Centres of mass and moments – A2 Further Mathematics Mechanics

1. June/2022/Paper_7367/03M/No.3

Three particles are attached to a light rod, AB, of length 40 cm

The particles are attached at A, B and the midpoint of the rod.

The particle at A has mass 5 kg

The particle at B has mass 1 kg

The particle at the midpoint has mass 4 kg

Find the distance of the centre of mass of this system from the midpoint of the rod.

Circle your answer.

[1 mark]

4 cm 8 cm 12 cm 28 cm

2. June/2022/Paper_7367/03M/No.9

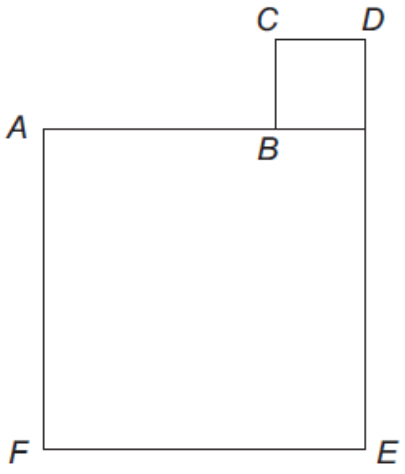
Two blocks have square cross sections.

One block has mass 9 kg and its cross section has sides of length 20 cm

The other block has mass 1 kg and its cross section has sides of length 4 cm

The blocks are fixed together to form the composite body shown in **Figure 1**.

Figure 1



(a) Find the distance of the centre of mass of the composite body from AF

[2 marks]

(b) A uniform rod has mass 12 kg and length 1 metre.

One end of the rod rests against a smooth vertical wall.

The other end of the rod rests on the composite body at point B

The composite body is on a horizontal surface.

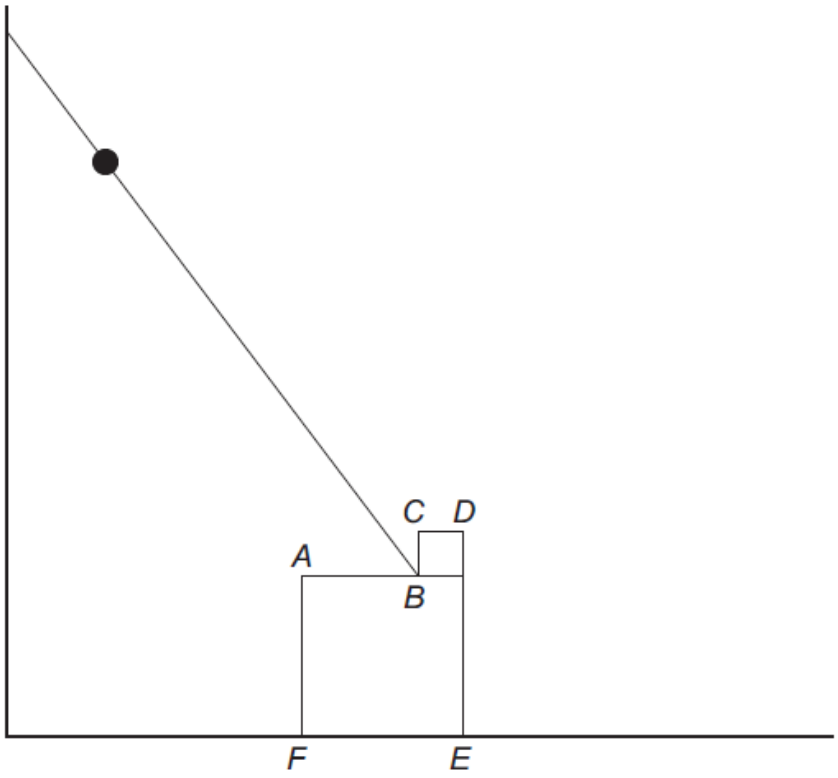
The coefficient of friction between the composite body and the horizontal surface is 0.3

The angle between the rod and AB is 60°

A particle of mass m kg is fixed to the rod at a distance of 75 cm from B

The rod, particle and composite body are shown in **Figure 2**.

Figure 2



(b) (i) Write down the magnitude of the vertical reaction force acting on the rod at B in terms of m and g

[1 mark]

(b) (ii) Show that the magnitude of the horizontal reaction force acting on the rod at B is

$$\frac{g(6 + 0.75m)}{\sqrt{3}}$$

[3 marks]

(b) (iii) Find the maximum value of m for which the composite body does not slide or topple.

Fully justify your answer.

[6 marks]