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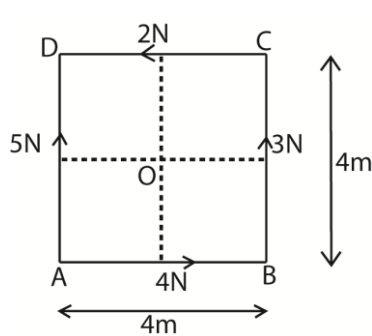
Moment of a force acting on a polygon

Example 1

ABCD is a square of side 4m. Forces of magnitude 4N, 3N, 2N and 5N act along AB, BC, CD and AD respectively in each case the direction of force being given by the order of the letters. Given that AB is horizontal, find the moment of force about

- center of the square
- point A

Solution



$$\begin{aligned} \curvearrowleft O \quad G &= 4 \times 2 + 3 \times 2 + 2 \times 2 - (5 \times 2) \\ &= 8\text{Nm anticlockwise} \end{aligned}$$

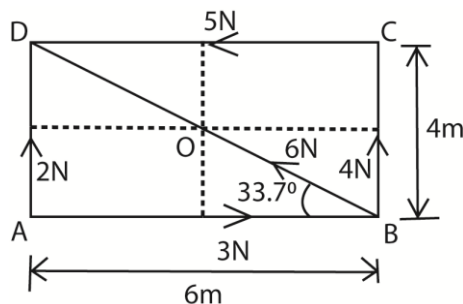
$$\begin{aligned} \curvearrowleft A \quad G &= (4 \times 0) + (3 \times 4) + (2 \times 2) - (5 \times 0) \\ &= 20\text{Nm anticlockwise} \end{aligned}$$

Example 2

ABCD is a rectangle where AB = 6m and BC = 4m. Forces of magnitude 3N, 4N, 5N, 2N and 6N act along line AB, BC, CD, AD, and BD respectively. In each case the direction of force being given by the order of the letters. Find the moment of forces about

- center of the rectangle
- point A

Solution



$$\begin{aligned} \curvearrowleft O \quad G &= 3 \times 3 + 4 \times 3 + 5 \times 2 - (3 \times 2) + (6 \sin 33.7^\circ \times 3) - \\ &\quad (6 \sin 33.7^\circ \times 3) = 22\text{Nm anticlockwise} \end{aligned}$$

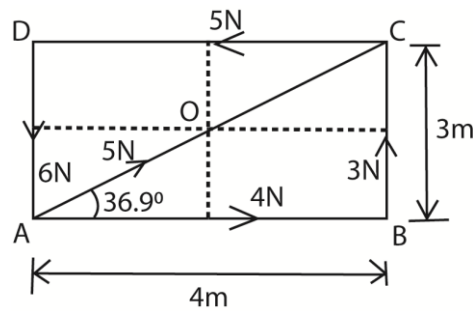
$$\begin{aligned} \curvearrowleft A \quad G &= (3 \times 0) + (4 \times 6) + (5 \times 4) - (2 \times 0) + \\ &\quad (6 \sin 33.7^\circ \times 0) - (6 \cos 33.7^\circ \times 0) \\ &= 63.97\text{Nm anticlockwise} \end{aligned}$$

Example 3

ABCD is a rectangle where AB = 4m and BC = 3m. Forces of magnitude 4N, 3N, 5N, 6N and 5N act along line AB, BC, CD, DA, and AC respectively. In each case the direction of force being given by the order of the letters. Find the moment of forces about

(i) center of the rectangle

(ii) point A



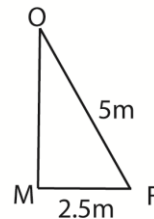
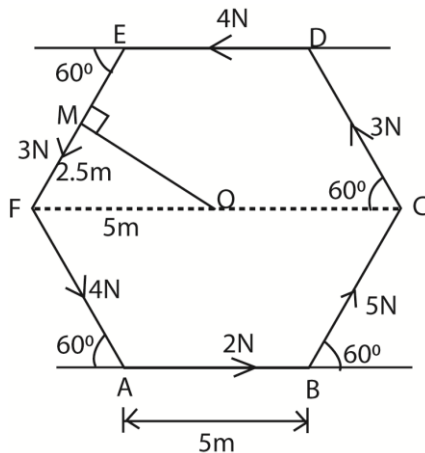
$$\begin{aligned} \overset{\curvearrowright}{O} G &= 4 \times 1.5 + 3 \times 2 + 5 \times 1.5 + (6 \times 2) - \\ &\quad (5 \sin 36.9^\circ \times 2) + (5 \sin 36.9^\circ \times 1.5) \\ &= 31.49 \text{ Nm anticlockwise} \end{aligned}$$

$$\begin{aligned} \overset{\curvearrowright}{A} G &= (3 \times 4) + (5 \times 3) \\ &= 27 \text{ Nm anticlockwise} \end{aligned}$$

Example 4

ABCDEF is a regular hexagon of side 5m. Forces of magnitude 2N, 5N, 3N, 4N, 3N and 4N act along the lines AB, BC, CD, DE, EF and FA respectively. In each case the direction of force being given by the order of the letters. Given that AB is horizontal, find the sum of moments of forces about

