

One end of a light inextensible string of length a is attached to a fixed point O . A particle of mass m is attached to the other end of the string and is held with the string taut at the point A . At A the string makes an angle θ with the upward vertical through O . The particle is projected perpendicular to the string in a downward direction from A with a speed u . It moves along a circular path in the vertical plane.

When the string makes an angle α with the downward vertical through O , the speed of the particle is $2u$ and the magnitude of the tension in the string is 10 times its magnitude at A .

It is given that $u = \sqrt{\frac{2}{3}ga}$.

(a) Find, in terms of m and g , the magnitude of the tension in the string at A . [6]

(b) Find the value of $\cos \alpha$. [2]