

## Moments - Edexcel Past Exam Questions

1.

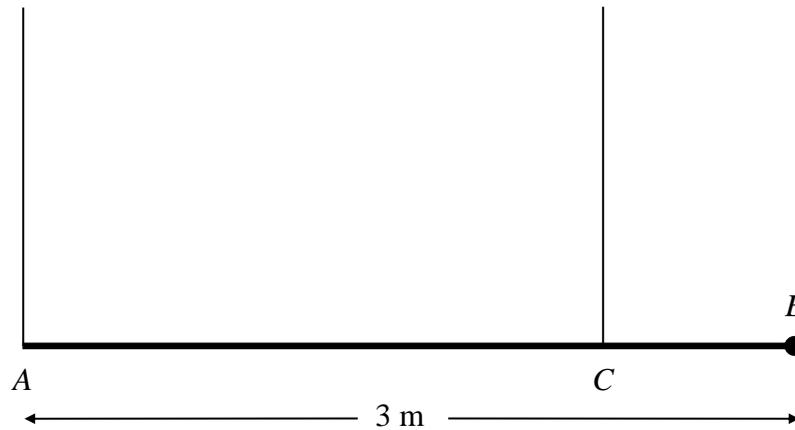


Figure 1

A plank  $AB$  has mass 40 kg and length 3 m. A load of mass 20 kg is attached to the plank at  $B$ . The loaded plank is held in equilibrium, with  $AB$  horizontal, by two vertical ropes attached at  $A$  and  $C$ , as shown in Figure 1. The plank is modelled as a uniform rod and the load as a particle. Given that the tension in the rope at  $C$  is three times the tension in the rope at  $A$ , calculate

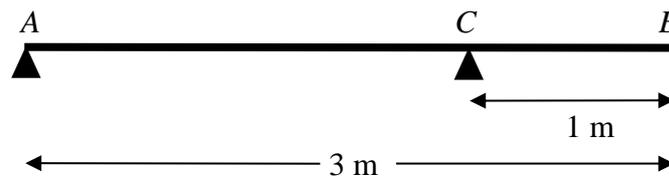
(a) the tension in the rope at  $C$ , (2)

(b) the distance  $CB$ . (5)

Jan 05 Q2

2.

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 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)

June 05 Q6

3.

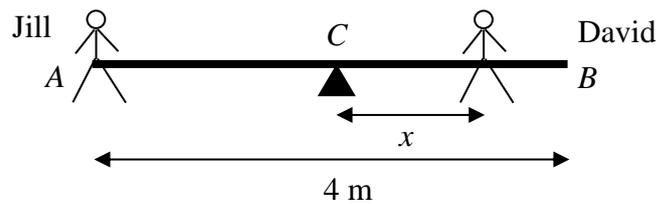


Figure 1

A seesaw in a playground consists of a beam  $AB$  of length 4 m which is supported by a smooth pivot at its centre  $C$ . Jill has mass 25 kg and sits on the end  $A$ . David has mass 40 kg and sits at a distance  $x$  metres from  $C$ , as shown in Figure 1. The beam is initially modelled as a uniform rod. Using this model,

- (a) find the value of  $x$  for which the seesaw can rest in equilibrium in a horizontal position. (3)
- (b) State what is implied by the modelling assumption that the beam is uniform. (1)

David realises that the beam is not uniform as he finds he must sit at a distance 1.4 m from  $C$  for the seesaw to rest horizontally in equilibrium. The beam is now modelled as a non-uniform rod of mass 15 kg. Using this model,

- (c) find the distance of the centre of mass of the beam from  $C$ . (4)
- Jan 06 Q3**

4.

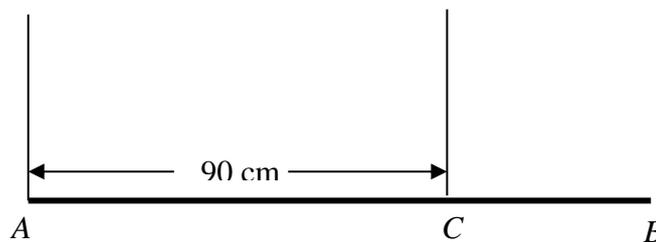


Figure 3

A steel girder  $AB$  has weight 210 N. It is held in equilibrium in a horizontal position by two vertical cables. One cable is attached to the end  $A$ . The other cable is attached to the point  $C$  on the girder, where  $AC = 90$  cm, as shown in Figure 3. The girder is modelled as a uniform rod, and the cables as light inextensible strings.

Given that the tension in the cable at  $C$  is twice the tension in the cable at  $A$ , find

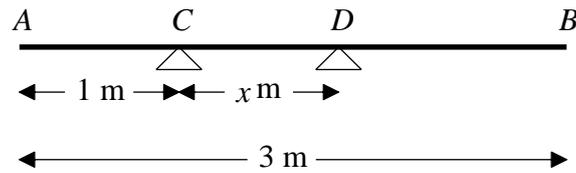
- (a) the tension in the cable at  $A$ , (2)
- (b) show that  $AB = 120$  cm. (4)

A small load of weight  $W$  newtons is attached to the girder at  $B$ . The load is modelled as a particle. The girder remains in equilibrium in a horizontal position. The tension in the cable at  $C$  is now three times the tension in the cable at  $A$ .