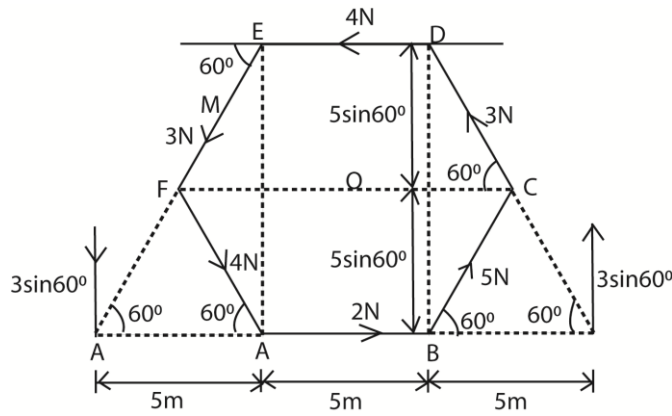
(i) center O of the hexagon



$$OM = \sqrt{5^2 - (2.5)^2} = 4.33 \text{ m}$$

$$\overset{\curvearrowright}{O} G = (2 + 5 + 3 + 4 + 3 + 4) \times OM = 21 \times 4.33 = 90.93 \text{ Nm anticlockwise}$$

(ii) Point A

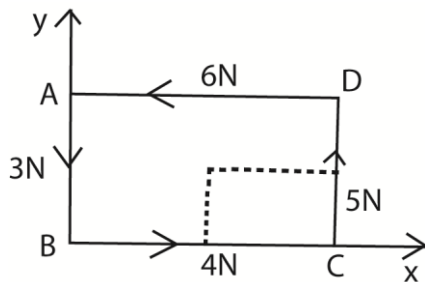


$$\begin{aligned} \curvearrowleft G &= (5\sin 60^\circ \times 5) + (3\sin 60^\circ \times 10) + (4 \times 10\sin 60^\circ) + (3\sin 60^\circ \times 5) \\ &= 95.26 \text{ Nm anticlockwise} \end{aligned}$$

Example 5

Forces of magnitude 3N, 4N, 5N and 6N act on a rectangle along lines AB, BC, CD and DA of a rectangle. Their direction is the order of the letters. BC is horizontal. Find the resultant force and the couple at the centre of a rectangle of sides 2m and 4m.

Solution

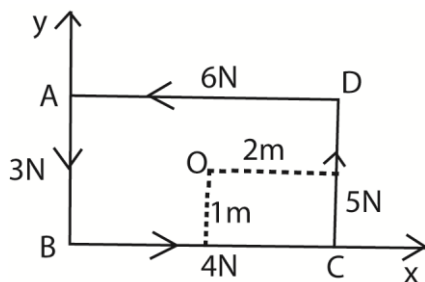


$$\rightarrow, X = 4 - 6 = -2$$

$$\uparrow, Y = 5 - 3 = 2$$

$$\begin{aligned} \text{The resultant force, } R &= \sqrt{(-2)^2 + 2^2} \\ &= 2.83 \text{ N} \end{aligned}$$

For a couple



$$\begin{aligned} \curvearrowleft O \quad G &= 4 \times 1 + 5 \times 2 + 6 \times 1 + 3 \times 2 \\ &= 26 \text{ Nm anticlockwise} \end{aligned}$$

For the system of forces to reduce to couple, an additional force equal in magnitude to the resultant but acting in opposite direction must be added. Hence the moment of the couple about the center is 26Nm in the sense BADC or clockwise.

Revision exercise

- Forces of 2N, 3N, 4N and 5N act along the sides of a square ABCD of side 4m in direction AB, BC, CD and AD respectively. Find the sum of moments of the forces about
 - the center of square [8Nm]
 - Point A [28Nm]
- Forces of 5N, 6N, 4N, 7N, 6N and 8N act in direction AB, BC, CD, DA, AC, and DB respectively of a square ABCD of side 6m. Find the sum of moments of forces about
 - centre of the square [66Nm]
 - point A [26Nm]
- ABCD is a rectangle with AB = 8cm and BC = 6 cm. Forces of 4N, 5N, 3N, 6N and 8N act in the direction AB, BC, CD, AD and BD respectively of the rectangle ABCD, find the sum of moments of the forces about
 - the center of the rectangle [17Nm]
 - point A [96.4Nm]
- ABCDEF is a regular hexagon 2m. Forces of magnitude 5N, 2N, 6N, 4N, 8N and 3N acting 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. Find the sum of moments of the force about point A. [50.23Nm]
- ABCDEF is a regular hexagon with side 3m. Forces of magnitude 4N, 5N, 1N, 3N, 7N and 2N act along 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. Find the sum of moments of the forces about point A [$30\sqrt{3}$ Nm]
- ABDCEF is a regular hexagon of 4m. Forces of magnitude 8N, 4N, 7N, 4N, 6N and 5N act along 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, find the sum of moments of the forces about point A [$64\sqrt{3}$ Nm]
- ABDCEF is a regular hexagon of 4m. Forces of magnitude 5N, 6N, 7N, 4N, 5N and 8N act along 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, find the sum of moments of the forces about
 - centre of hexagon [$70\sqrt{3}$ Nm]
 - point A [$66\sqrt{3}$ Nm]
- ABDCEF is a regular hexagon of 3m. Forces of magnitude 3N, 1N, 2N, 5N, 6N and 4N act along AB, BC, CD, ED, 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, find the sum of moments of the forces about
 - centre of hexagon [$4.5\sqrt{3}$ Nm]
 - point A

Thank You

Dr. Bbosa Science