

1. A particle of mass 0.25 kg is moving with velocity $(3\mathbf{i} + 7\mathbf{j}) \text{ m s}^{-1}$ when it receives the impulse $(5\mathbf{i} - 3\mathbf{j}) \text{ N s}$.

Find the speed of the particle immediately after the impulse.

(5)

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Question 1 continued

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Q1

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Question 2 continued

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The number of protons in a neutral atom is equal to the number of electrons in that atom. The number of protons in a neutral atom is equal to the atomic number, which is 11 for sodium. Therefore, the number of electrons in a neutral sodium atom is 11.

The number of protons in a neutral atom is equal to the number of electrons in that atom. The number of protons in a neutral atom is equal to the atomic number, which is 11 for sodium. Therefore, the number of electrons in a neutral sodium atom is 11.

(Total 9 marks)

Q2





Question 3 continued

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Q3



N 3 4 2 7 4 A 0 7 2 8



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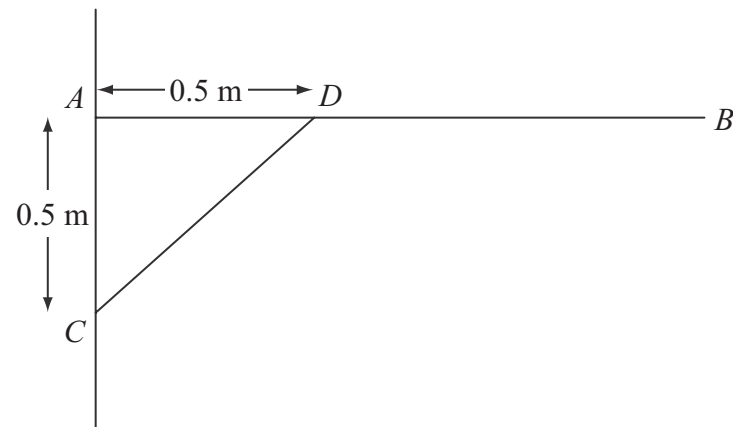


Figure 1

A uniform rod AB , of length 1.5 m and mass 3 kg, is smoothly hinged to a vertical wall at A . The rod is held in equilibrium in a horizontal position by a light strut CD as shown in Figure 1. The rod and the strut lie in the same vertical plane, which is perpendicular to the wall. The end C of the strut is freely jointed to the wall at a point 0.5 m vertically below A . The end D is freely jointed to the rod so that AD is 0.5 m.

(a) Find the thrust in CD . (4)

(b) Find the magnitude and direction of the force exerted on the rod AB at A . (7)

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Question 4 continued

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Q4

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5.

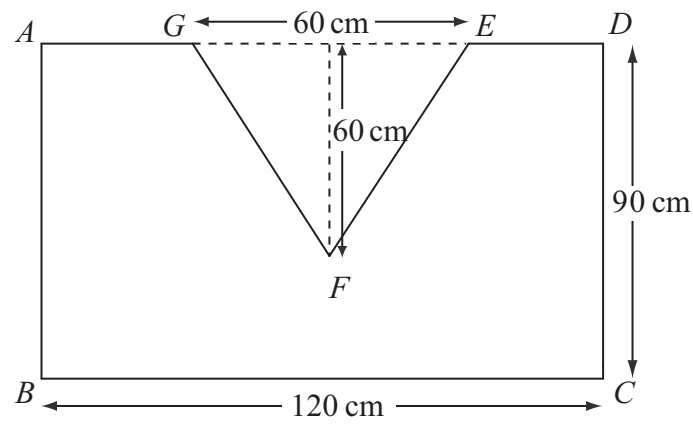


Figure 2

A shop sign $ABCDEFG$ is modelled as a uniform lamina, as illustrated in Figure 2. $ABCD$ is a rectangle with $BC = 120$ cm and $DC = 90$ cm. The shape EFG is an isosceles triangle with $EG = 60$ cm and height 60 cm. The mid-point of AD and the mid-point of EG coincide.

