Dr. Bbosa Science

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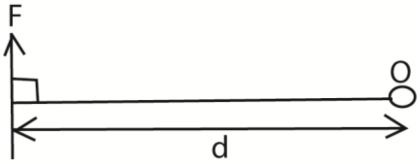
Moment of a force

This is the product of a force and perpendicular distance from the pivot to the line of action of the force. The unit of moments is Nm.



The moment of force about point O is F x d

Matrix approach of finding sum of moments about the origin

If forces (a_1i + b_1j)N, (a_2i + b_2j)N, ……….(a_ni + b_nj) act on the body at point (x_1 + y_1), (x_2 + y_2), ….. ((x_n + y_n). The sum of the moments about the origin is

$$G = \begin{vmatrix} x_1 & a_1 \\ y_1 & b_1 \end{vmatrix} + \begin{vmatrix} x_2 & a_2 \\ y_2 & b_2 \end{vmatrix} + \cdots + \begin{vmatrix} x_n & a_n \\ y_n & b_n \end{vmatrix}$$

$$G = (b_1x_1 - a_1y_1) + (b_2x_2 - a_2y_2) + \cdots + (b_nx_n - a_ny_n)$$

Note

If G is positive, the sum of moments will be anticlockwise and if G is negative the sum of moments will be clockwise.

Example 1

Find the moment about the origin of a force of 4jN acting at a point which has position vector -5iN

Solution

$G = \begin{vmatrix} -5 & 0 \\ 0 & 4 \end{vmatrix}$= -5x4 – 0x0 = -20Nm clockwise

Example 2

Find the moment about the origin of a force of 4jN acting at a point which has position vector 5iN

$G = \begin{vmatrix} 5 & 0 \\ 0 & 4 \end{vmatrix}$= 5x4 – 0x0 = 20Nm anticlockwise

Example 3

Forces of (2i-3j)N, (4i + j)N and (5i -3j)N act on a body at points with Cartesian co-ordinates (1,1), (2, 4), and (-1, 3) respectively. Find the sum of moments of the forces about the origin.

Solution

$G = \begin{vmatrix} 1 & 2 \\ 1 & -3 \end{vmatrix} + \begin{vmatrix} 2 & 4 \\ 4 & 1 \end{vmatrix} + \begin{vmatrix} -1 & 5 \\ 3 & -3 \end{vmatrix}$= (1 x -3 – 2 x 1)+(2 x 1 – 4x 4)+(-1 x -3 – 3 x 5) = -31Nm

= 31Nm clockwise

Example 4

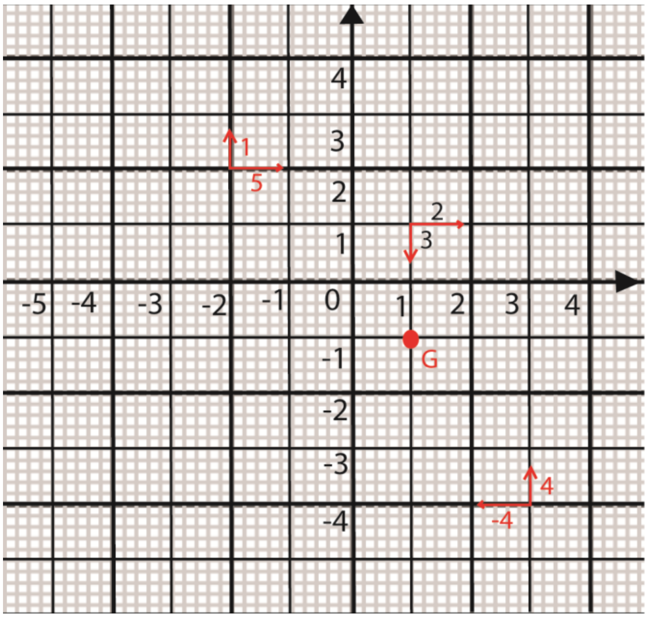
Forces (2i -3j)N, (5i + j)N and (-4i+4j) act on a body at points with position vector (i + j), (-2i +2j) and (3i -4j) respectively. Find the sum of moments of forces about the

(i) origin

$G = \begin{vmatrix} 1 & 2 \\ 1 & -3 \end{vmatrix} + \begin{vmatrix} -2 & 5 \\ 2 & 1 \end{vmatrix} + \begin{vmatrix} 3 & -4 \\ -4 & 4 \end{vmatrix}$= (1 x -3 -2 x 1) + (-2 x 1 – 2 x 5) + (3 x 4 - –4x -4)

= -21Nm = 21Nm clockwise

(ii) point with position vector (i –j)



G = (5 x 3) + (1 x 3) +(2 x 0) + (2 x 2) + (4 x 3) – (4 x 2) = 26Nm clockwise

Revision exercise

1. Find the moment about the origin of a force of 3i acting at a point which has position vector (2i + 3j)m. [9Nm clockwise]
2. Find the moment about the origin of force (4i + 2j)N acting at a point which has position vector (3i + 2j)m. [2Nm clockwise]
3. A force of (3i -2j)N act at a point which has position vector (5i + j)m. Find the moment about the point which has a position vector (i +2j)m. [5Nm clockwise]
4. A force of (2i + j)N act at a point which has position vector (2i + 2j)m and a force of 5iN at a point which has position vector (-2i + j)m. Find the sum of moments of these forces about the origin. [7Nm clockwise]
5. A force of (3i + 2j)N act at a point which has position vector (5i + j)m and a force of (I + j)N act at a point which has position vector (2i + j)m. Find the sum of moments of these forces about the point which has position vector (i + 3j)m. [17Nm anticlockwise]