

## Section 2: Moments of forces at an angle

### **Section test**

1. Find the anticlockwise moment of the 10 N force about the point A in the diagram below. Give your answer to 3 s.f.



2. Find the total anticlockwise moment of the forces shown about the point A in the diagram below. Give your answer to 3 s.f.



3. In the diagram below, the total moment of the forces shown about O is zero. The length of the rod (which has negligible weight) is 6 m. How far from O does the 12 N force act?



- 4. A ladder of mass 8 kg and length 4 m is placed against a smooth wall, with its foot on rough horizontal ground, making an angle of 60° with the ground. A woman of mass 60 kg stands 1 m from the top of the ladder. Find the frictional force between the foot of the ladder and the ground.
- 5. A uniform beam AB of mass 10 kg is freely hinged at A and is kept horizontal by a string from B to a point vertically above A. The string makes an angle of 30° with the beam. Find, in terms of *g*, the tension in the string. Find, in terms of *g*, the magnitude of the reaction at the hinge. Find the angle which the reaction with the hinge makes with AB.
- 6. A heavy rod AB of mass 25 kg and length 2.4 m is hinged at A to a point on a vertical wall. It is kept horizontal by a chain attached to B and to a point 1.5 m vertically above A. The bar carries an additional mass of 10 kg, 1.8 m from A.

Find the tension in the chain. Find the magnitude of the reaction at A. Find the direction of the reaction at A .



### **Edexcel A level Maths Moments 2 section test solutions**

#### Solutions to section test

- 1) Moment =  $8 \times 10 \sin 25^{\circ} = 33.8$  Nm
- 2) Total moment anticlockwise =  $5 \times 4 \sin 35^{\circ} 5 \times 3 = -3.53$
- 3) Let the distance of the 12N force from 0 be x m.  $6 \times 8 \sin 30^\circ - 12x = 0$  x = 2So the force is 2 m from 0.





Resolving vertically: R-8g-60g=0 R=68gTaking moments about A:  $60g\cos 60^{\circ} \times 1 + 8g\cos 60^{\circ} \times 2 + F\sin 60^{\circ} \times 4 - R\cos 60^{\circ} \times 4 = 0$   $30g+8g+2F\sqrt{3}-2R=0$  $38g+2F\sqrt{3}-136g=0$ 

$$2F\sqrt{3} = 98g$$
  

$$F = \frac{98 \times 9.8}{2\sqrt{3}} = 277 \text{ N} (3 \text{ s.f.})$$

5)



## **Edexcel A level Maths Moments 2 section test solutions**

Taking moments about A:

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$$T \sin 30^{\circ} \times 2 \not - 10g \times \not = 0$$

$$T \times \frac{1}{2} \times 2 = 10g$$

$$T = 10g$$
Taking moments about B:  

$$\gamma \times 2 \not - 10g \times \not = 0$$

$$2\gamma = 10g$$

$$\gamma = 5g$$
Resolving horizontally:  

$$X - T\cos 30^{\circ} = 0$$

$$x = 10g \times \frac{\sqrt{3}}{2} = 5g\sqrt{3}$$
Magnitude of reaction =  $\sqrt{X^2 + \gamma^2}$   

$$= \sqrt{75g^2 + 25g^2}$$



$$\tan \theta = \frac{5g}{5g\sqrt{3}} = \frac{1}{\sqrt{3}}$$
$$\theta = 30^{\circ}$$

6)



Taking moments about A:  $25g \times 1.2 + 10g \times 1.8 - T \sin \theta \times 2.4 = 0$  $48g = 2.4T \text{ sin } 32^{\circ}$ T = 370 (3 s.f.)

Taking moments about B:

# **Edexcel A level Maths Moments 2 section test solutions**

2.4
$$\gamma$$
 - 25 $g \times 1.2 + 10g \times 0.6 = 0$   
2.4 $\gamma$  = 36 $g$   
 $\gamma$  = 15 $g$  = 14 $7$   
Resolving horizontally:  
 $X - T \cos \theta = 0$   
 $X = 369.87 \cos 32^{\circ} = 313.67$   
Magnitude of reaction =  $\sqrt{147^{2} + 313.67^{2}} = 346$  N (3 s.f.)

$$\tan \alpha = \frac{147}{313.67}$$

 $\alpha = 25^{\circ}$  (to nearest degree) The reaction of A is at 25° above the horizontal.