

# resultant of coplanar forces meeting at point

Tuesday, September 9, 2025 11:34 PM

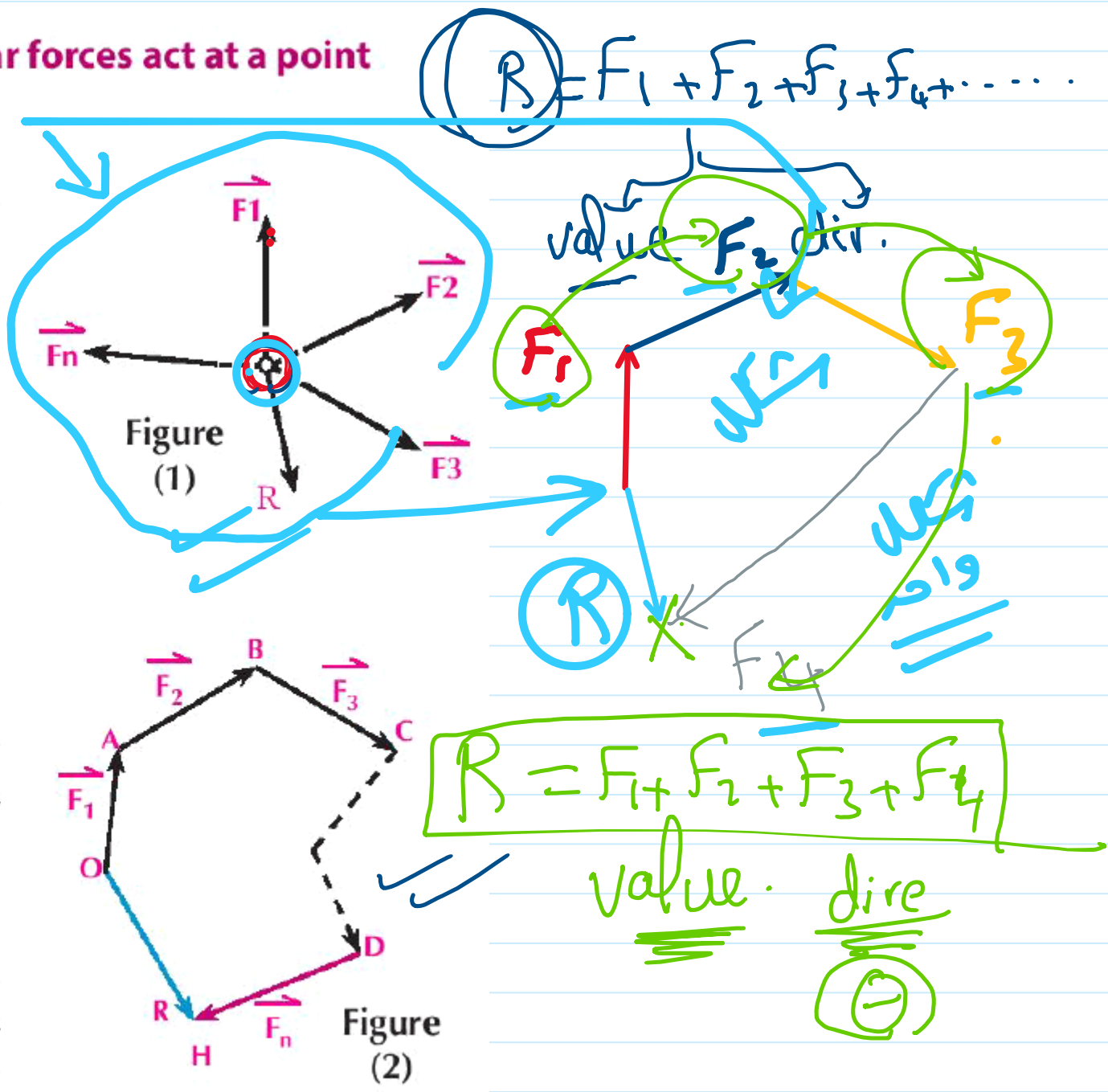
## Resultant of a set of coplanar forces act at a point geometrically:

If set of forces  $\vec{F}_1, \vec{F}_2, \vec{F}_3, \dots, \vec{F}_n$  act on a particle as shown in figure (1).

Using a suitable drawing scale, draw  $\vec{OA}$  represents  $\vec{F}_1$ ,  $\vec{AB}$  represents  $\vec{F}_2$ ,  $\vec{BC}$  represents  $\vec{F}_3$  and so on, .... till  $\vec{F}_n$  is represented by  $\vec{DH}$ .

