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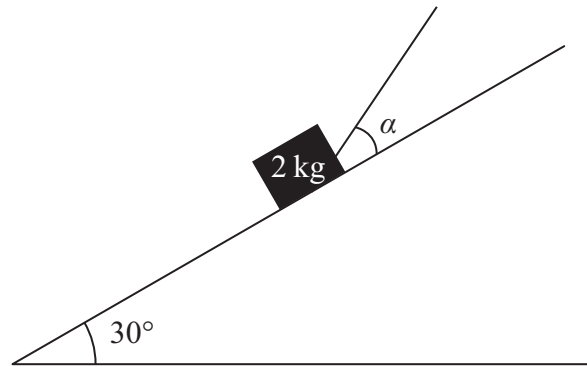


Figure 1

A box of mass 2 kg is held in equilibrium on a fixed rough inclined plane by a rope. The rope lies in a vertical plane containing a line of greatest slope of the inclined plane. The rope is inclined to the plane at an angle  $\alpha$ , where  $\tan \alpha = \frac{3}{4}$ , and the plane is at an angle of  $30^\circ$  to the horizontal, as shown in Figure 1. The coefficient of friction between the box and the inclined plane is  $\frac{1}{3}$  and the box is on the point of slipping up the plane. By modelling the box as a particle and the rope as a light inextensible string, find the tension in the rope.

**(8)**

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**Question 3 continued**

Lined area for writing answers to Question 3.

**Q3**

**(Total 8 marks)**











5. A car is travelling along a straight horizontal road. The car takes 120 s to travel between two sets of traffic lights which are 2145 m apart. The car starts from rest at the first set of traffic lights and moves with constant acceleration for 30 s until its speed is  $22 \text{ m s}^{-1}$ . The car maintains this speed for  $T$  seconds. The car then moves with constant deceleration, coming to rest at the second set of traffic lights.

(a) Sketch, in the space below, a speed-time graph for the motion of the car between the two sets of traffic lights. (2)

(b) Find the value of  $T$ . (3)

A motorcycle leaves the first set of traffic lights 10 s after the car has left the first set of traffic lights. The motorcycle moves from rest with constant acceleration,  $a \text{ m s}^{-2}$ , and passes the car at the point  $A$  which is 990 m from the first set of traffic lights. When the motorcycle passes the car, the car is moving with speed  $22 \text{ m s}^{-1}$ .

(c) Find the time it takes for the motorcycle to move from the first set of traffic lights to the point  $A$ . (4)

(d) Find the value of  $a$ . (2)











6. 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)

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**Question 6 continued**

Handwriting practice lines for Question 6. The page contains 31 horizontal lines for writing, starting from the line below the title and ending at the line above the 'Q6' label.

**(Total 14 marks)**

**Q6**

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P 4 1 8 2 8 A 0 2 1 2 8











8.

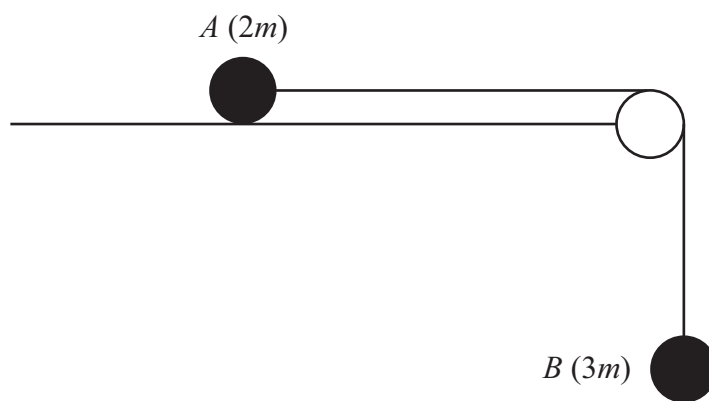


Figure 2

Two particles  $A$  and  $B$  have masses  $2m$  and  $3m$  respectively. The particles are attached to the ends of a light inextensible string. Particle  $A$  is held at rest on a smooth horizontal table. The string passes over a small smooth pulley which is fixed at the edge of the table. Particle  $B$  hangs at rest vertically below the pulley with the string taut, as shown in Figure 2. Particle  $A$  is released from rest. Assuming that  $A$  has not reached the pulley, find

- (a) the acceleration of  $B$ , (5)
- (b) the tension in the string, (1)
- (c) the magnitude and direction of the force exerted on the pulley by the string. (4)

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**Question 8 continued**

Ruled area for writing the answer to Question 8.

Q8

(Total 10 marks)

**TOTAL FOR PAPER: 75 MARKS**

**END**

