

3. A car starts from rest and moves with constant acceleration along a straight horizontal road. The car reaches a speed of $V \text{ m s}^{-1}$ in 20 seconds. It moves at constant speed $V \text{ m s}^{-1}$ for the next 30 seconds, then moves with constant deceleration $\frac{1}{2} \text{ m s}^{-2}$ until it has speed 8 m s^{-1} . It moves at speed 8 m s^{-1} for the next 15 seconds and then moves with constant deceleration $\frac{1}{3} \text{ m s}^{-2}$ until it comes to rest.

(a) Sketch, in the space below, a speed-time graph for this journey.

(3)

In the first 20 seconds of this journey the car travels 140 m.

Find

(b) the value of V ,

(2)

(c) the total time for this journey,

(4)

(d) the total distance travelled by the car.

(4)



6.

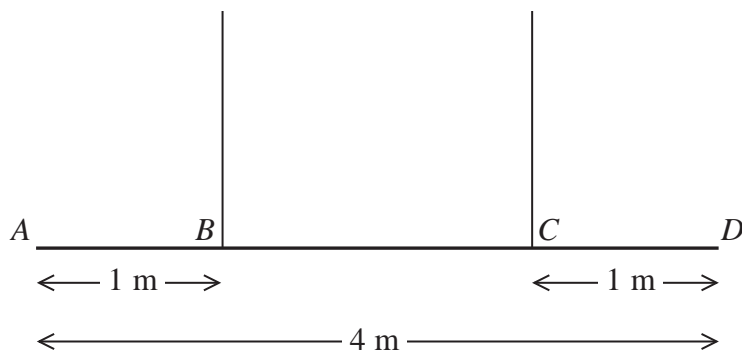


Figure 3

A non-uniform beam AD has weight W newtons and length 4 m. It is held in equilibrium in a horizontal position by two vertical ropes attached to the beam. The ropes are attached to two points B and C on the beam, where $AB = 1$ m and $CD = 1$ m, as shown in Figure 3. The tension in the rope attached to C is double the tension in the rope attached to B . The beam is modelled as a rod and the ropes are modelled as light inextensible strings.

- (a) Find the distance of the centre of mass of the beam from A . (6)

A small load of weight kW newtons is attached to the beam at D . The beam remains in equilibrium in a horizontal position. The load is modelled as a particle.

Find

- (b) an expression for the tension in the rope attached to B , giving your answer in terms of k and W , (3)
- (c) the set of possible values of k for which both ropes remain taut. (2)



7.

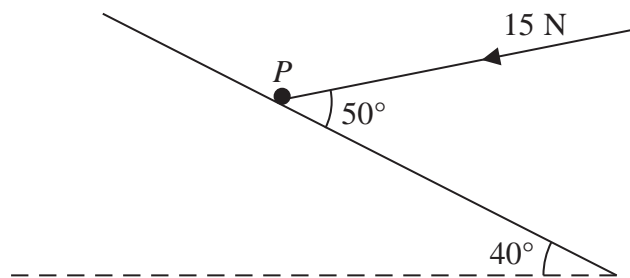


Figure 4

A particle P of mass 2.7 kg lies on a rough plane inclined at 40° to the horizontal. The particle is held in equilibrium by a force of magnitude 15 N acting at an angle of 50° to the plane, as shown in Figure 4. The force acts in a vertical plane containing a line of greatest slope of the plane. The particle is in equilibrium and is on the point of sliding down the plane.

Find

(a) the magnitude of the normal reaction of the plane on P , (4)

(b) the coefficient of friction between P and the plane. (5)

The force of magnitude 15 N is removed.

(c) Determine whether P moves, justifying your answer. (4)



