Answer on #37758 – Physics - Mechanics

Five forces act on an object.
(1) 59 N at 90°
(2) 40 N at 0°
(3) 81 N at 270°
(4) 40 N at 180°
(5) 50 N at 60°
What are the magnitude and direction of a sixth force that would produce equilibrium?

Solution
We can split the forces into their two components, x and y.

$$\text{For x}: \ \mathrm{F(x)} \ = \ -\mathrm{F} \cdot \cos(\theta)$$
$$\text{For y}: \ \mathrm{F(y)} \ = \ -\mathrm{F} \cdot \sin(\theta)$$

The sum of all x-components and y-components must be zero for equilibrum.

$$\text{For x: } 0 \ + \ (-40) \ + \ 0 \ + \ 40 \ + \ (-50) \cdot \frac{1}{2} \ + \ \mathrm{F_x} \ = \ 0$$
$$\mathrm{F_x} = 25\mathrm{N}$$
$$\text{For y: } -59 \ + \ 0 \ + \ 81 \ + \ 0 \ + \ (-50) \cdot \frac{\sqrt{3}}{2} \ + \ \mathrm{F_y} \ = \ 0$$
$$\mathrm{F_y} = 21.3\mathrm{N}$$

The total force F:

$$\mathrm{F} = \sqrt{\mathrm{F_x^2} + \mathrm{F_y^2}} = \sqrt{(25\mathrm{N})^2 + (21.3\mathrm{N})^2} = 32.8\mathrm{N}$$

The angle between the X-axis and the force is:

$$\theta = \arctan\left(\frac{21.3\mathrm{N}}{25\mathrm{N}}\right) = 40.4°$$

Answer: magnitude of the force: $32.8\mathrm{N}$; angle between the X-axis and the force: $40.4°$