

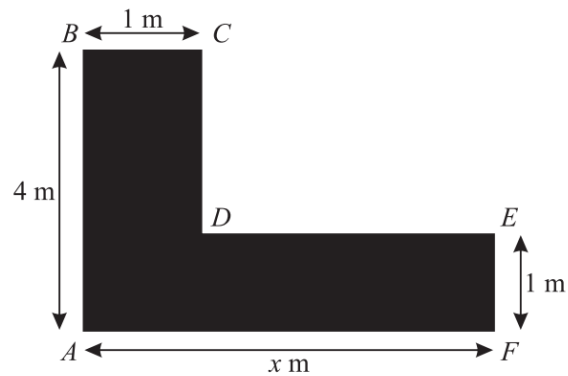
- 1 A uniform metal bar, of mass 30 kg and length 3 m, rests in a horizontal position, on two supports at A and B , as shown in the diagram below.



Find the magnitude of each of the reaction forces acting on the bar at the supports at A and B .
(4 marks)

Question	Solution	Marks	Total Marks	Comments
1	$1.5 \times R_B = 1 \times 30 \times 9.8$ $R_B = 196 \text{ N}$ $R_A + 196 = 30 \times 9.8$ $R_A = 98 \text{ N}$	M1 A1 M1 A1	(4)	M1: moment equation M1: 2nd moment equation or vertical forces in equilibrium
		TOTAL	4	

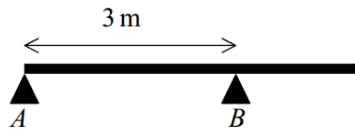
6 The diagram shows a uniform lamina.



- (a) For a particular lamina, $x = 7$.
- (i) Find the distance of the centre of mass of the lamina from the side AB . (3 marks)
- (ii) The lamina is suspended from the corner C . Find the angle between the side CD and the vertical. (5 marks)
- (b) Another lamina is suspended from the corner C . Given that the side CD is vertical, find x . (4 marks)

Question	Solution	Marks	Total Marks	Comments
6 (a)(i)	$10\bar{x} = 3 \times 0.5 + 7 \times 3.5$ $\bar{x} = 2.6$	M1 A1 A1	(3)	M1: 3 term equation
(ii)	$10\bar{y} = 3 \times 2.5 + 7 \times 0.5$ $\bar{y} = 1.1$ $\tan \theta = \frac{2.6 - 1}{4 - 1.1}$ $= 28.9^\circ$	M1 A1 M1 A1 A1		M1: 3 term equation M1: calculating values for finding the angle
(b)	$(x + 3) \times 1 = 3 \times 0.5 + x \times \frac{x}{2}$ $x^2 - 2x - 3 = 0$ $x = 3$ or $x = -1$ $x = 3$	M1 A1 M1 A1	(4)	M1: equation using $\bar{x} = 1$ M1: solving quadratic for x
		TOTAL	12	

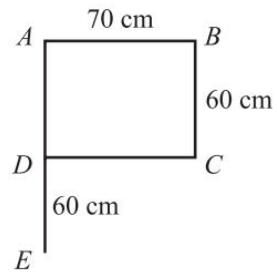
- 4 A uniform metal beam has length 5 metres and mass 250 kg. It rests horizontally on two supports, A and B , which are 3 metres apart. Support A is at one end of the beam, as shown in the diagram.



- (a) Find the magnitudes of the forces exerted on the beam by the supports. (4 marks)
- (b) A man, of mass 80 kg, walks along the beam from A towards the other end of the beam. Find the distance he can walk past B , before the beam starts to tip. (3 marks)

Question	Solution	Marks	Total	Comments
4(a)	$3 \times R_B = 2.5 \times 250g$ $R_B = 2040 \text{ N}$ $R_A + 2040 = 250g$ $R_A = 408 \text{ N}$	M1 A1 m1 A1	4	Uses moments about one support to get 2 term equation Correct reaction force Uses moments or vertical equilibrium Correct force
(b)	$80 \times 9.8x = 250 \times 9.8 \times 0.5$ $x = \frac{125}{80} = 1.56 \text{ m}$	M1A1 A1	3	Two term moments equation with x Correct distance
	Total		7	

- 8 A letter P is formed by bending a uniform steel rod into the shape shown below, in which $ABCD$ is a rectangle.



- (a) Find the distance of the centre of mass of the letter from the side
- (i) AE , (3 marks)
- (ii) AB . (3 marks)

The letter is to be suspended from a point F on the side AB . The point F is a distance x cm from A .

- (b) State the value of x if the side AB is to be horizontal. (1 mark)
- (c) Find the value of x if the side AB is to be at an angle of 5° to the horizontal, with A higher than B . (3 marks)

8 (a)(i)	$320x = 70 \times 35 + 70 \times 35 + 60 \times 70$ $x = \frac{455}{16} = 28.4375 = 28.4 \text{ to 3 sf}$	M1 A1 A1	(3)	M1: for a four-term moment equation
(ii)	$320y = 120 \times 60 + 70 \times 60 + 60 \times 30$ $y = \frac{165}{4} = 41.25 = 41.3 \text{ to 3 sf}$	M1 A1 A1	(3)	M1: for a four term moment equation
(b)	$x = 28.4 \text{ cm}$	B1 ✓	(1)	
(c)	$\tan 5^\circ = \frac{28.4375 - x}{41.3}$ $x = 24.8 \text{ cm to 3 sf}$	M1 A1 A1	(3)	
		TOTAL	(10)	