- (c) Find the value of  $W$ . (7)
- June 06 Q5**

5.

Figure 2



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

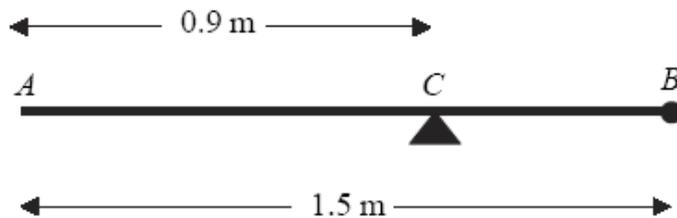
(c) the magnitude of the reaction of the support on the plank at  $D$ . (2)

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

**Jan 07 Q2**

6.

Figure 3



A uniform rod  $AB$  has length  $1.5 \text{ m}$  and mass  $8 \text{ kg}$ . A particle of mass  $m \text{ kg}$  is attached to the rod at  $B$ . The rod is supported at the point  $C$ , where  $AC = 0.9 \text{ m}$ , and the system is in equilibrium with  $AB$  horizontal, as shown in Figure 2.

(a) Show that  $m = 2$ . (4)

A particle of mass  $5 \text{ kg}$  is now attached to the rod at  $A$  and the support is moved from  $C$  to a point  $D$  of the rod. The system, including both particles, is again in equilibrium with  $AB$  horizontal.

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

**June 07 Q3**

7.

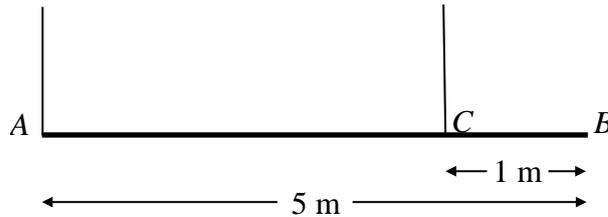


Figure 2

A beam  $AB$  has mass  $12\text{ kg}$  and length  $5\text{ m}$ . It is held in equilibrium in a horizontal position by two vertical ropes attached to the beam. One rope is attached to  $A$ , the other to the point  $C$  on the beam, where  $BC = 1\text{ m}$ , as shown in Figure 2. The beam is modelled as a uniform rod, and the ropes as light strings.

(a) Find

(i) the tension in the rope at  $C$ ,

(ii) the tension in the rope at  $A$ .

(5)

A small load of mass  $16\text{ kg}$  is attached to the beam at a point which is  $y$  metres from  $A$ . The load is modelled as a particle. Given that the beam remains in equilibrium in a horizontal position,

(b) find, in terms of  $y$ , an expression for the tension in the rope at  $C$ .

(3)

The rope at  $C$  will break if its tension exceeds  $98\text{ N}$ . The rope at  $A$  cannot break.

(c) Find the range of possible positions on the beam where the load can be attached without the rope at  $C$  breaking.

(3)

Jan 08 Q5

8.

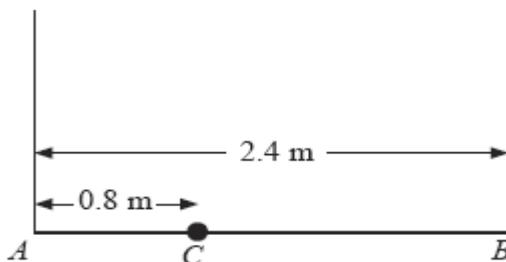


Figure 2

A plank  $AB$  has mass  $12\text{ kg}$  and length  $2.4\text{ m}$ . A load of mass  $8\text{ kg}$  is attached to the plank at the point  $C$ , where  $AC = 0.8\text{ m}$ . 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  $10\text{ N}$  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)

June 08 Q6

9.

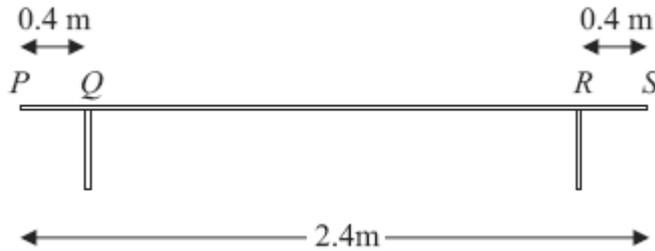


Figure 1

A bench consists of a plank which is resting in a horizontal position on two thin vertical legs. The plank is modelled as a uniform rod  $PS$  of length 2.4 m and mass 20 kg. The legs at  $Q$  and  $R$  are 0.4 m from each end of the plank, as shown in Figure 1.

