MOMENTS

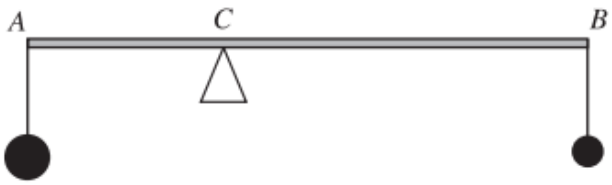
A2 Unit 4: Applied Mathematics B

Section B: Mechanics

WJEC past paper questions: 2010 – 2017

Total marks available 112 (approximately 2 hours 15 minutes)

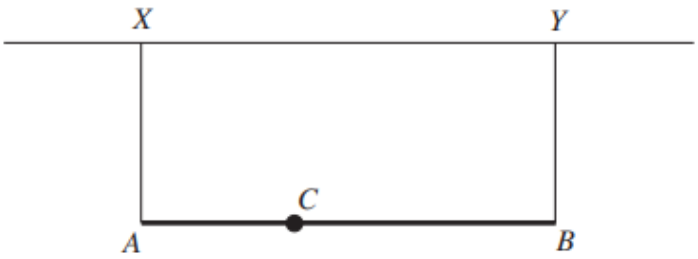
1. A uniform rod AB, of mass 3 kg, has length 2 m. A particle of mass 5 kg is attached to the end A, and a particle of mass 2 kg is attached to the end B. The diagram shows the rod resting horizontally in equilibrium on a smooth support at the point C, where $AC = x$ m.



Calculate the magnitude of the reaction of the support at C and the value of x. [6]

(January 11)

2. A uniform rod AB is suspended horizontally from the ceiling by means of two vertical light inextensible strings XA and YB of equal length.

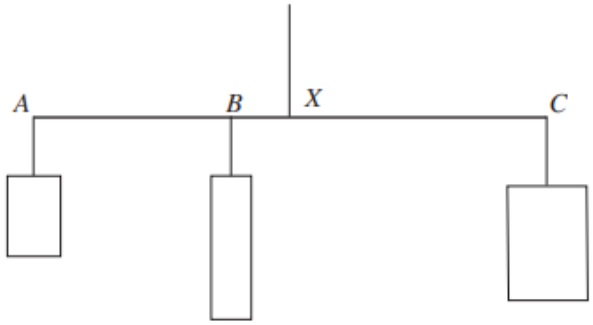


The rod AB has mass 6 kg and length 1·4 m. A particle, of mass 10 kg, is attached to the rod at point C, where $AC = 0{\cdot}3$ m. Calculate the tension in **each** of the strings XA and YB. [7]

(Summer 10)

3.

The diagram shows a wind chime consisting of a horizontal uniform rod AC, suspended in equilibrium by means of a light string attached to the mid-point X of the rod, together with three objects hanging from the points A, B and C of the rod.



The length of the rod AC is 20 cm and the length of AB is 8 cm. The masses of the objects hanging from A, B, C are 0·1 kg, M kg, 0·4 kg respectively. The mass of the rod is 0·5 kg.

(a) Find the value of M. [4]

(b) Calculate the tension in the string. [3]

(January 10)

4.

The diagram shows a uniform rod AB, of mass 4 kg and length 1·6 m, with a particle, of mass 0·5 kg, attached at a point C of the rod, where $AC = 0{\cdot}5$ m.
The rod is resting horizontally in equilibrium on two smooth supports at points X and Y of the rod, where $AX = 0{\cdot}6$ m and $AY = 1{\cdot}2$ m.

(a) Calculate the reaction at X and the reaction at Y. [7]

(b) When an additional particle of mass M kg is attached to the point C, the rod is on the point of turning about X. Calculate the value of M. [4]

(Summer 11)

5.

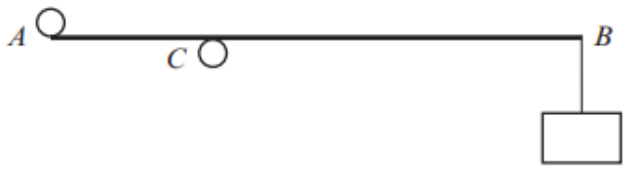
A light uniform rod AB has length 1·4 m. A particle of mass 5 kg is attached to end A, and a particle of mass 2 kg is attached to end B. The rod rests horizontally in equilibrium on a smooth support at C.

(a) Calculate the reaction of the support at C. [2]

(b) Find the distance AC. [4]

(Summer 12)

6. The diagram shows a body, of mass 65 kg, attached to the end B of a uniform rigid rod AB of length 4 m. The mass of the rod is 35 kg. The rod is held horizontally in equilibrium by two smooth cylindrical pegs, one at A and another at C, where $AC = 1{\cdot}2$ m.

