

Figure 1

A particle of weight 8 N is attached at C to the ends of two light inextensible strings AC and BC . The other ends, A and B , are attached to a fixed horizontal ceiling. The particle hangs at rest in equilibrium, with the strings in a vertical plane. The string AC is inclined at 35° to the horizontal and the string BC is inclined at 25° to the horizontal, as shown in Figure 1. Find

- (i) the tension in the string AC ,
- (ii) the tension in the string BC .

(8)



3.

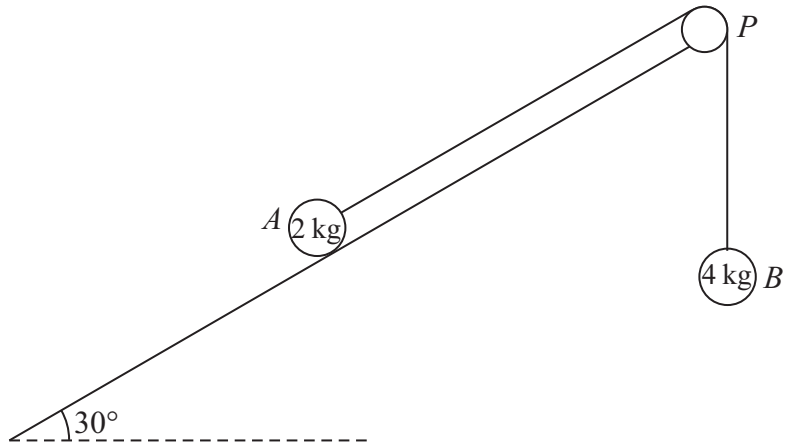


Figure 2

A fixed rough plane is inclined at 30° to the horizontal. A small smooth pulley P is fixed at the top of the plane. Two particles A and B , of mass 2 kg and 4 kg respectively, are attached to the ends of a light inextensible string which passes over the pulley P . The part of the string from A to P is parallel to a line of greatest slope of the plane and B hangs freely below P , as shown in Figure 2. The coefficient of friction between A and the plane is $\frac{1}{\sqrt{3}}$. Initially A is held at rest on the plane. The particles are released from rest with the string taut and A moves up the plane.

Find the tension in the string immediately after the particles are released.

(9)



5.

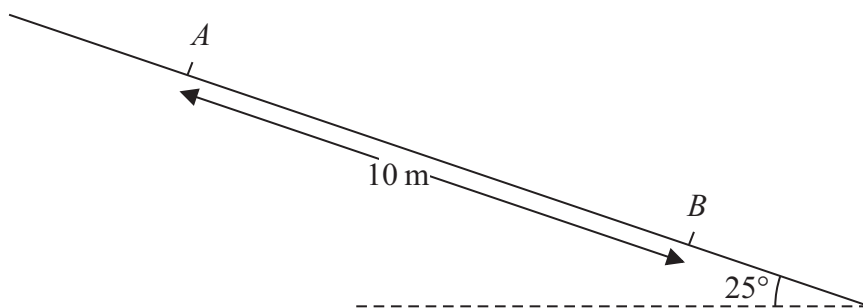


Figure 3

A particle P of mass 0.6 kg slides with constant acceleration down a line of greatest slope of a rough plane, which is inclined at 25° to the horizontal. The particle passes through two points A and B , where $AB = 10\text{ m}$, as shown in Figure 3. The speed of P at A is 2 m s^{-1} . The particle P takes 3.5 s to move from A to B . Find

- (a) the speed of P at B , (3)
- (b) the acceleration of P , (2)
- (c) the coefficient of friction between P and the plane. (5)



Question 5 continued

Area for writing the answer to Question 5 continued, featuring horizontal lines for text entry.



P 4 2 9 5 8 A 0 1 7 3 2

6. [In this question \mathbf{i} and \mathbf{j} are horizontal unit vectors due east and due north respectively. Position vectors are given with respect to a fixed origin O .]

A ship S is moving with constant velocity $(3\mathbf{i} + 3\mathbf{j}) \text{ km h}^{-1}$. At time $t = 0$, the position vector of S is $(-4\mathbf{i} + 2\mathbf{j}) \text{ km}$.

(a) Find the position vector of S at time t hours. (2)

A ship T is moving with constant velocity $(-2\mathbf{i} + n\mathbf{j}) \text{ km h}^{-1}$. At time $t = 0$, the position vector of T is $(6\mathbf{i} + \mathbf{j}) \text{ km}$. The two ships meet at the point P .

(b) Find the value of n . (5)

(c) Find the distance OP . (4)



7.

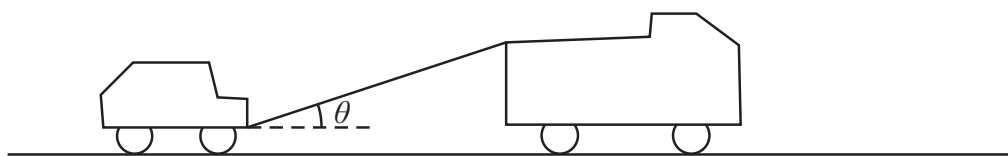


Figure 4

A truck of mass 1750 kg is towing a car of mass 750 kg along a straight horizontal road. The two vehicles are joined by a light towbar which is inclined at an angle θ to the road, as shown in Figure 4. The vehicles are travelling at 20 m s^{-1} as they enter a zone where the speed limit is 14 m s^{-1} . The truck's brakes are applied to give a constant braking force on the truck. The distance travelled between the instant when the brakes are applied and the instant when the speed of each vehicle is 14 m s^{-1} is 100 m.

- (a) Find the deceleration of the truck and the car. (3)

The constant braking force on the truck has magnitude R newtons. The truck and the car also experience constant resistances to motion of 500 N and 300 N respectively. Given that $\cos \theta = 0.9$, find

- (b) the force in the towbar, (4)

- (c) the value of R . (4)



8.

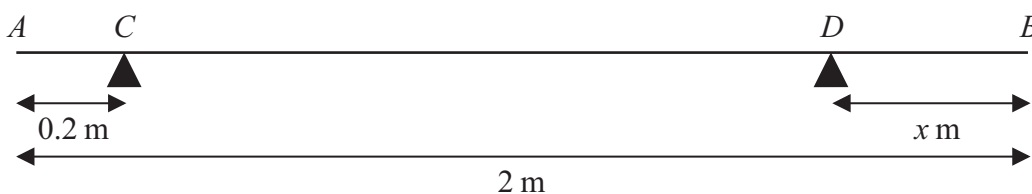


Figure 5

A uniform rod AB has length 2 m and mass 50 kg. The rod is in equilibrium in a horizontal position, resting on two smooth supports at C and D , where $AC = 0.2$ metres and $DB = x$ metres, as shown in Figure 5. Given that the magnitude of the reaction on the rod at D is twice the magnitude of the reaction on the rod at C ,

(a) find the value of x .

(6)

The support at D is now moved to the point E on the rod, where $EB = 0.4$ metres. A particle of mass m kg is placed on the rod at B , and the rod remains in equilibrium in a horizontal position. Given that the magnitude of the reaction on the rod at E is four times the magnitude of the reaction on the rod at C ,

(b) find the value of m .

(7)
