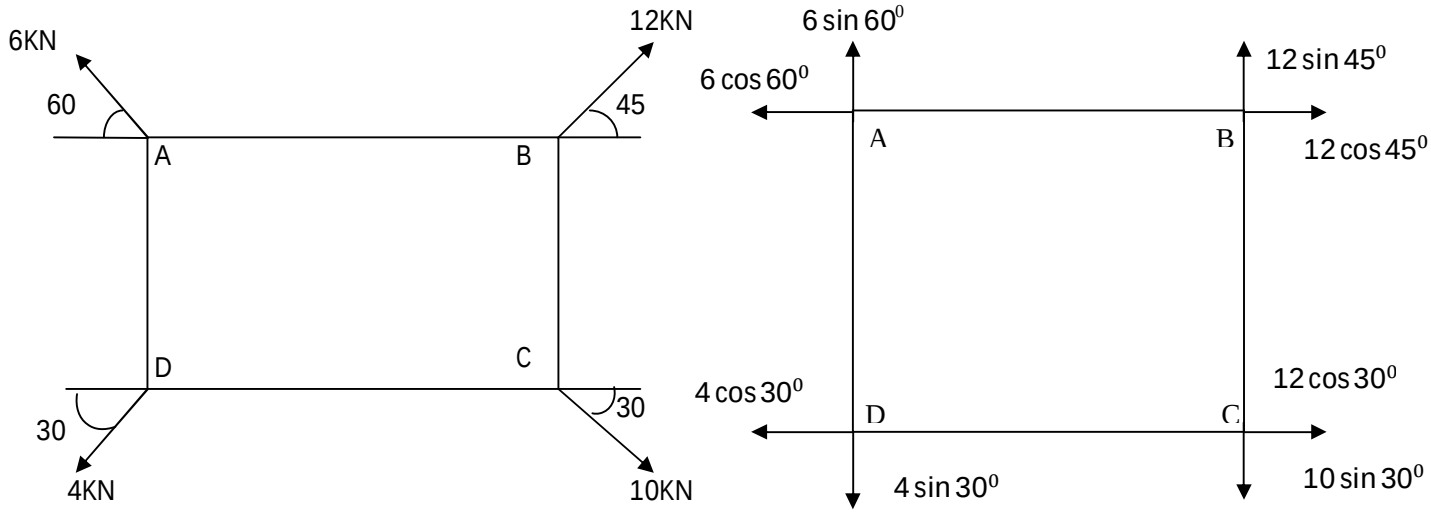
Problem 4:

Four forces of magnitude and direction acting on a square ABCD of side 2m one shown in fig. calculate the resultant in magnitude and direction and also locate its point of application with respect to the sides AB and AD



Solution:

Algebric sum of horizontal forces

$$\sum H = 12\cos 45 + 10\cos 30 - 4\cos 30 - 60\cos 60 = 10.681KN$$

Algebric sum of vertical forces

$$\sum v = 12\sin 45 - 10\sin 30 - 4\sin 30 + 60\sin 60$$

$$= 6.681KN$$

Magnitude of the resultant force

$$R = \sqrt{\left(\sum H\right)^2 + \left(\sum v\right)^2} = \sqrt{(10.681)^2 + (6.681)^2} = 12.598KN$$

Direction of the resultant force

$$\alpha = \tan^{-1}\left(\frac{\sum v}{\sum H}\right) = \tan^{-1}\left(\frac{6.681}{10.681}\right) = 32$$

Location of the resultant force

$$\therefore \sum m_A = (4\cos 30 \times 2) + (10\sin 30 \times 2) - (10\cos 30 \times 2) - (12\sin 45 \times 2)$$

$$= -17.36KNm\ (Anticlockwise)$$

Hence, to have anticlockwise moment by the resultant force, R is to be taken on the right hand side of A.

Location of resultant force w.r.t AB

Resolve the resultant force into two components $\sum H$ and $\sum V$ at m.

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

$$= \sqrt{(\sum H)^2 + (\sum V)^2} \times x$$

as $\sum H$ moment about A is zero.

So, $\sum m_A = \sum V \times x$

$17.36 = 6.681 \times x$

x=2.598m

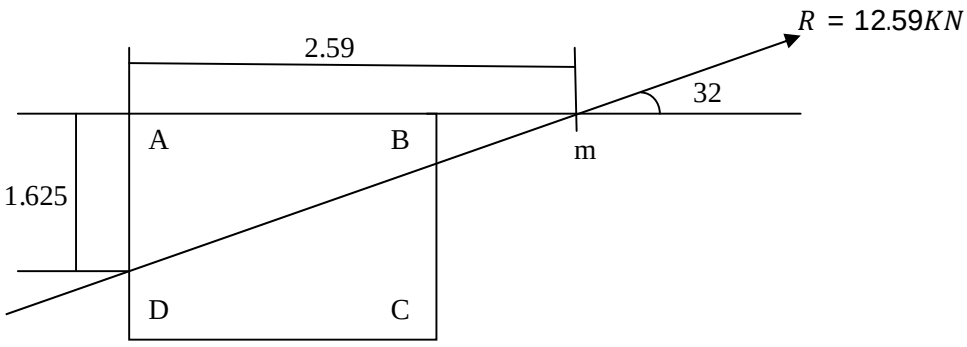
Location of Resultant force w.r.t AD

Resolve the force

$\sum m_A = \sum H \times y$ (As moment of $\sum V$ about A is zero)

$17.36 = 10.681 \times y$

$y = 1.625$m



Statistics of Rigid bodies – Force couple system