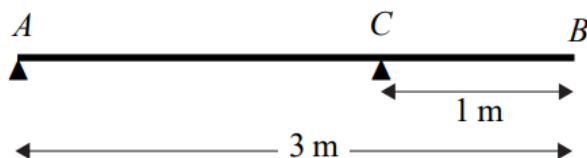


Moments In 1 Dimension (From Edexcel 6677)

Q1, (Jun 2005, Q6)

Figure 3



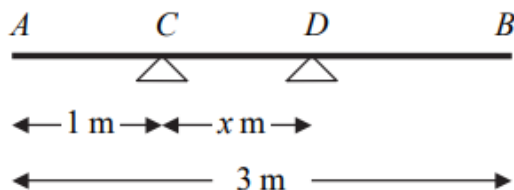
A uniform beam AB has mass 12 kg and length 3 m. The beam rests in equilibrium in a horizontal position, resting on two smooth supports. One support is at the end A , the other at a point C on the beam, where $BC = 1$ m, as shown in Figure 3. The beam is modelled as a uniform rod.

- (a) Find the reaction on the beam at C . (3)

A woman of mass 48 kg stands on the beam at the point D . The beam remains in equilibrium. The reactions on the beam at A and C are now equal.

- (b) Find the distance AD . (7)

Q2, (Jan 2007, Q2)



A uniform plank AB has weight 120 N and length 3 m. The plank rests horizontally in equilibrium on two smooth supports C and D , where $AC = 1$ m and $CD = x$ m, as shown in Figure 2. The reaction of the support on the plank at D has magnitude 80 N. Modelling the plank as a rod,

- (a) show that $x = 0.75$ (3)

A rock is now placed at B and the plank is on the point of tilting about D . Modelling the rock as a particle, find

- (b) the weight of the rock, (4)

- (c) the magnitude of the reaction of the support on the plank at D . (2)

- (d) State how you have used the model of the rock as a particle. (1)

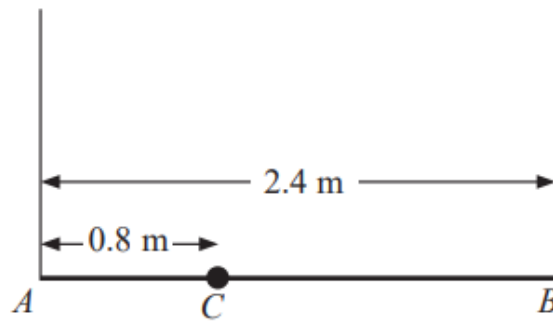


Figure 2

A plank AB has mass 12 kg and length 2.4 m. A load of mass 8 kg is attached to the plank at the point C , where $AC = 0.8$ m. The loaded plank is held in equilibrium, with AB horizontal, by two vertical ropes, one attached at A and the other attached at B , as shown in Figure 2. The plank is modelled as a uniform rod, the load as a particle and the ropes as light inextensible strings.

- (a) Find the tension in the rope attached at B . (4)

The plank is now modelled as a non-uniform rod. With the new model, the tension in the rope attached at A is 10 N greater than the tension in the rope attached at B .

- (b) Find the distance of the centre of mass of the plank from A . (6)

Q4, (Jan 2011, Q3)

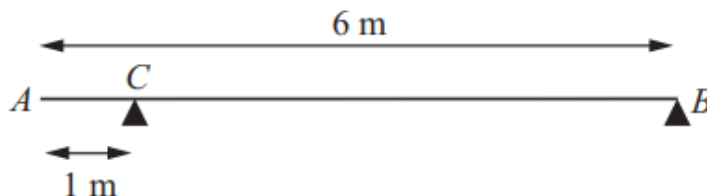


Figure 1

A uniform beam AB has mass 20 kg and length 6 m. The beam rests in equilibrium in a horizontal position on two smooth supports. One support is at C , where $AC = 1$ m, and the other is at the end B , as shown in Figure 1. The beam is modelled as a rod.

