6.

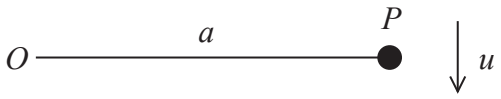


Figure 5

A particle P of mass m is attached to one end of a light inextensible string of length a. The other end of the string is attached to a fixed point O. The particle P is held at rest with the string taut and horizontal and is then projected vertically downwards with speed u, as shown in Figure 5.

Air resistance is modelled as being negligible.

At the instant when the string has turned through an angle θ and the string is taut, the tension in the string is T.

(a) Show that $T = \dfrac{mu^2}{a} + 3mg\sin\theta$

(7)

Given that $u = 2\sqrt{\dfrac{3ag}{5}}$

(b) find, in terms of a and g, the speed of P at the instant when the string goes slack.

(4)

(c) Hence find, in terms of a, the maximum height of P above O in the subsequent motion.

(5)

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Question 6 continued

(Total for Question 6 is 16 marks)