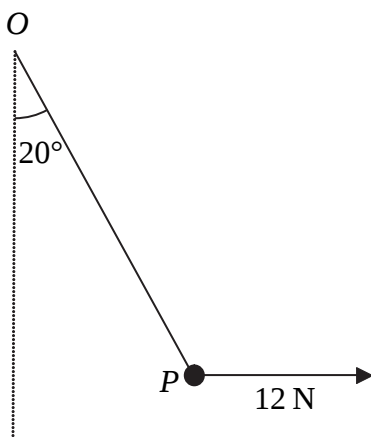


1.

Figure 1



A particle P is attached to one end of a light inextensible string. The other end of the string is attached to a fixed point O . A horizontal force of magnitude 12 N is applied to P . The particle P is in equilibrium with the string taut and OP making an angle of 20° with the downward vertical, as shown in Figure 1.

Find

- (a) the tension in the string,

(3)

- (b) the weight of P .

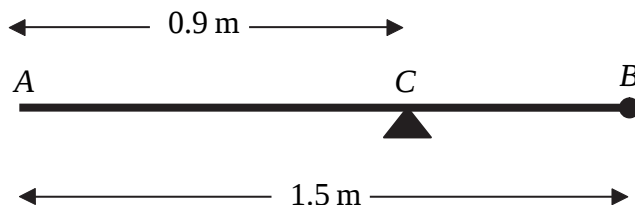
(4)



(3)

(4)

Figure 2



A uniform rod AB has length 1.5 m and mass 8 kg. A particle of mass m kg is attached to the rod at B . The rod is supported at the point C , where $AC = 0.9$ m, and the system is in equilibrium with AB horizontal, as shown in Figure 2.

- (a) Show that $m = 2$.

(4)

A particle of mass 5 kg is now attached to the rod at A and the support is moved from C to a point D of the rod. The system, including both particles, is again in equilibrium with AB horizontal.

- (b) Find the distance AD .

(5)



Q3

N 2 6 1 1 4 A 0 7 2 0

4. A car is moving along a straight horizontal road. At time $t = 0$, the car passes a point A with speed 25 m s^{-1} . The car moves with constant speed 25 m s^{-1} until $t = 10 \text{ s}$. The car then decelerates uniformly for 8 s . At time $t = 18 \text{ s}$, the speed of the car is $V \text{ m s}^{-1}$ and this speed is maintained until the car reaches the point B at time $t = 30 \text{ s}$.

- (a) Sketch, in the space below, a speed–time graph to show the motion of the car from A to B .

(3)

Given that $AB = 526 \text{ m}$, find

- (b) the value of V ,

(5)

- (c) the deceleration of the car between $t = 10 \text{ s}$ and $t = 18 \text{ s}$.

(3)

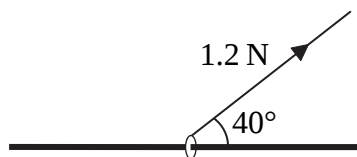


Question 4 continued

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

5.

Figure 3



A small ring of mass 0.25 kg is threaded on a fixed rough horizontal rod. The ring is pulled upwards by a light string which makes an angle 40° with the horizontal, as shown in Figure 3. The string and the rod are in the same vertical plane. The tension in the string is 1.2 N and the coefficient of friction between the ring and the rod is μ . Given that the ring is in limiting equilibrium, find

- (a) the normal reaction between the ring and the rod,

(4)

- (b) the value of μ .

(6)



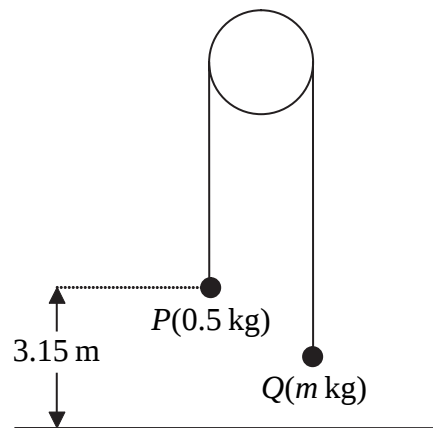
Q5

(Total 10 marks)



6.

Figure 4



Two particles P and Q have mass 0.5 kg and $m \text{ kg}$ respectively, where $m < 0.5$. The particles are connected by a light inextensible string which passes over a smooth, fixed pulley. Initially P is 3.15 m above horizontal ground. The particles are released from rest with the string taut and the hanging parts of the string vertical, as shown in Figure 4. After P has been descending for 1.5 s , it strikes the ground. Particle P reaches the ground before Q has reached the pulley.

(a) Show that the acceleration of P as it descends is 2.8 m s^{-2} . (3)

(b) Find the tension in the string as P descends. (3)

(c) Show that $m = \frac{5}{18}$. (4)

(d) State how you have used the information that the string is inextensible. (1)

When P strikes the ground, P does not rebound and the string becomes slack. Particle Q then moves freely under gravity, without reaching the pulley, until the string becomes taut again.

(e) Find the time between the instant when P strikes the ground and the instant when the string becomes taut again. (6)

[illegible]

- At time t hours after noon, the position vector of B is $\mathbf{b}$ km.

- Another boat C is also moving with constant velocity. The position vector of C , $\mathbf{c}$ km, at time t hours after noon, is given by

$$\mathbf{c} = (-9\mathbf{i} + 20\mathbf{j}) + t(6\mathbf{i} + \lambda\mathbf{j}),$$

where λ is a constant. Given that C intercepts B ,

- (d) show that, before C intercepts B , the boats are moving with the same speed. (3)

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Question 7 continued

This image shows a full page of blank, lined paper. It features approximately 20 evenly spaced horizontal grey lines across its entire width, providing a guide for handwriting or typing. The paper itself is a clean, off-white color. There are no margins, text, or other markings present on the page.

(Total 14 marks)

Q7

TOTAL FOR PAPER: 75 MARKS

END

