

Section 1: The moment of a force

Section test

In this test, take the anticlockwise sense to be positive for all moments.

1. Find the total moment of this system of forces about the point O.



- 2. Find the total moment of two equal and opposite forces of 25 N acting on a corkscrew, along lines 10 cm apart.
- 3. Find the total anticlockwise moment about the origin of a force of $6\mathbf{i} + 4\mathbf{j}$ which acts at the point $3\mathbf{i} + 2\mathbf{j}$.
- 4. Find the total anticlockwise moment about the origin of a force of 7**i** 4**j** which acts at the point 5**i** 2**j**.
- 5. Zahra (45 kg) and Olga (30 kg) sit on a perfectly balanced uniform see-saw, pivoted at its midpoint. Zahra is 2 m from the pivot point. How far from the pivot point is Olga?
- 6. A ladder 4 m long (whose weight may be neglected) is being carried by a builder, with his tools weighing 50 N at one end and a tin of paint weighing 30 N at the other end. How far from the end with the tools should he place his shoulder so that the ladder is balanced?
- 7. A non-uniform plank AB of mass 20 kg and length 2 m is pivoted at its midpoint. The plank is in equilibrium in a horizontal position when a particle of mass 5 kg is placed 40 cm from A and another particle of mass 8 kg is placed 30 cm from B. Find the distance of the centre of mass of the plank from A.



8. The diagram below shows a light plank balanced on two supports, A and B. Weights of 50 N, 25 N and 30N are placed on the plank as shown. *X* and *Y* are the normal reactions to the supports.



Find the reaction force *X*. Find the reaction force *Y*. What is the turning moment of the 30 N weight about support B?

Solutions to section test

1) Moment of 3 N force anticlockwise $= 3 \times 5 = 15$ Nm Moment of 8 N force anticlockwise $= -8 \times 7 = -56$ Nm Total moment of forces anticlockwise = 15 - 56 = -41 Nm

2)



Total moment about mídpoínt = $25 \times 0.05 + 25 \times 0.05 = 2.5$ Nm

3)



Moment of $6\underline{i}$ component = $-6 \times 2 = -12$ Moment of $4\underline{j}$ component = $4 \times 3 = 12$ Total moment = 0 Nm

4)



Moment of $\mathcal{F}_{\underline{i}}$ component = $\mathcal{F} \times 2 = 14$ Moment of $-4\underline{j}$ component = $-4 \times 5 = -20$ Total moment = -6 Nm

5)



3 of 5 integralmaths.org

10/07/17 © MEI

Taking moments about C: $2 \times 45g - 30gx = 0$

Olga is 3 m from the pivot point.

6)



Taking moments about pivot point: 50x - 30(4 - x) = 0 50x - 120 + 30x = 0 80x = 120x = 1.5

He should place his shoulder 1.5 m from the end with the tools.

ア)



Taking moments about pivot: $5g \times 0.6 + 20gx - 8g \times 0.7 = 0$ 3 + 20x - 5.6 = 020x = 2.6x = 0.13

The centre of mass of the plank is 0.87 m from A.

8) Taking moments about B: (50×0.45)+(25×0.15)-0.3X-(30×0.2)=0
22.5+3.75-0.3X-6=0
0.3X = 20.25
X = 67.5

The reaction force X is 67.5 N.

Resolving vertically: $X + \gamma - 50 - 25 - 30 = 0$ $67.5 + \gamma = 105$ $\gamma = 37.5$ The reaction force γ is 37.5 N.

The turning moment is clockwise, so this is negative. Moment = $-30 \times 0.2 = -6$ Nm.