8.

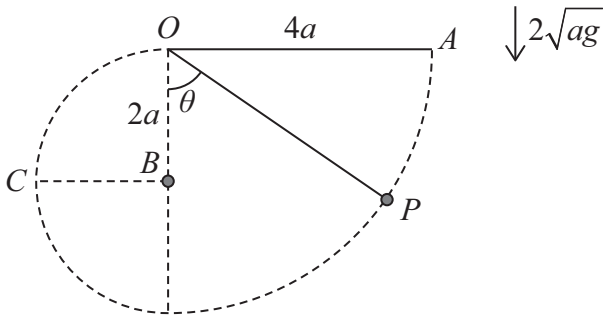


Figure 5

A particle P of mass m is attached to one end of a light inextensible string of length $4a$
The other end of the string is attached to a fixed point O
The particle is held at the point A, where $OA = 4a$, and OA is horizontal, as shown in Figure 5.

The particle is projected vertically downwards with speed $2\sqrt{ag}$

When the string makes an angle $\theta \left(0 \leqslant \theta \leqslant \frac{\pi}{2} \right)$ with the downward vertical through O and the string is still taut, the tension in the string is T

Air resistance is assumed to be negligible.

(a) Show that $T = mg(1 + 3\cos\theta)$

(6)

(b) Find, in terms of a and g, the speed of P at the lowest point of its path.

(2)

There is a fixed small horizontal peg at the point B, which is a distance $2a$ vertically below O. The peg is smooth and is perpendicular to the vertical plane of the motion of P and the string.

The string comes into contact with the peg and P continues to move clockwise in the same vertical plane. The point C is such that $CB = 2a$ and CB is horizontal, as shown in Figure 5.

When the particle passes through C, the string is still taut.

(c) Find, in terms of a and g, the exact speed of the particle at the instant when it passes through C

(3)

(d) Find, in terms of m and g, the tension in the string at the instant when P reaches O

(3)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
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 8 continued

Question 8 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
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 8 continued

Question 8 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
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 8 continued

Question 8 continued

(Total for Question 8 is 14 marks)

TOTAL FOR PAPER IS 75 MARKS

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA