

Direction of resultant force $\alpha = \tan^{-1}\left[\frac{\sum H}{\sum v}\right]$

Location of resultant

$$\sum m = R \times x$$

Problem 3:

ABCD is a weightless rod under the action of forces $P, Q, S \; and \; T$ as shown in fig. if $P = 10N, Q = 4N, S = 8N \; and \; T = 12N$, calculate the resultant and mark the same in direction with respect to the end A of the rod.