

- (a) Give a reason why the maximum speed of P occurs when $x = 30$.

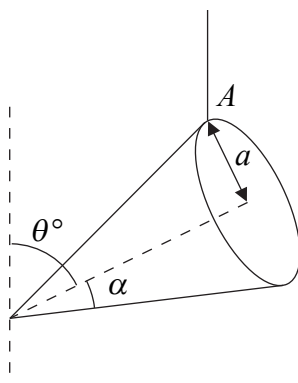
(1)

(b) find an expression for v^2 in terms of x .

(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.

Figure 1



Find, to one decimal place, the value of θ .

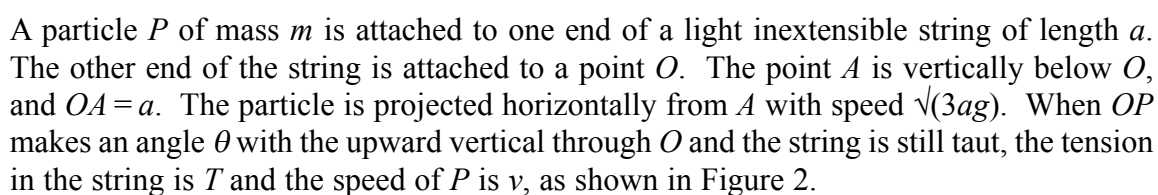
[illegible]

- (3)**

(6)

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Figure 2



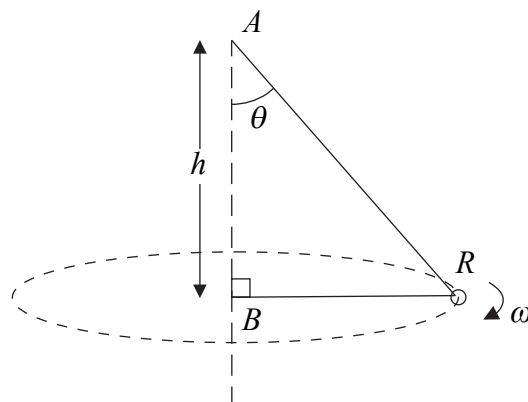
- (b) Show that $T = (1 - 3 \cos \theta)mg$. (3)

(c) Find, in terms of a , the vertical height of B above A . (2)

(d) Find, in terms of a , the vertical height of C above B . (5)

[illegible]

Figure 3



(a) Show that $\omega^2 = \frac{g}{h} \left(\frac{1 + \sin \theta}{\sin \theta} \right)$. (7)

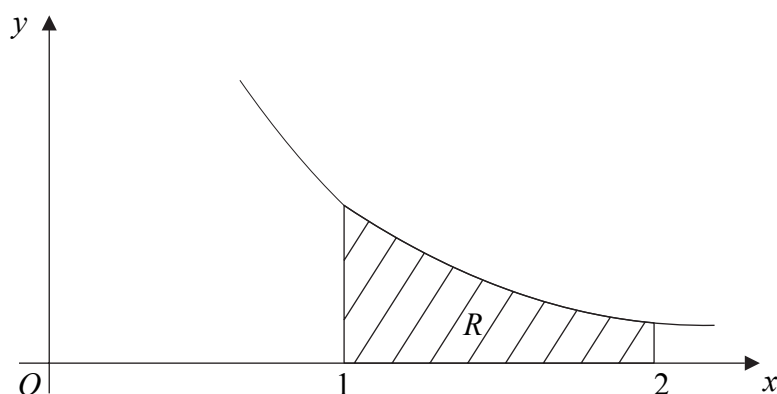
(b) Deduce that $\omega > \sqrt{\frac{2g}{h}}$. (2)

(c) find, in terms of m and g , the tension in the string.

[illegible]

6.

Figure 4

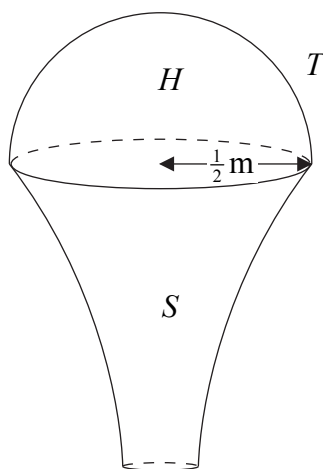


The shaded region R is bounded by the curve with equation $y = \frac{1}{2x^2}$, the x -axis and the lines $x = 1$ and $x = 2$, as shown in Figure 4. The unit of length on each axis is 1 m. A uniform solid S has the shape made by rotating R through 360° about the x -axis.

- (a) Show that the centre of mass of S is $\frac{2}{7}$ m from its larger plane face.

(6)

Figure 5



A sporting trophy T is a uniform solid hemisphere H joined to the solid S . The hemisphere has radius $\frac{1}{2}$ m and its plane face coincides with the larger plane face of S , as shown in Figure 5. Both H and S are made of the same material.

- (b) Find the distance of the centre of mass of T from its plane face.

(7)



[illegible]

- (a) Show that $\lambda = 39.2$.

(2)

(b) Prove that, while the string remains stretched, P moves with simple harmonic motion of period $\frac{\pi}{7}$ s. (6)

(6)

- (c) Calculate the speed of P at the instant when the string first becomes slack.

(3)

(d) Find, to 3 significant figures, the time taken for P to move from B to C .

(5)

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