

- The ends of the string are attached to fixed points P and Q which are on the same horizontal level and 12 m apart. A particle is attached to the mid-point of the string and hangs in equilibrium at a point 4.5 m below PQ .

(6)

(3)

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.

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- A diagram of a cone with a cylindrical section at its base. The total height of the cone is labeled $9h$. The height of the cylindrical section is labeled $2h$. The radius of the base is labeled r .

A marker for the route of a charity walk consists of a uniform hollow cone fixed on to a uniform solid cylindrical ring, as shown in Figure 1. The hollow cone has base radius r , height $9h$ and mass m . The solid cylindrical ring has outer radius r , height $2h$ and mass $3m$. The marker stands with its base on a horizontal surface.

- When the marker stands on a plane inclined at $\arctan \frac{1}{12}$ to the horizontal it is on the point of toppling over. The coefficient of friction between the marker and the plane is large enough to be certain that the marker will not slip.

- [illegible]

Leave
blank**Question 2 continued****Q2****(Total 8 marks)**

A particle P of mass m moves on the smooth inner surface of a hemispherical bowl of radius r . The bowl is fixed with its rim horizontal as shown in Figure 2. The particle moves with constant angular speed $\sqrt{\left(\frac{3g}{2r}\right)}$ in a horizontal circle at depth d below the centre of the bowl.

- (a) Find, in terms of m and g , the magnitude of the normal reaction of the bowl on P . (4)
- (b) Find d in terms of r . (4)

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(5)

This image shows a full page of blank, lined paper. It features approximately 20 horizontal grey 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 or other markings present.

- (a) Show that

(6)

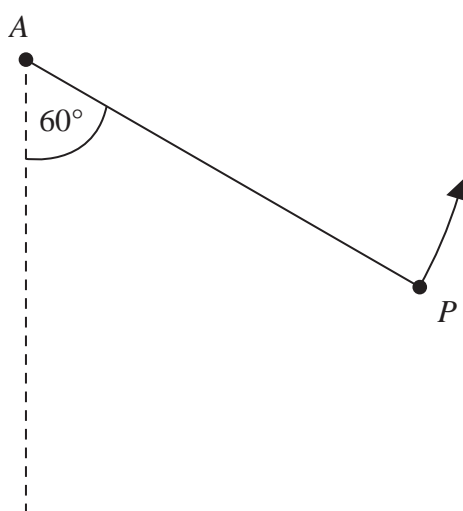


Figure 3

(b) Find d in terms of l .

(5)

[illegible]



A horizontal line segment is labeled A at the left end and B at the right end. A point P is marked on the segment. Below the segment, a dimension line with arrows at both ends indicates a distance of 5 m from point A to point P .

A and B are two points on a smooth horizontal floor, where $AB = 5$ m.

(a) Find the extensions in the two springs when the particle is at rest in equilibrium. (5)

(b) Show that P oscillates with simple harmonic motion about the equilibrium position. (4)

(c) Given that the initial speed of P is $\sqrt{10} \text{ m s}^{-1}$, find the proportion of time in each complete oscillation for which P stays within 0.25 m of the equilibrium position. (7)

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