Two pupils, Arthur and Beatrice, sit on the plank. Arthur has mass 60 kg and sits at the middle of the plank and Beatrice has mass 40 kg and sits at the end  $P$ . The plank remains horizontal and in equilibrium. By modelling the pupils as particles, find

- (a) the magnitude of the normal reaction between the plank and the leg at  $Q$  and the magnitude of the normal reaction between the plank and the leg at  $R$ . (7)

Beatrice stays sitting at  $P$  but Arthur now moves and sits on the plank at the point  $X$ . Given that the plank remains horizontal and in equilibrium, and that the magnitude of the normal reaction between the plank and the leg at  $Q$  is now twice the magnitude of the normal reaction between the plank and the leg at  $R$ ,

- (b) find the distance  $QX$ .

(6)

Jan 09 Q4

10.

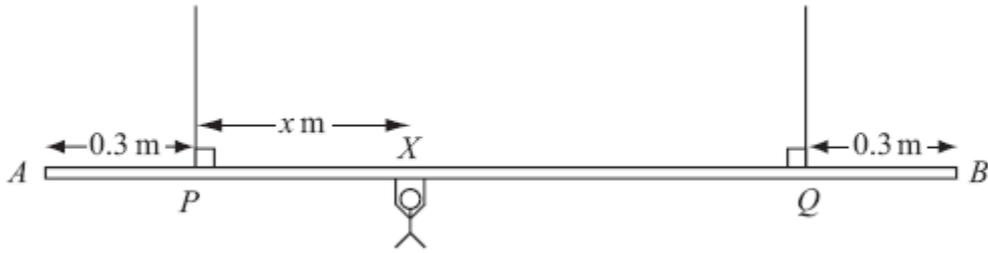


Figure 2

A beam  $AB$  is supported by two vertical ropes, which are attached to the beam at points  $P$  and  $Q$ , where  $AP = 0.3$  m and  $BQ = 0.3$  m. The beam is modelled as a uniform rod, of length 2 m and mass 20 kg. The ropes are modelled as light inextensible strings. A gymnast of mass 50 kg hangs on the beam between  $P$  and  $Q$ . The gymnast is modelled as a particle attached to the beam at the point  $X$ , where  $PX = x$  m,  $0 < x < 1.4$  as shown in Figure 2. The beam rests in equilibrium in a horizontal position.

- (a) Show that the tension in the rope attached to the beam at  $P$  is  $(588 - 350x)$  N. (3)
- (b) Find, in terms of  $x$ , the tension in the rope attached to the beam at  $Q$ . (3)
- (c) Hence find, justifying your answer carefully, the range of values of the tension which could occur in each rope. (3)

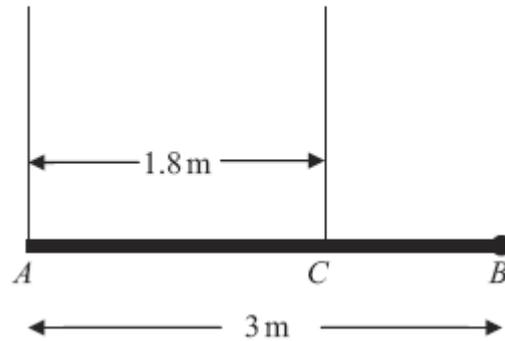
Given that the tension in the rope attached at  $Q$  is three times the tension in the rope attached at  $P$ ,

- (d) find the value of  $x$ . (3)

June 09 Q7

11.

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)

Jan 10 Q4

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12. A beam  $AB$  has length 6 m and weight 200 N. The beam rests in a horizontal position on two supports at the points  $C$  and  $D$ , where  $AC = 1$  m and  $DB = 1$  m. Two children, Sophie and Tom, each of weight 500 N, stand on the beam with Sophie standing twice as far from the end  $B$  as Tom. The beam remains horizontal and in equilibrium and the magnitude of the reaction at  $D$  is three times the magnitude of the reaction at  $C$ . By modelling the beam as a uniform rod and the two children as particles, find how far Tom is standing from the end  $B$ .

(7)

June 10 Q4

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13.

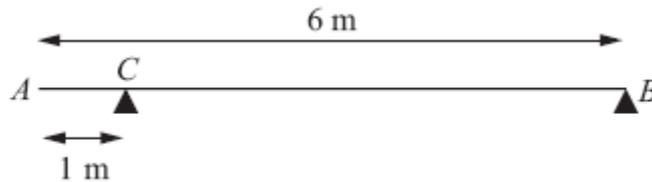


Figure 1

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)

Jan 11 Q3

14. A plank  $PQR$ , of length 8 m and mass 20 kg, is in equilibrium in a horizontal position on two supports at  $P$  and  $Q$ , where  $PQ = 6$  m.

A child of mass 40 kg stands on the plank at a distance of 2 m from  $P$  and a block of mass  $M$  kg is placed on the plank at the end  $R$ . The plank remains horizontal and in equilibrium. The force exerted on the plank by the support at  $P$  is equal to the force exerted on the plank by the support at  $Q$ .

By modelling the plank as a uniform rod, and the child and the block as particles,

(a) (i) find the magnitude of the force exerted on the plank by the support at  $P$ ,

(ii) find the value of  $M$ . (10)

(b) State how, in your calculations, you have used the fact that the child and the block can be modelled as particles. (1)

June 11 Q5