

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  $O$ . When the particle is hanging vertically below  $O$ , it is projected horizontally with speed  $u$  so that it begins to move along a circular path. When  $P$  is at the lowest point of its motion, the tension in the string is  $T$ . When  $OP$  makes an angle  $\theta$  with the upward vertical, the tension in the string is  $S$ .

(a) Show that  $S = T - 3mg(1 + \cos \theta)$ . [5]

(b) Given that  $u = \sqrt{4ag}$ , find the value of  $\cos \theta$  when the string goes slack. [2]