M2 Moments Challenge

Challenge 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.
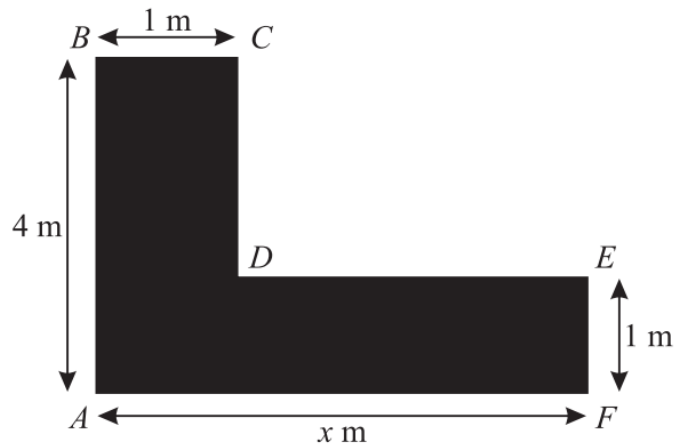

Find the magnitude of each of the reaction forces acting on the bar at the supports at A and B.

(4 marks)
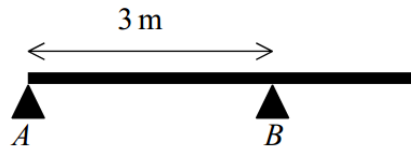
Challenge 2

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)*

Challenge 3

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.
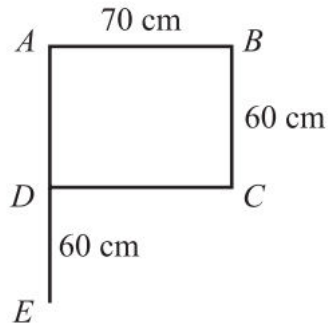
3 m

A   B

(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)*

Final Challenge

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)*