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Mathematics

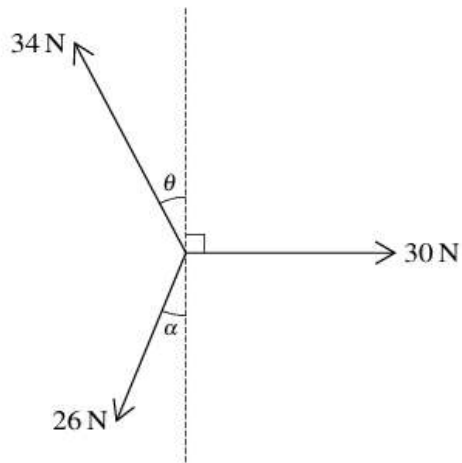
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Paper 4 Mechanics

May/June 2021

Question No (2)

2



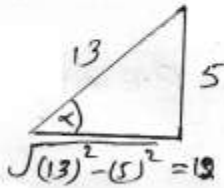
Coplanar forces of magnitudes 34 N, 30 N and 26 N act at a point in the directions shown in the diagram.

Given that $\sin \alpha = \frac{5}{13}$ and $\sin \theta = \frac{8}{17}$, find the magnitude and direction of the resultant of the three forces.

Solution:

By Given data

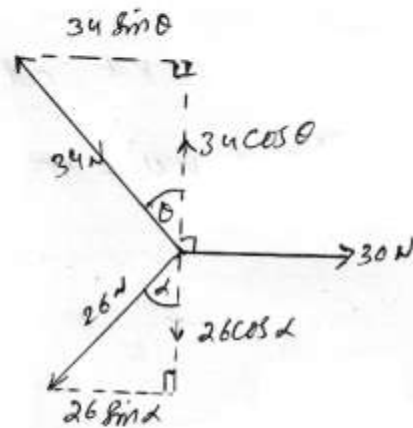
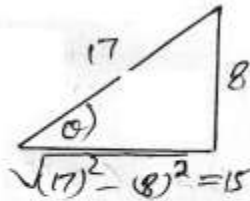
$$\sin \alpha = \frac{5}{13}$$



$$\cos \alpha = \frac{12}{13}$$

and

$$\sin \theta = \frac{8}{17}$$



$$\cos \theta = \frac{15}{17}$$

Resolving the forces horizontally

$$\begin{aligned}\sum F_x &= 30 - 34 \sin \theta - 26 \sin \alpha \\ &= 30 - 34 \left(\frac{8}{17} \right) - 26 \left(\frac{5}{13} \right) \\ &= 30 - 16 - 10 \\ \sum F_x &= 4\end{aligned}$$

Resolving forces vertically

$$\begin{aligned}\sum F_y &= 34 \cos \theta - 26 \cos \alpha \\ &= 34 \left(\frac{15}{17} \right) - 26 \left(\frac{12}{13} \right) \\ \sum F_y &= 30 - 24 = 6\end{aligned}$$

$$\therefore \text{Resultant force, } R = \sqrt{(\sum F_x)^2 + (\sum F_y)^2}$$

$$= \sqrt{(4)^2 + (6)^2}$$

$$= \sqrt{16 + 36}$$

$$= \sqrt{52} = \sqrt{2 \times 2 \times 13}$$

$$R = 2\sqrt{13} \text{ N}$$

$$\text{Direction, } \theta = \tan^{-1}\left(\frac{F_y}{F_x}\right)$$

$$= \tan^{-1}(6/4)$$

$$= 56.3^\circ \text{ anticlockwise from } 30^\circ \text{ force.}$$