

**STATICS**  
**Vector Algebra**  
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**Question:** Determine the sum of the planar forces  $\mathbf{F}_1 = 15\mathbf{i} + 8.5\mathbf{j}$ ,  $\mathbf{F}_2 = -3\mathbf{i} + 4\mathbf{j}$ ,  $\mathbf{F}_3 = -6\mathbf{i} - 6.75\mathbf{j}$  and  $\mathbf{F}_4 = -2\mathbf{i} - 11.4\mathbf{j}$ . Next, determine direction of the sum.

**Solution:**

The sum of the components (having same unit vectors) of the given forces are obtained. Then, the resultant force are given in cartesian coordinates as,

$$\mathbf{R} = \mathbf{F}_1 + \mathbf{F}_2 + \mathbf{F}_3 + \mathbf{F}_4 = (15\mathbf{i} + 8.5\mathbf{j}) + (-3\mathbf{i} + 4\mathbf{j}) + (-6\mathbf{i} - 6.75\mathbf{j}) + (-2\mathbf{i} - 11.4\mathbf{j})$$

$$\mathbf{R} = (15 - 3 - 6 - 2)\mathbf{i} + (8.5 + 4 - 6.75 - 11.4)\mathbf{j}$$

$$\mathbf{R} = (4)\mathbf{i} + (-5.65)\mathbf{j}$$

The direction of the sum with respect to the axis  $x$  is obtained by Arctan of the ratio  $R_y/R_x$ ,

$$\tan^{-1}\left(\frac{R_y}{R_x}\right) = \tan^{-1}\left(\frac{-5.65}{4}\right) = \theta \Rightarrow \theta = -54.7^\circ$$