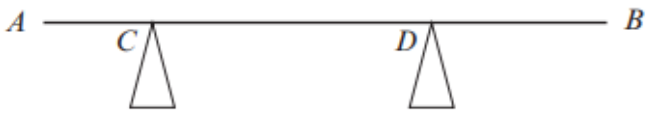


(a) Write down the moment of the weight of the rod about the point A. State your units clearly. [2]

(b) Find the forces exerted on the rod at A and C. [6]

(January 12)

7. A uniform beam AB, of length 6 m, rests in a horizontal position on two smooth supports at C and D, where $AC = 1$ m and $BD = 1{\cdot}2$ m, as shown in the diagram.



(a) When a vertical force of magnitude 1800 N is applied upwards to the beam at the end A, the beam is about to tilt about the support at D. Determine the weight of the beam. [5]

(b) The vertical force is now removed so that the beam is resting in equilibrium on the two supports. Calculate the magnitude of the reaction of each of the supports at C and D on the beam. [5]

(January 13)

8. The diagram shows a uniform plank AB of mass 12 kg and length 2 m. The plank rests horizontally in equilibrium on two supports at C and at D, where $AC = 0{\cdot}8$ m and $AD = x$ m.

(a) The reaction of the support on the plank at D has magnitude 84 N.

(i) Determine the reaction of the support on the plank at C.

(ii) Calculate the value of x. [7]

(b) A rock of mass M kg is placed at A so that the plank is on the point of tilting about C. Calculate the value of M. [3]

(Summer 13)

9. A uniform plank AB, of length 4·8 m and mass M kg, is resting on two smooth supports at points X and Y, such that $AX = BY = 1·2$ m.

(a) A person of mass 84 kg stands on the plank at a point which is 0·8 m from B. The reaction of the support at X is of magnitude 156·8 N.
Find

(i) the value of M,

(ii) the magnitude of the reaction of the support at Y. [6]

(b) The person of mass 84 kg walks along the plank towards A. At the instant that the plank starts to tilt about X, find

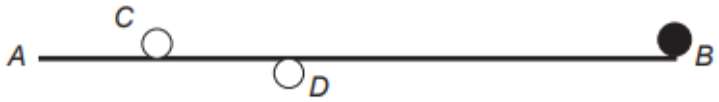
(i) the magnitude of the reaction of the support at X,

(ii) the distance of the person from X. [5]

(January 14)

10.

The diagram shows a uniform rod AB, of length 1·8 m and mass 3 kg, held in horizontal equilibrium by two small fixed cylinders C and D. An object of mass 12 kg rests on the rod at B. The length AC is 0·3 m and CD, the distance between the cylinders, is 0·4 m. The force exerted on the rod by each of the cylinders is vertical.



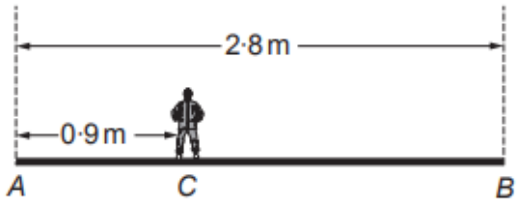
Find the magnitude of each of the forces exerted on the rod by the cylinders. [7]

(Summer 14)

11. A uniform rod AB is of mass 8 kg and length 6 m. It is suspended horizontally in equilibrium by means of two vertical light strings attached to the rod AB at point C and point D on the rod, where $AC = 1·6$ m and $AD = 4·8$ m. Calculate the tension in the string at C and the tension in the string at D. [7]

(Summer 16)

12. The diagram shows a plank AB, of mass 15 kg and length 2·8 m, being held in equilibrium with AB horizontal by means of two vertical ropes, one attached to the end A and the other attached to the end B. A man of mass 80 kg stands on the plank at point C, where $AC = 0{\cdot}9$ m.



(a) Modelling the plank as a uniform rod, find the tensions in the ropes attached to the end A and the end B of the plank. [7]

(b) The plank is now modelled as a **non-uniform** rod. Given that the tension in the rope attached to A is 1·5 times the tension in the rope attached to B, determine the distance of the centre of mass of the plank from A. [5]

(Summer 15)

13.

The diagram shows a uniform plank AB, of mass 20 kg and length 2·4 m, supported in horizontal equilibrium by two pivots, one at C and one at D. The distance AC and the distance DB are both 0·5 m. A person of mass 40 kg stands at a point which is 0·6 m from B.

(a) Calculate the magnitudes of the reaction at C and the reaction at D. [7]

(b) The person starts to walk towards A. Determine the greatest distance of the person from B if equilibrium is to be maintained. [3]

(Summer 17)