## Edexcel A level Maths Moments

## 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 $\mathbf{7 i}-4 \mathbf{j}$ which acts at the point $5 \mathbf{i}-2 \mathbf{j}$.
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 $A B$ 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.

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8. The diagram below shows a light plank balanced on two supports, A and B. Weights of $50 \mathrm{~N}, 25 \mathrm{~N}$ and 30 N 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 ?

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## Solutions to section test

1) Moment of 3 N force anticlockwise $=3 \times 5=15 \mathrm{Nm}$ Moment of 8 N force anticlockwise $=-8 \times 7=-56 \mathrm{Nm}$ Total moment of forces anticlockwise $=15-56=-41 \mathrm{Nm}$
2) 



Total moment about midpoint $=25 \times 0.05+25 \times 0.05=2.5 \mathrm{Nm}$
3)

4)


Moment of $7 \underline{i}$ component $=7 \times 2=14$
Moment of $-4 \underline{j}$ component $=-4 \times 5=-20$
Total moment $=-6 \mathrm{Nm}$
5)


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Taking moments about $C$ :

$$
2 \times 45 g-309 x=0
$$

$$
\begin{aligned}
& 90=30 x \\
& x=3
\end{aligned}
$$

Olga is 3 m from the pivot point.
6)


Taking moments about pivot point: $50 x-30(4-x)=0$

$$
50 x-120+30 x=0
$$

$$
80 x=120
$$

$$
x=1.5
$$

He should place his shoulder 1.5 m from the end with the tools.
7)


Taking moments about pivot: $5 g \times 0.6+20 g x-8 g \times 0.7=0$

$$
\begin{aligned}
& 3+20 x-5.6=0 \\
& 20 x=2.6 \\
& x=0.13
\end{aligned}
$$

The centre of mass of the plank is 0.87 m from $A$.
8) Taking moments about B: $(50 \times 0.45)+(25 \times 0.15)-0.3 \chi-(30 \times 0.2)=0$

$$
\begin{aligned}
& 22.5+3.75-0.3 x-6=0 \\
& 0.3 x=20.25 \\
& x=67.5
\end{aligned}
$$

The reaction force $x$ is 67.5 N .

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Resolving vertically: $x+y-50-25-30=0$

$$
67.5+Y=105
$$

$$
Y=37.5
$$

The reaction force $Y$ is 37.5 N .

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