Then the vector  $\vec{OH}$  in the opposite cyclic order represents the resultant of the forces, where:

$\vec{R} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \dots + \vec{F}_n$  and the polygon is called polygon of forces, it is easy to notice that forming a polygon of forces is the result of applying the triangle of forces several consecutive times.



# resultant of coplaner forces meeting at point\_1

Thursday, October 9, 2025 8:37 AM

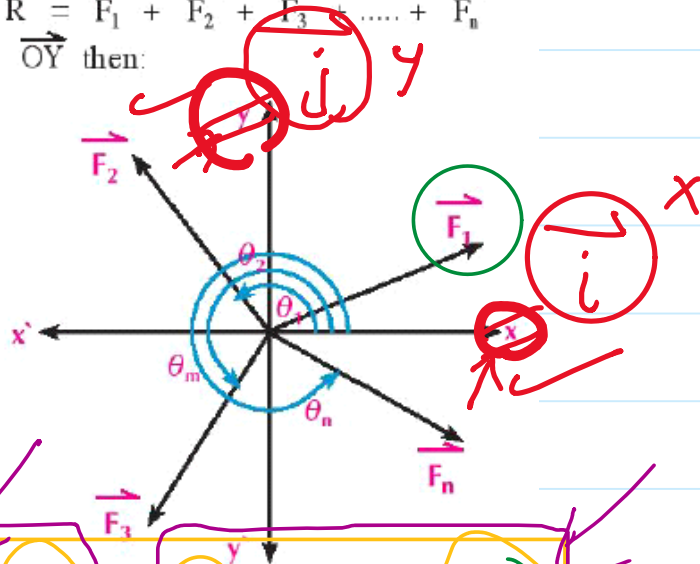
## The resultant of coplaner forces meeting at a point analytically

If the coplaner forces  $\vec{F}_1, \vec{F}_2, \vec{F}_3, \dots, \vec{F}_n$  act at a point in the coordinate plane system, to make the polar angles  $\theta_1, \theta_2, \theta_3, \dots, \theta_n$  respectively and  $\vec{i}, \vec{j}$  are two fundamental unit vectors in directions  $\vec{OX}, \vec{OY}$  then:  $\vec{R} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \dots + \vec{F}_n$   
Resolving each force in the perpendicular directions  $\vec{OX}, \vec{OY}$  then:

$$\begin{aligned} \vec{R} &= (F_1 \cos \theta_1 \vec{i}, F_1 \sin \theta_1 \vec{j}) \\ &+ (F_2 \cos \theta_2 \vec{i}, F_2 \sin \theta_2 \vec{j}) \\ &+ \dots + (F_n \cos \theta_n \vec{i}, F_n \sin \theta_n \vec{j}) \end{aligned}$$

$$\vec{R} = (F_1 \cos \theta_1 + F_2 \cos \theta_2 + \dots + F_n \cos \theta_n) \vec{i} + (F_1 \sin \theta_1 + F_2 \sin \theta_2 + \dots + F_n \sin \theta_n) \vec{j}$$

$$\vec{R} = \left( \sum_{r=1}^n F_r \cos \theta_r \right) \vec{i} + \left( \sum_{r=1}^n F_r \sin \theta_r \right) \vec{j}$$



value / dir.

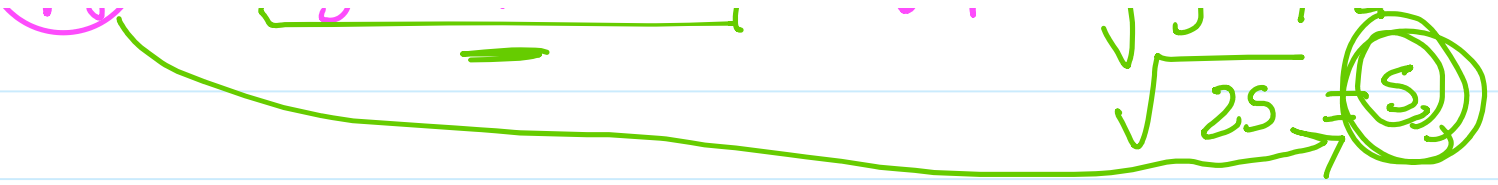
$\vec{F}_1 = F_1 \cos \theta_1 \vec{i} + F_1 \sin \theta_1 \vec{j}$   
 value      direc x      y