- (a) Find the distance of the centre of mass of the sign from the side AD . (5)

The sign is freely suspended from A and hangs at rest.

- (b) Find the size of the angle between AB and the vertical. (4)

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Question 5 continued

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Question 5 continued

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(Total 9 marks)

Q5



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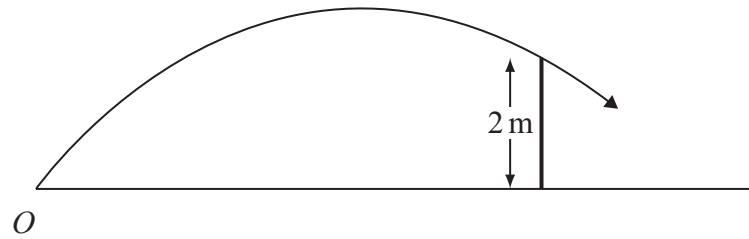


Figure 3

A child playing cricket on horizontal ground hits the ball towards a fence 10 m away. The ball moves in a vertical plane which is perpendicular to the fence. The ball just passes over the top of the fence, which is 2 m above the ground, as shown in Figure 3.

The ball is modelled as a particle projected with initial speed $u \text{ m s}^{-1}$ from point O on the ground at an angle α to the ground.

- (a) By writing down expressions for the horizontal and vertical distances, from O of the ball t seconds after it was hit, show that

$$2 = 10 \tan \alpha - \frac{50g}{u^2 \cos^2 \alpha}. \quad (6)$$

Given that $\alpha = 45^\circ$,

- (b) find the speed of the ball as it passes over the fence. (6)





Question 6 continued

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Question 6 continued

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Question 6 continued

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Q6

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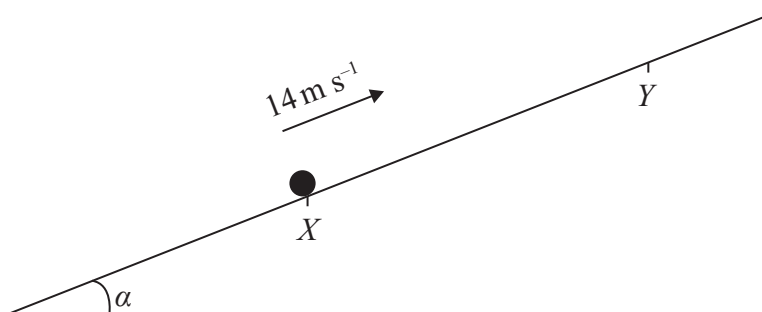


Figure 4

A particle P of mass 2 kg is projected up a rough plane with initial speed 14 m s^{-1} , from a point X on the plane, as shown in Figure 4. The particle moves up the plane along the line of greatest slope through X and comes to instantaneous rest at the point Y . The plane is inclined at an angle α to the horizontal, where $\tan \alpha = \frac{7}{24}$. The coefficient of friction between the particle and the plane is $\frac{1}{8}$.

(a) Use the work-energy principle to show that $XY = 25 \text{ m}$. (7)

After reaching Y , the particle P slides back down the plane.

(b) Find the speed of P as it passes through X . (4)





Question 7 continued

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- 8.** Particles A , B and C of masses $4m$, $3m$ and m respectively, lie at rest in a straight line on a smooth horizontal plane with B between A and C . Particles A and B are projected towards each other with speeds u m s^{-1} and v m s^{-1} respectively, and collide directly.

As a result of the collision, A is brought to rest and B rebounds with speed kv m s^{-1} . The coefficient of restitution between A and B is $\frac{3}{4}$.

- (a) Show that $u = 3v$. **(6)**

- (b) Find the value of k . **(2)**

Immediately after the collision between A and B , particle C is projected with speed $2v$ m s^{-1} towards B so that B and C collide directly.

- (c) Show that there is no further collision between A and B . **(4)**



Question 8 continued

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Question 8 continued

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