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Resolutions of forces acting on a polygon

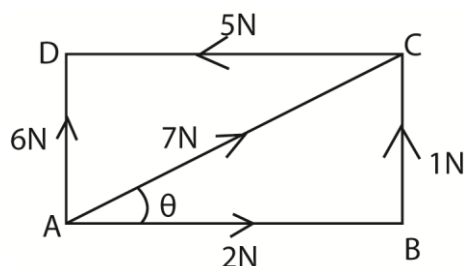
For any regular polygon

- all sides are equal
- all angles are equal
- an exterior angle = $\frac{360}{n}$ where n is the number of sides

Example 1

ABCD is a rectangle with AB= 4cm and BC = 3cm. Forces of magnitude 2N, 1N, 5N,6N and 7N act along AB, BC, CD, AD and AC respectively. In each case the direction of the force being given by the order of the letters. Given that AB is horizontal determine

(i) the magnitude of the resultant force

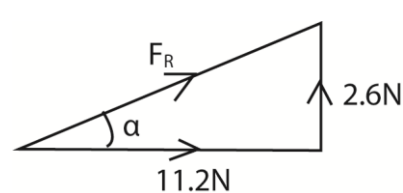


$$\theta = \tan^{-1}\left(\frac{3}{4}\right) = 36.87$$

$$R = \begin{pmatrix} 2 \\ 0 \end{pmatrix} + \begin{pmatrix} 0 \\ 1 \end{pmatrix} + \begin{pmatrix} -5 \\ 0 \end{pmatrix} + \begin{pmatrix} 0 \\ 6 \end{pmatrix} + \begin{pmatrix} 7\cos 36.87 \\ 7\sin 36.87 \end{pmatrix} = \begin{pmatrix} 2.6 \\ 11.2 \end{pmatrix}$$

$$R = \sqrt{2.6^2 + 11.2^2} = 11.498\text{N}$$

(ii) direction of the resultant with AB



$$\text{Direction, } \alpha = \tan^{-1}\left(\frac{2.6}{11.2}\right)$$

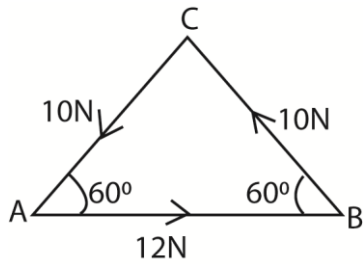
$$= 13.069^\circ$$

Direction is 13.069° above AB

Example 2

ABC is an equilateral triangle. Forces of magnitude 12N, 10N and 10N act along AB, BC and CA respectively, in each case the direction of the force being given by the order of the letters. Given that AB is horizontal determine

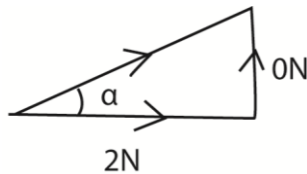
(i) the magnitude of the resultant force



$$R = \begin{pmatrix} 12 \\ 0 \end{pmatrix} + \begin{pmatrix} -10\cos 60 \\ 10\sin 60 \end{pmatrix} + \begin{pmatrix} -10\cos 60 \\ -10\sin 60 \end{pmatrix} = \begin{pmatrix} 2 \\ 0 \end{pmatrix}$$

$$R = \sqrt{2^2 + 0^2} = 2\text{N}$$

(ii) Direction of the resultant with AB

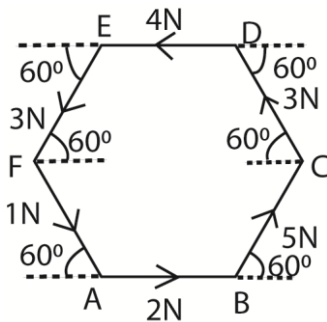


$$\text{Direction } \alpha = \tan^{-1}\left(\frac{0}{2}\right) = 0^\circ$$

Example 3

ABCDEF is a regular hexagon. Force of magnitude 2N, 5N, 3N, 4N, 3N and 1N act along the line AB, BC, CD, DE, EF and FA respectively, in each case the direction of the force being given by the order of the letters. Given that AB is horizontal, determine

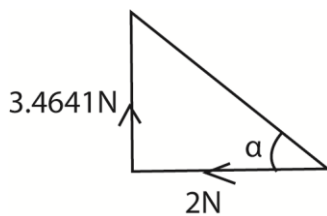
(i) the magnitude of the resultant force and



$$R = \begin{pmatrix} 2 \\ 0 \end{pmatrix} + \begin{pmatrix} 5\cos 60 \\ 5\sin 60 \end{pmatrix} + \begin{pmatrix} -3\cos 60 \\ 3\sin 60 \end{pmatrix} + \begin{pmatrix} -4 \\ 0 \end{pmatrix} + \begin{pmatrix} -3\cos 60 \\ -3\sin 60 \end{pmatrix} + \begin{pmatrix} 1\cos 60 \\ -1\sin 60 \end{pmatrix} = \begin{pmatrix} -2 \\ 3.4641 \end{pmatrix}$$

$$R = \sqrt{(-2)^2 + 3.4641^2} = 4\text{N}$$

(ii) direction of the resultant with AB.

