

By : Eng . YOUNIS FAKHER

### Resultant of forces system

#### Resultant of non-concurrent coplanar forces system

We will find out the resultant force for many non – concurrent forces acting on a rigid body by using the following equations :

$$R_x = F_1.\cos \theta_1 \mp F_2.\cos \theta_2 \mp F_3.\cos \theta_3 \mp \dots \mp F_n.\cos \theta_n$$

$$R_y = F_1.\sin \theta_1 \mp F_2.\sin \theta_2 \mp F_3.\sin \theta_3 \mp \dots \mp F_n.\sin \theta_n$$

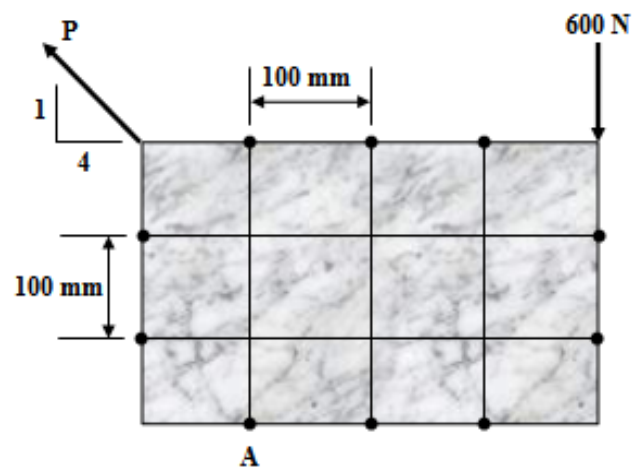
$$R = \sqrt{(R_x)^2 + (R_y)^2}$$

The direction of resultant force may be determined as :

$$\theta = \tan^{-1}\left(\frac{R_y}{R_x}\right)$$

#### Ex ( 1 ):

Determine the force ( P ) shown in fig. knowing that the resultant of the two forces pass through the point ( A ).



#### Solution

$$R_x = F_1.\cos \theta_1 \mp F_2.\cos \theta_2$$

$$R * \cos \theta = -P * \frac{4}{\sqrt{17}}$$

$$R * \cos \theta = -0.9701 * P \dots\dots\dots (1)$$

$$R_y = F_1.\sin \theta_1 \mp F_2.\sin \theta_2$$

$$R * \sin \theta = -600 + P * \frac{1}{\sqrt{17}}$$

$$R * \sin \theta = -600 + 0.2425 P \dots\dots\dots (2)$$

$$\sum M_A = 0$$

$$600 * 300 + P * \frac{1}{\sqrt{17}} * 100 - P * \frac{4}{\sqrt{17}} * 300 = 0$$

$$180000 + 24.25 P - 291 P = 0$$

$$180000 = 266.7 P$$

$$P = \frac{180000}{266.7} = -674.68 N$$

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**Ex ( 2 ) :**

Determine the distance from point ( A ) to the line of action of the resultant of the three forces shown in fig.

**Solution**

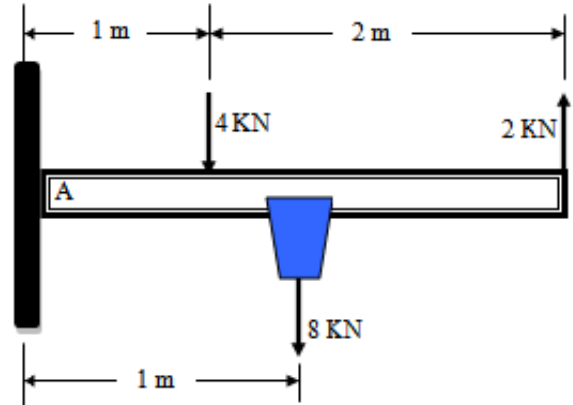
$$R = 2 - 8 - 4 = - 10 \text{ KN}$$

$$M_A = - 4 * 1 - 8 * 1 + 2 * 3 = - 6 \text{ KN.m}$$

$$M_A = R * d$$

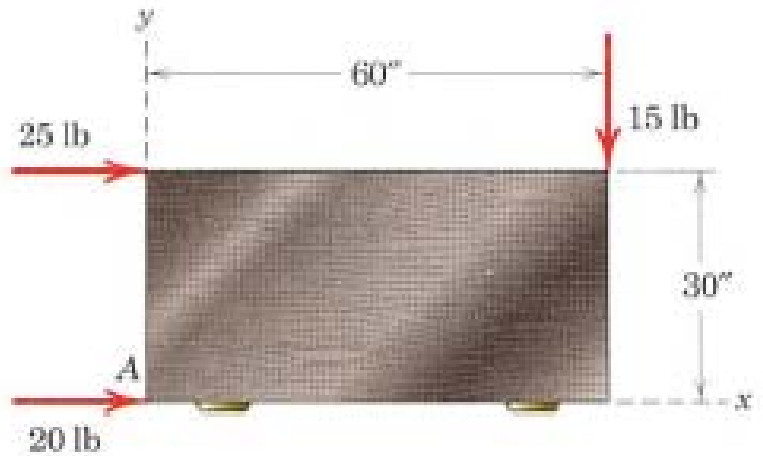
$$-6 = - 10 * d$$

$$d = 6 / 10 = 0.6 \text{ m}$$

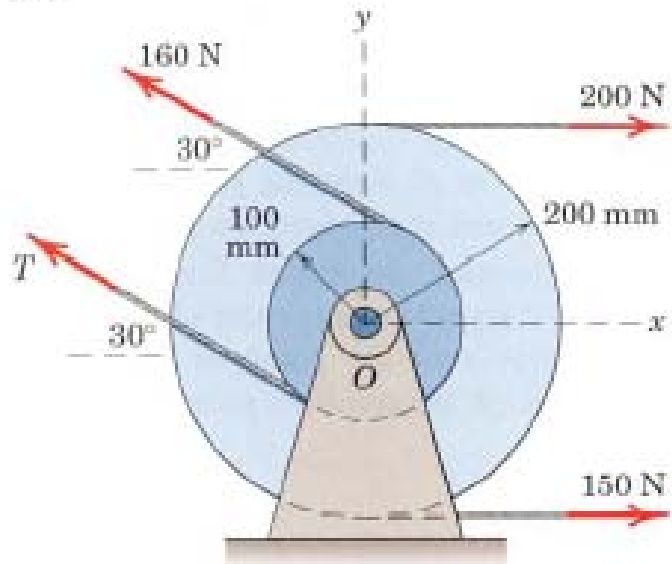


**PROBLEMS**

1 - Find the resultant force for the non - concurrent coplanar forces system, shown in fig



2 – Two integral pulleys are subjected to the belt tension shown . if the resultant of these forces passes through the center ( O ) , Determine ( T ) and the magnitude of ( R ) and the counterclockwise angle ( θ ) it makes with the x – axis .



3 – Replace the three forces acting on the bent pipe by a single equivalent force ( R ) . specify the distance ( x ) from point ( O ) th the point on x – axis through which the line of action of ( R ) passes .

