2 A small ball of mass m is fixed to one end of a light rigid rod. The ball is made to move at constant speed around the circumference of a vertical circle with centre at C, as shown in Fig. 2.1.

For Examiner's Use

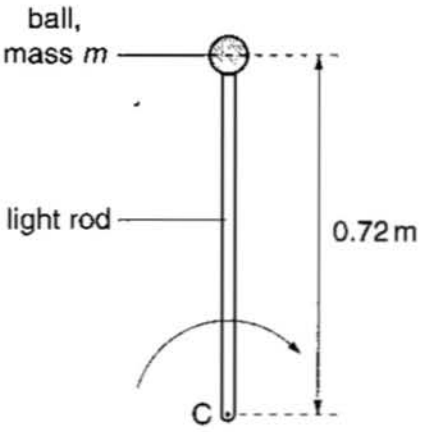

Fig. 2.1

When the rod is vertical with the ball above C, the tension T in the rod is given by

$$T = 2mg$$

where g is the acceleration of free fall.

(a) (i) Explain why the centripetal force on the ball is greater than $2mg$.

.....

.....

.....[1]

(ii) State, in terms of mg, the magnitude of the centripetal force.

centripetal force = ... [1]

(iii) Determine the magnitude of the tension, in terms of mg, in the rod when the rod is vertical, with the ball below point C.

tension = ... [1]

(b) The distance from the centre of the ball to point C is 0.72 m.

For Examiner's Use

Use your answer in **(a)(ii)** to determine, for the ball,

(i) the angular speed,

angular speed = ... $rad\,s^{-1}$ [3]

(ii) the linear speed.

linear speed = ... $m\,s^{-1}$ [2]

(c) The ball has a constant angular speed.

(i) Explain why work has to be done for the ball to move from the position where it is vertically above point C to the position where it is vertically below C.

.....

.....

.....

..... [2]

(ii) Calculate the work done in **(i)** for a ball of mass 240 g.

work done = ... J [2]

[Turn over