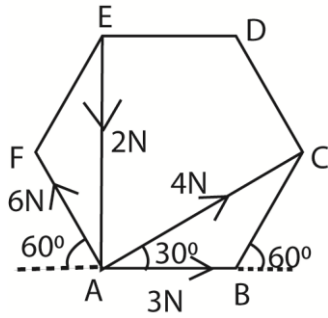


$$\alpha = \tan^{-1}\left(\frac{3.461}{2}\right) = 60^\circ \text{ to AB}$$

Example 4

ABCDEF is a regular hexagon. Forces of magnitude 3N, 4N, 2N and 6N act along the line AB, AC, EA and AF respectively, in each case the direction of the force being given by the order of the letters. Given that AB is horizontal, determine

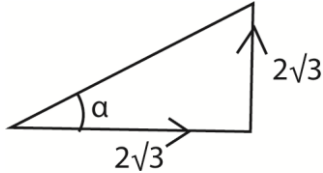
(i) the magnitude of the resultant force



$$R = \begin{pmatrix} 3 \\ 0 \end{pmatrix} + \begin{pmatrix} 4\cos 30 \\ 4\sin 30 \end{pmatrix} + \begin{pmatrix} -6\cos 60 \\ 6\sin 60 \end{pmatrix} + \begin{pmatrix} 0 \\ -2 \end{pmatrix} = \begin{pmatrix} 2\sqrt{3} \\ 3\sqrt{3} \end{pmatrix}$$

$$R = \sqrt{(2\sqrt{3})^2 + (3\sqrt{3})^2} = 6.245\text{N}$$

(ii) direction of the resultant force



$$\theta = \tan^{-1} \left(\frac{3\sqrt{3}}{2\sqrt{3}} \right) = 56.3^\circ$$

1. ABCD is a square. Forces of magnitude 6N, 4N and $2\sqrt{2}N$ act along AD, AB and AC respectively in each case the direction of force being the order of the letters. Given that AB is horizontal, determine the magnitude and direction of the resultant force. [10N at 53.1° with AB]
2. ABCD is a square. Forces of magnitude 2N, 1N, $\sqrt{2}N$ and 4N act along AB, BC and AC and DA respectively in each case the direction of force being the order of the letters. Given that AB is horizontal, determine the magnitude and direction of the resultant force. [5.13N at 33.7° with AB]
3. ABCD is a square. Three forces of magnitude 4N, 10N and 7N act along AB, AD and CA respectively in each case the direction of force being the order of the letters. Given that AB is horizontal, determine the magnitude [5.1388N]
4. In equilateral triangle PQR, three forces of magnitude 5N, 10N and 8N act along the side PQ, QR and PR respectively. Their direction are the order the letters. Find the magnitude of the resultant force. [16.1N]
5. ABCD is a square. Forces of magnitude $6\sqrt{3}N$, 2N and $4\sqrt{3}N$ act along AB, CB and CD respectively in each case the direction of force being the order of the letters. Given that AB is horizontal, determine the magnitude and direction of the resultant force. [4N at 30° to AB]
6. ABCD is a rectangle with AB= 4cm and BC= 3cm. Forces of magnitude 3N, 1N, and 10N act along AB, DC and AC respectively. In each case the direction of the force being given by the order of the letters. Given that AB is horizontal determine the magnitude and direction of the resultant force. [13.4N at 26.6° with AB]
7. ABCD is a rectangle. Forces of magnitude 8N, 4N, 10N and 2N act along AB, CB, CD and AD respectively. In each case the direction of the force being given by the order of the letters. Given that AB is horizontal determine the magnitude and direction of the resultant force. [283N at 45° at AB]
8. In equilateral triangle ABC, forces of magnitude 10N each act along the side AB, BC and AC respectively. Their direction are the order the letters. Find the magnitude of the resultant force and the angle it makes with AB. [20N at 60° to AB]
9. In equilateral triangle ABC, forces of magnitude 5N, 9N and 7N act along the side AB, BC and CA respectively. Their direction are the order the letters. Find the magnitude of the resultant force and the angle it makes with AB. [$2\sqrt{3}N$ at 30° to AB]

10. In equilateral triangle ABC, forces of magnitude 4N, 4N and 6N act along the side AB, BC and AC respectively. Their direction are the order the letters. Find the magnitude of the resultant force and the angle it makes with AB. [10N at 60° to AB]
11. ABCDEF is a regular hexagon. Forces of magnitude 2N, 5N, 3N, 4N, 3N and 1N act along the line AB, BC, CD, DE, EF and AF respectively, in each case the direction of the force being given by the order of the letters. Given that AB is horizontal, determine the magnitude and direction of the resultant force. [6N at 60° to AB]
12. ABCDEF is a regular hexagon. Forces of magnitude 8N, 7N, 6N, 4N, 7N, and 6N act along the line AB, BC, CD, DE, EF and FA respectively, in each case the direction of the force being given by the order of the letters. Given that AB is horizontal, determine the magnitude and direction of the resultant force. [12.5N at 76° to AB]
13. PQRSTU is a regular hexagon. Forces of magnitude 4N, 5N, 2N, and 6N act along the line PQ, PR, PT and PU respectively, in each case the direction of the force being given by the order of the letters. Given that PQ is horizontal, determine the magnitude and direction of the resultant force. [11.065N at 61.2° to PQ]
14. ABCD is a square. Forces of magnitude 10N, 9N, 8N and 5N act along AB, BC, CD and AD respectively in each case the direction of force being the order of the letters. Given that AB is horizontal, determine the magnitude and direction of the resultant force.
[$2\sqrt{5}$ N at 63.43° to AB]
15. ABCD is a rectangle with AB= 4cm and BC = 3cm. Forces of magnitude 3N, 10N, 4N, 6N and 5N act along AB, BC, CD, DA, and AC respectively. In each case the direction of the force being given by the order of the letters. Given that AB is horizontal determine the magnitude and direction of the resultant force. [7.62N at 66.8° with AB]

Thank you

Dr. Bbosa Science