

1. A particle P of mass 0.25 kg is moving along the positive x -axis under the action of a single force. At time t seconds P is x metres from the origin O and is moving away from O with speed v m s⁻¹ where $\frac{dv}{dx} = 3$. It is given that $x = 2$ and $v = 3$ when $t = 0$

(a) Find the magnitude of the force acting on P when $x = 5$

(4)

(b) Find the value of t when $x = 5$

(4)

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.

2.

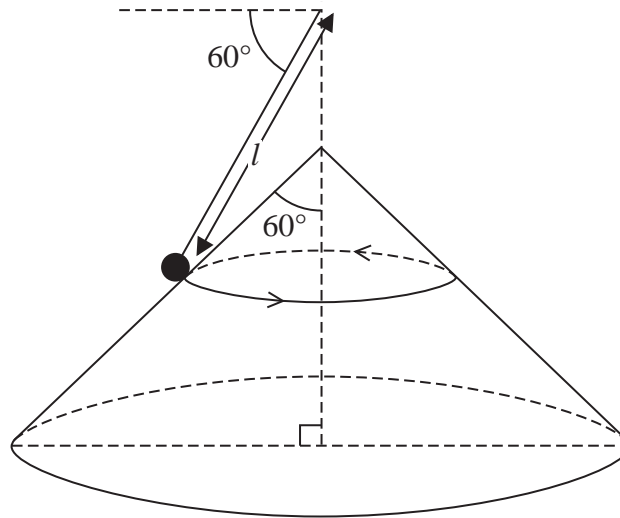


Figure 1

A cone of semi-vertical angle 60° is fixed with its axis vertical and vertex upwards. A particle of mass m is attached to one end of a light inextensible string of length l . The other end of the string is attached to a fixed point vertically above the vertex of the cone. The particle moves in a horizontal circle on the smooth outer surface of the cone with constant angular speed ω , with the string making a constant angle 60° with the horizontal, as shown in Figure 1.

- (a) Find the tension in the string, in terms of m , l , ω and g .

(7)

The particle remains on the surface of the cone.

- (b) Show that the time for the particle to make one complete revolution is greater than

$$2\pi\sqrt{\frac{l\sqrt{3}}{2g}}$$

(6)

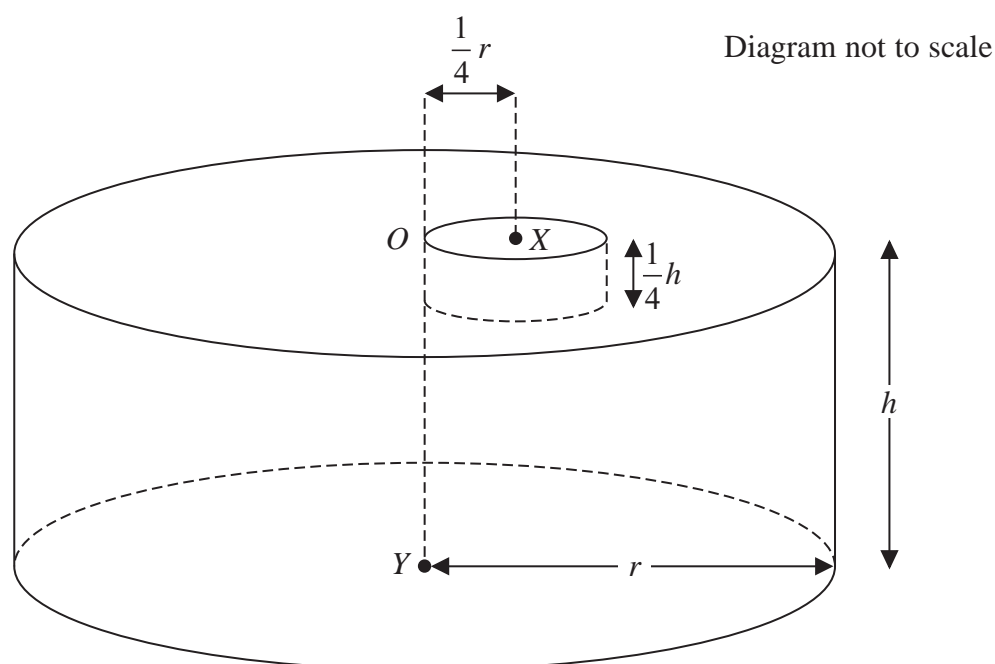
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5.

**Figure 3**

A uniform solid right circular cylinder has height h and radius r . The centre of one plane face is O and the centre of the other plane face is Y . A cylindrical hole is made by removing a solid cylinder of radius $\frac{1}{4}r$ and height $\frac{1}{4}h$ from the end with centre O . The axis of the cylinder removed is parallel to OY and meets the end with centre O at X , where $OX = \frac{1}{4}r$. One plane face of the cylinder removed coincides with the plane face through O of the original cylinder. The resulting solid S is shown in Figure 3.

- (a) Show that the centre of mass of S is at a distance $\frac{85h}{168}$ from the plane face containing O . (7)

The solid S is freely suspended from O . In equilibrium the line OY is inclined at an angle $\arctan(17)$ to the horizontal.

- (b) Find r in terms of h . (6)





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Question 6 continued

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Q6

(Total 14 marks)

TOTAL FOR PAPER: 75 MARKS

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