- (a) Find the magnitudes of the reactions on the beam at B and at C . (5)

A boy of mass 30 kg stands on the beam at the point D . The beam remains in equilibrium. The magnitudes of the reactions on the beam at B and at C are now equal. The boy is modelled as a particle.

- (b) Find the distance AD . (5)
-

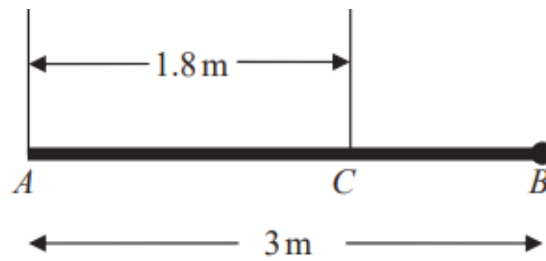


Figure 2

A pole AB has length 3 m and weight W newtons. The pole is held in a horizontal position in equilibrium by two vertical ropes attached to the pole at the points A and C where $AC = 1.8$ m, as shown in Figure 2. A load of weight 20 N is attached to the rod at B . The pole is modelled as a uniform rod, the ropes as light inextensible strings and the load as a particle.

- (a) Show that the tension in the rope attached to the pole at C is $\left(\frac{5}{6}W + \frac{100}{3}\right)$ N. (4)
- (b) Find, in terms of W , the tension in the rope attached to the pole at A . (3)

Given that the tension in the rope attached to the pole at C is eight times the tension in the rope attached to the pole at A ,

- (c) find the value of W . (3)

Q6, (Jun 2013, Q6)

A beam AB has length 15 m. The beam rests horizontally in equilibrium on two smooth supports at the points P and Q , where $AP = 2$ m and $QB = 3$ m. When a child of mass 50 kg stands on the beam at A , the beam remains in equilibrium and is on the point of tilting about P . When the same child of mass 50 kg stands on the beam at B , the beam remains in equilibrium and is on the point of tilting about Q . The child is modelled as a particle and the beam is modelled as a non-uniform rod.

- (a) (i) Find the mass of the beam.
- (ii) Find the distance of the centre of mass of the beam from A . (8)

When the child stands at the point X on the beam, it remains horizontal and in equilibrium. Given that the reactions at the two supports are equal in magnitude,

- (b) find AX . (6)
-

Q7, (Jan 2013, Q2)

A steel girder AB , of mass 200 kg and length 12 m, rests horizontally in equilibrium on two smooth supports at C and at D , where $AC = 2$ m and $DB = 2$ m. A man of mass 80 kg stands on the girder at the point P , where $AP = 4$ m, as shown in Figure 1.

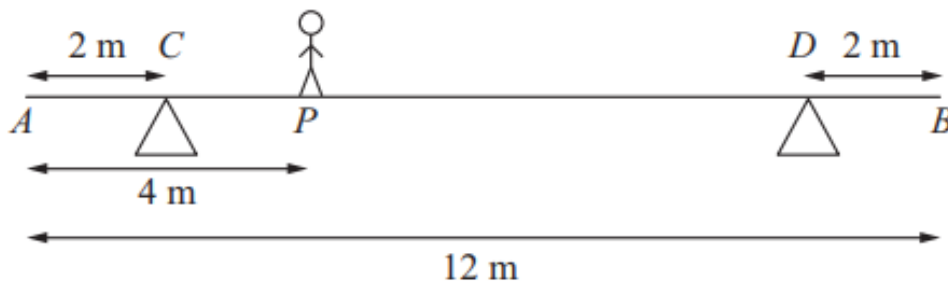


Figure 1

The man is modelled as a particle and the girder is modelled as a uniform rod.

- (a) Find the magnitude of the reaction on the girder at the support at C . (3)

The support at D is now moved to the point X on the girder, where $XB = x$ metres. The man remains on the girder at P , as shown in Figure 2.

