





Leave  
blank

2. A particle of mass 2 kg is moving with velocity  $(5\mathbf{i} + \mathbf{j}) \text{ m s}^{-1}$  when it receives an impulse of  $(-6\mathbf{i} + 8\mathbf{j}) \text{ N s}$ . Find the kinetic energy of the particle immediately after receiving the impulse.

**(5)**



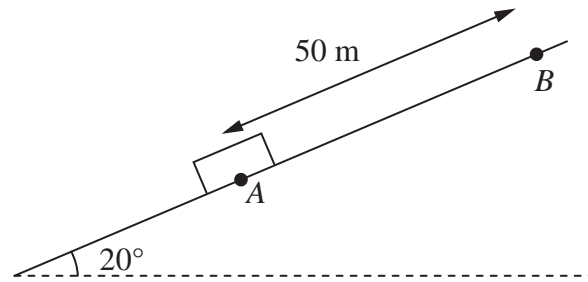
Leave  
blank

### Question 3 continued

[illegible]

Leave  
blank

4.



### Figure 1

A box of mass 30 kg is held at rest at point A on a rough inclined plane. The plane is inclined at  $20^\circ$  to the horizontal. Point B is 50 m from A up a line of greatest slope of the plane, as shown in Figure 1. The box is dragged from A to B by a force acting parallel to AB and then held at rest at B. The coefficient of friction between the box and the plane is  $\frac{1}{4}$ . Friction is the only non-gravitational resistive force acting on the box. Modelling the box as a particle,

- (a) find the work done in dragging the box from  $A$  to  $B$ .

(6)

The box is released from rest at the point  $B$  and slides down the slope. Using the work-energy principle, or otherwise,

- (b) find the speed of the box as it reaches A.

(5)

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.

Leave  
blank

**Question 4 continued**

This image shows a full page of blank, lined paper. It features approximately 28 horizontal gray lines spaced evenly apart, typical of standard notebook paper. The lines extend across the entire width of the page, leaving small margins at the top and bottom. There are no vertical lines, text, or other markings present.

Leave  
blank

**Question 4 continued**

[illegible]



Leave  
blank

**Question 4 continued**

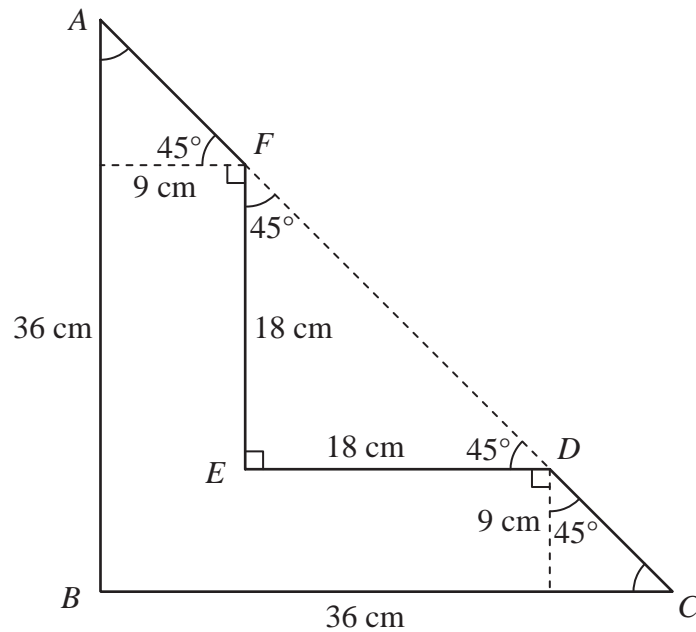
## Q4

**(Total 11 marks)**



Leave  
blank

5.

**Figure 2**

The uniform L-shaped lamina  $ABCDEF$ , shown in Figure 2, has sides  $AB$  and  $FE$  parallel, and sides  $BC$  and  $ED$  parallel. The pairs of parallel sides are 9 cm apart. The points  $A$ ,  $F$ ,  $D$  and  $C$  lie on a straight line.

