

QQQ – Mechanics Year 2 – Chapter 4 – Moments (Version 1)

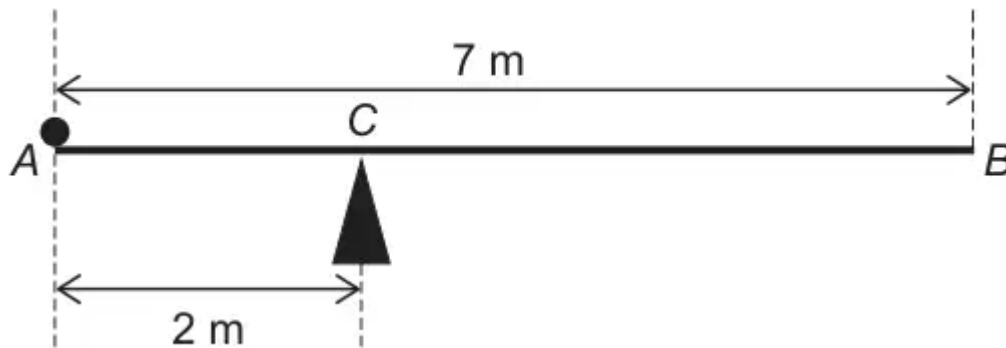
Total Marks: 23

(23 = Platinum, 21 = Gold, 18 = Silver, 16 = Bronze)

1. A uniform rod, AB , has length 7 metres and mass 4 kilograms.

The rod rests on a single fixed pivot point, C , where $AC = 2$ metres.

A particle of weight W newtons is fixed at A , as shown in the diagram.



The system is in equilibrium with the rod resting horizontally.

(a) Find W , giving your answer in terms of g . [2 marks]

(b) Explain how you have used the fact that the rod is uniform in part (a). [1 mark]

(Total 3 marks)

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2. Fig. 4 shows a uniform beam of mass 4 kg and length 2.4 m resting on two supports P and Q. P is at one end of the beam and Q is 0.3 m from the other end.

Determine whether a person of mass 50 kg can tip the beam by standing on it. [3]

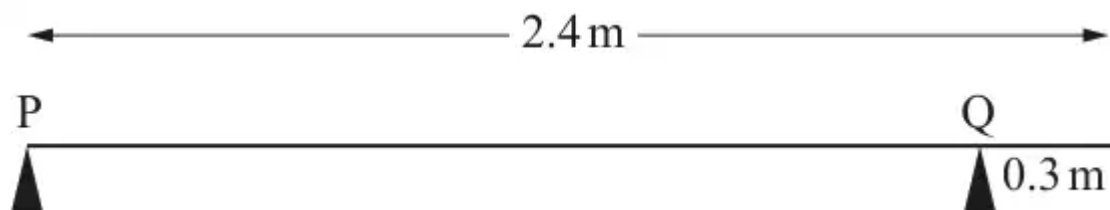


Fig. 4

(Total 3 marks)

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3.

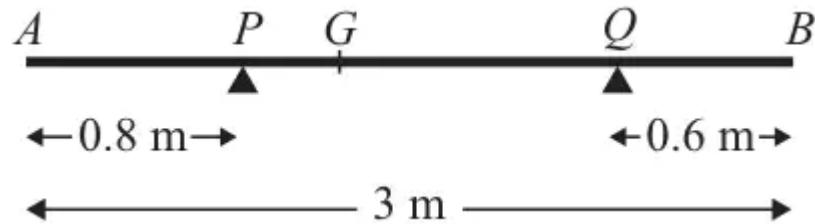


Figure 1

A non-uniform rod AB has length 3 m and mass 4.5 kg . The rod rests in equilibrium, in a horizontal position, on two smooth supports at P and at Q , where $AP = 0.8\text{ m}$ and $QB = 0.6\text{ m}$, as shown in Figure 1. The centre of mass of the rod is at G . Given that the magnitude of the reaction of the support at P on the rod is twice the magnitude of the reaction of the support at Q on the rod, find

(a) the magnitude of the reaction of the support at Q on the rod, (3)

(b) the distance AG . (4)

(Total 7 marks)

4.

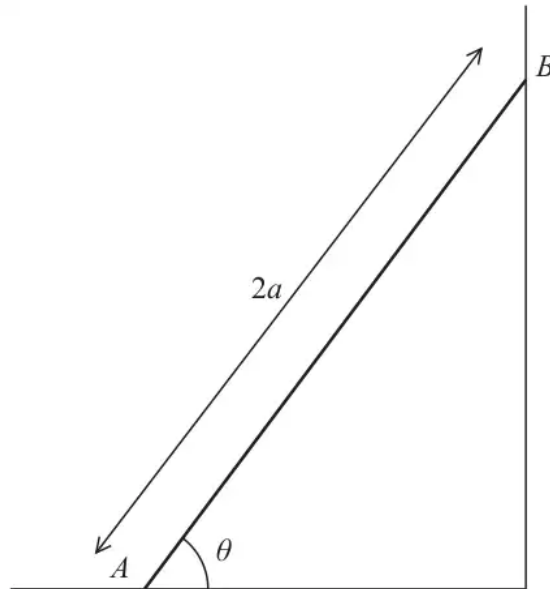


Figure 2

A beam AB has mass m and length $2a$.

The beam rests in equilibrium with A on rough horizontal ground and with B against a smooth vertical wall.

The beam is inclined to the horizontal at an angle θ , as shown in Figure 2.

The coefficient of friction between the beam and the ground is μ

The beam is modelled as a uniform rod resting in a vertical plane that is perpendicular to the wall.

Using the model,

(a) show that $\mu \geq \frac{1}{2} \cot \theta$ (5)

A horizontal force of magnitude kmg , where k is a constant, is now applied to the beam at A .

This force acts in a direction that is perpendicular to the wall and towards the wall.

Given that $\tan \theta = \frac{5}{4}$, $\mu = \frac{1}{2}$ and the beam is now in limiting equilibrium,

(b) use the model to find the value of k . (5)

(Total 10 marks)