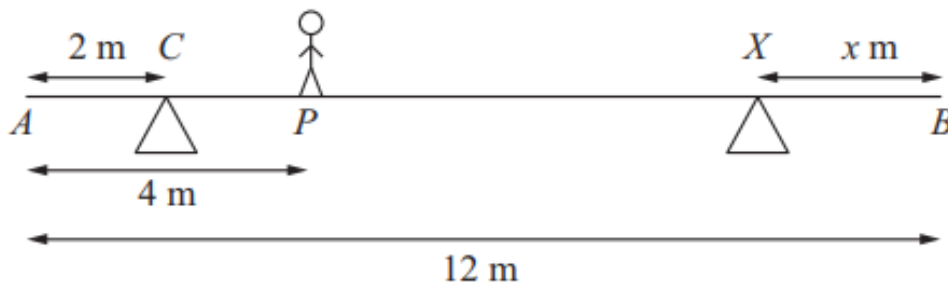


Figure 2

Given that the magnitudes of the reactions at the two supports are now equal and that the girder again rests horizontally in equilibrium, find

- (b) the magnitude of the reaction at the support at X , (2)
- (c) the value of x . (4)
-

Q8, (Jun 2014, Q4)

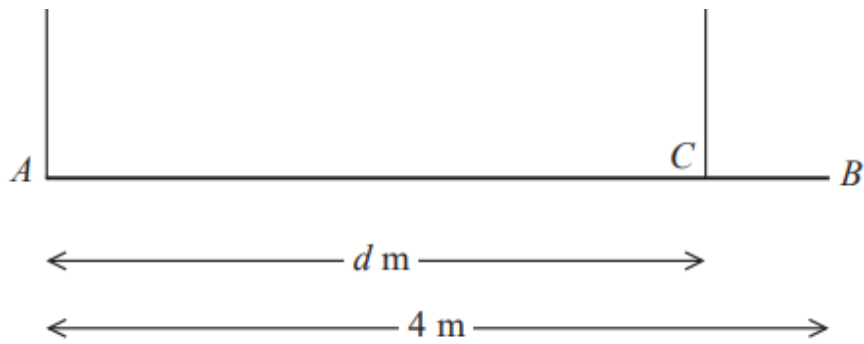


Figure 3

A beam AB has weight W newtons and length 4 m. The beam is held in equilibrium in a horizontal position by two vertical ropes attached to the beam. One rope is attached to A and the other rope is attached to the point C on the beam, where $AC = d$ metres, as shown in Figure 3. The beam is modelled as a uniform rod and the ropes as light inextensible strings. The tension in the rope attached at C is double the tension in the rope attached at A .

(a) Find the value of d .

(6)

A small load of weight kW newtons is attached to the beam at B . The beam remains in equilibrium in a horizontal position. The load is modelled as a particle. The tension in the rope attached at C is now four times the tension in the rope attached at A .

(b) Find the value of k .

(6)

Q9, (Jun 2016, Q6)

A non-uniform plank AB has length 6 m and mass 30 kg. The plank rests in equilibrium in a horizontal position on supports at the points S and T of the plank where $AS = 0.5$ m and $TB = 2$ m.

When a block of mass M kg is placed on the plank at A , the plank remains horizontal and in equilibrium and the plank is on the point of tilting about S .

When the block is moved to B , the plank remains horizontal and in equilibrium and the plank is on the point of tilting about T .

The distance of the centre of mass of the plank from A is d metres. The block is modelled as a particle and the plank is modelled as a non-uniform rod. Find

(i) the value of d ,

(ii) the value of M .

(7)



Figure 3

A beam AB has length 5 m and mass 25 kg. The beam is suspended in equilibrium in a horizontal position by two vertical ropes. One rope is attached to the beam at A and the other rope is attached to the point C on the beam where $CB = 0.5$ m, as shown in Figure 3. A particle P of mass 60 kg is attached to the beam at B and the beam remains in equilibrium in a horizontal position. The beam is modelled as a uniform rod and the ropes are modelled as light strings.

(a) Find

- (i) the tension in the rope attached to the beam at A ,
- (ii) the tension in the rope attached to the beam at C .

(6)

Particle P is removed and replaced by a particle Q of mass M kg at B . Given that the beam remains in equilibrium in a horizontal position,

(b) find

- (i) the greatest possible value of M ,
- (ii) the greatest possible tension in the rope attached to the beam at C .

(6)