$AB = BC = 36$  cm,  $FE = ED = 18$  cm.  $\angle ABC = \angle FED = 90^\circ$ , and  $\angle BCD = \angle EDF = \angle EFD = \angle BAC = 45^\circ$ .

(a) Find the distance of the centre of mass of the lamina from

(i) side  $AB$ ,

(ii) side  $BC$ .

**(7)**

The lamina is freely suspended from  $A$  and hangs in equilibrium.

(b) Find, to the nearest degree, the size of the angle between  $AB$  and the vertical.

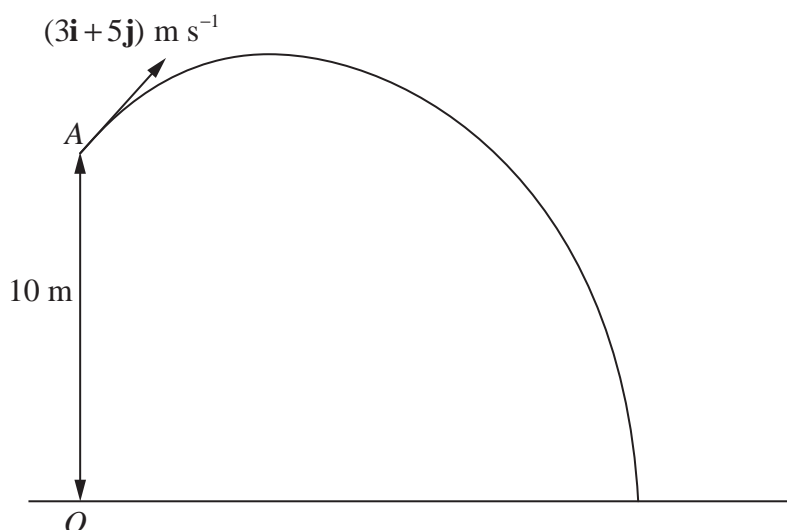
**(3)**

Leave  
blank

**Question 5 continued**

This image shows a full page of blank, lined paper. It features approximately 28 horizontal gray lines spaced evenly apart, typical of standard notebook paper. The lines extend across the entire width of the page, leaving small margins at the top and bottom. There are no vertical lines, text, or other markings present.

6. [In this question, the unit vectors  $\mathbf{i}$  and  $\mathbf{j}$  are in a vertical plane,  $\mathbf{i}$  being horizontal and  $\mathbf{j}$  being vertically upwards.]



**Figure 3**

At time  $t = 0$ , a particle  $P$  is projected from the point  $A$  which has position vector  $10\mathbf{j}$  metres with respect to a fixed origin  $O$  at ground level. The ground is horizontal. The velocity of projection of  $P$  is  $(3\mathbf{i} + 5\mathbf{j}) \text{ m s}^{-1}$ , as shown in Figure 3. The particle moves freely under gravity and reaches the ground after  $T$  seconds.

- (a) For  $0 \leq t \leq T$ , show that, with respect to  $O$ , the position vector,  $\mathbf{r}$  metres, of  $P$  at time  $t$  seconds is given by

$$\mathbf{r} = 3t\mathbf{i} + (10 + 5t - 4.9t^2)\mathbf{j} \quad (3)$$

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

- (c) Find the velocity of  $P$  at time  $t$  seconds ( $0 \leq t \leq T$ ). (2)

When  $P$  is at the point  $B$ , the direction of motion of  $P$  is  $45^\circ$  below the horizontal.

- (d) Find the time taken for  $P$  to move from  $A$  to  $B$ . (2)

- (e) Find the speed of  $P$  as it passes through  $B$ . (2)

---

---

---

---

---



Leave  
blank

**Question 6 continued**

[illegible]

**7.**



**(10)**

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.

Leave  
blank

**Question 7 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.





Leave  
blank

**Question 8 continued**

This image shows a full page of blank, lined paper. It features approximately 28 horizontal gray lines spaced evenly apart, typical of notebook paper. The lines extend across the entire width of the page, leaving small margins at the top and bottom. There are no vertical lines, text, or other markings present.