

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

$$v = (t - 2)(3t - 10), \quad t \geq 0$$

(2)

(3)

(3)

DO NOT WRITE IN THIS AREA

6. A light inextensible string has length $7a$. One end of the string is attached to a fixed point A and the other end of the string is attached to a fixed point B , with A vertically above B and $AB = 5a$. A particle of mass m is attached to a point P on the string where $AP = 4a$. The particle moves in a horizontal circle with constant angular speed ω , with both AP and BP taut.

(a) Show that

(i) the tension in AP is $\frac{4m}{25}(9a\omega^2 + 5g)$

(ii) the tension in BP is $\frac{3m}{25}(16a\omega^2 - 5g)$.

(10)

The string will break if the tension in it reaches a magnitude of $4mg$.

The time for the particle to make one revolution is S .

(b) Show that

$$3\pi\sqrt{\frac{a}{5g}} < S < 8\pi\sqrt{\frac{a}{5g}} \quad (5)$$

(c) State how in your calculations you have used the assumption that the string is light.

(1)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 6 continued

Question 6 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(Total for Question 6 is 16 marks)

7.

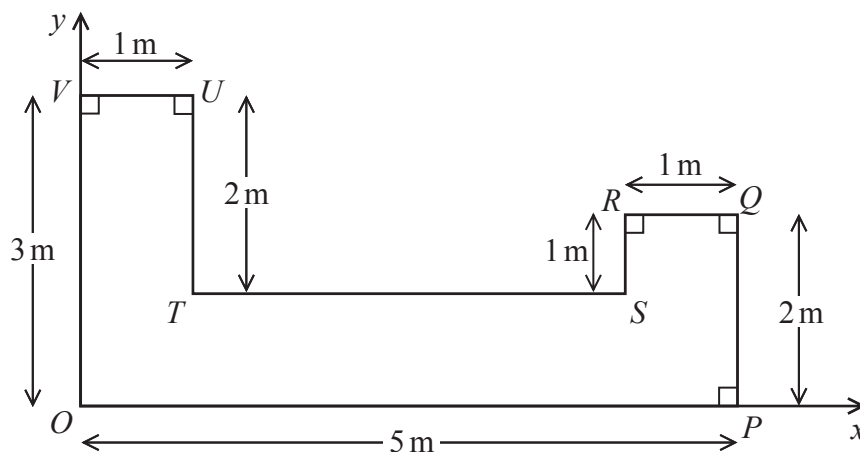


Figure 1

Figure 1 shows the shape and dimensions of a template $OPQRSTUVWXYZ$ made from thin uniform metal.

$OP = 5$ m, $PQ = 2$ m, $QR = 1$ m, $RS = 1$ m, $TU = 2$ m, $UV = 1$ m, $VO = 3$ m.

Figure 1 also shows a coordinate system with O as origin and the x -axis and y -axis along OP and OV respectively. The unit of length on both axes is the metre.

The centre of mass of the template has coordinates $(\bar{x}, \bar{y})$.

(a) (i) Show that $\bar{y} = 1$

(ii) Find the value of $\bar{x}$.

(7)

A new design requires the template to have its centre of mass at the point $(2.5, 1)$. In order to achieve this, two circular discs, each of radius r metres, are removed from the template which is shown in Figure 1, to form a new template L . The centre of the first disc is $(0.5, 0.5)$ and the centre of the second disc is $(0.5, a)$ where a is a constant.

(b) Find the value of r .

(4)

(c) (i) Explain how symmetry can be used to find the value of a .

(ii) Find the value of a .

(2)

The template L is now freely suspended from the point U and hangs in equilibrium.

(d) Find the size of the angle between the line TU and the horizontal.

(3)

Question 7 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 7 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(Total for Question 7 is 16 marks)

TOTAL FOR SECTION B IS 40 MARKS
TOTAL FOR PAPER IS 80 MARKS