4 **(a)** Explain why an object moving with uniform speed in a circle must experience a resultant force towards the centre of the circle.

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..... [2]

(b) Fig. 4.1 shows a pendulum bob of mass *m*, attached to the end of a light rigid rod of length *L*, moving in a vertical circle at a constant speed *v*.

The rod starts from position A and sweeps through an angle θ in moving to position B.

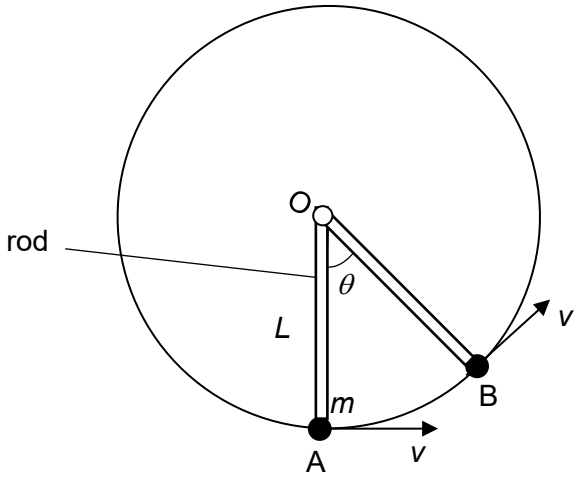

Fig. 4.1

(i) Show that the tension T in the rod at position B is

$$T = mg\cos\theta + \frac{mv^2}{L}.$$

[2]

(ii) As the bob moves in the vertical circle, the force in the rod can change from being in tension to being compressed at certain points in the circle.

For a rod of length L = 0.80 m and the bob moving at $v = 2.0$ m s^{-1}, determine the angle θ beyond which the rod is under compression.

θ = ... ° [2]

(iii) On the axes of Fig. 4.2, sketch the variation with θ of T (for $0° \leq \theta \leq 180°$). Label the maximum and minimum T in terms of m, v, L and g.

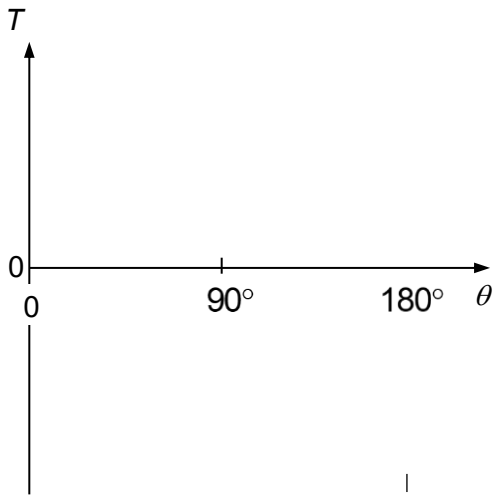

Fig. 4.2

[2]

(iv) Using energy considerations, discuss how the mass can move at a constant speed in a vertical circle.

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..... [2]