$\vec{F}_2 = F_2 \cos \theta_2 \vec{i} + F_2 \sin \theta_2 \vec{j}$

$\vec{F}_3 = F_3 \cos \theta_3 \vec{i} + F_3 \sin \theta_3 \vec{j}$

$$\vec{R} = (F_1 \cos \theta_1 + F_2 \cos \theta_2 + F_3 \cos \theta_3) \vec{i} + (F_1 \sin \theta_1 + F_2 \sin \theta_2 + F_3 \sin \theta_3) \vec{j}$$

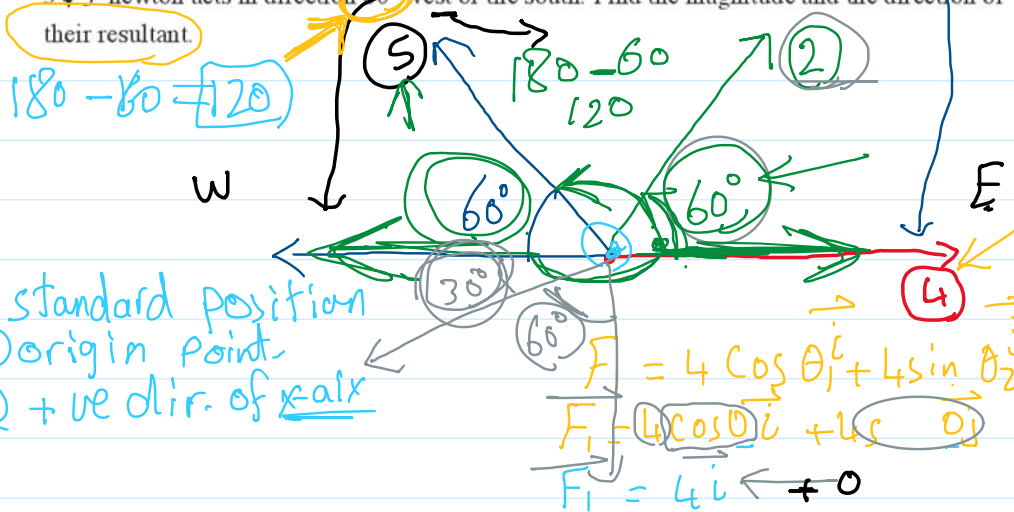
$\vec{R} = 9\vec{i} + 4\vec{j}$       value =  $\sqrt{9^2 + 4^2} = \sqrt{25} = 5$



# resultant of coplaner forces meeting at point\_2

Thursday, October 9, 2025 8:37 AM

- 1 Four coplanar forces act on a particle, the first of magnitude 4 newton, acts in the East direction, The second of magnitude 2 newton, acts in direction  $60^\circ$  North of the East, the third of magnitude 5 newton, acts in direction  $60^\circ$  North of the West and the fourth of magnitude  $3\sqrt{3}$  newton acts in direction  $60^\circ$  west of the south. Find the magnitude and the direction of their resultant.



$$\vec{F}_2 = 2 \cos 60 \hat{i} + 2 \sin 60 \hat{j} = \hat{i} + \sqrt{3} \hat{j}$$

$$\vec{F}_3 = 5 \cos 120 \hat{i} + 5 \sin 120 \hat{j} = -\frac{5}{2} \hat{i} + \frac{5\sqrt{3}}{2} \hat{j}$$

$$F_4 = 3\sqrt{3} \cos 210 \hat{i} + 3\sqrt{3} \sin 210 \hat{j} = -\frac{9}{2} \hat{i} - \frac{3\sqrt{3}}{2} \hat{j}$$

$$\vec{R} = (4 + 1 - \frac{5}{2} - \frac{9}{2}) \hat{i} + (\sqrt{3} + \frac{5}{2} \sqrt{3} - \frac{3\sqrt{3}}{2}) \hat{j}$$

$$\vec{R} = -2 \hat{i} + 2\sqrt{3} \hat{j} \Rightarrow R = \sqrt{(-2)^2 + (2\sqrt{3})^2}$$

$$R = \sqrt{16} = 4 \text{ N}$$

$$\tan \theta = \frac{y}{x} = \frac{2\sqrt{3}}{-2} = -\sqrt{3} \Rightarrow \theta = -60^\circ \text{ or } 300^\circ$$

$\Rightarrow 120^\circ$