

- 2 A steel sphere of mass  $0.29\text{ kg}$  is suspended in equilibrium from a vertical spring. The centre of the sphere is  $8.5\text{ cm}$  from the top of the spring, as shown in Fig. 2.1.

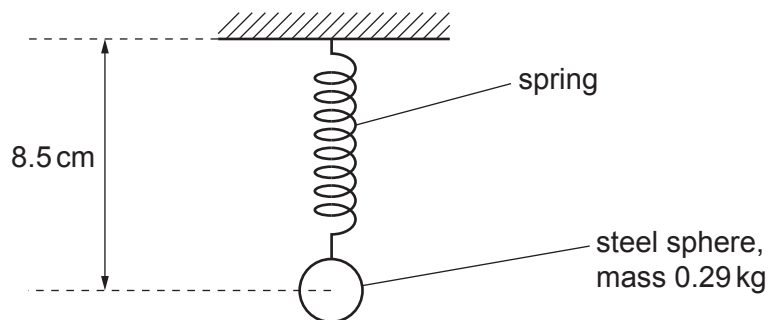


Fig. 2.1

The sphere is now set in motion so that it is moving in a horizontal circle at constant speed, as shown in Fig. 2.2.

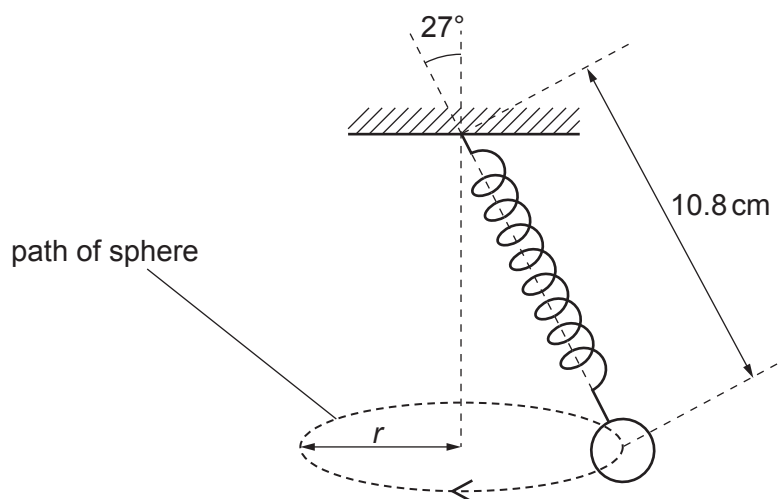


Fig. 2.2

The distance from the centre of the sphere to the top of the spring is now  $10.8\text{ cm}$ .

- (a) Explain, with reference to the forces acting on the sphere, why the length of the spring in Fig. 2.2 is greater than in Fig. 2.1.

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..... [3]

**(b)** The angle between the linear axis of the spring and the vertical is  $27^\circ$ .

**(i)** Show that the radius  $r$  of the circle is 4.9 cm.

[1]

**(ii)** Show that the tension in the spring is 3.2 N.

[2]

**(iii)** The spring obeys Hooke's law.

Calculate the spring constant, in  $\text{N cm}^{-1}$ , of the spring.

spring constant = .....  $\text{N cm}^{-1}$  [2]

**(c) (i)** Use the information in **(b)** to determine the centripetal acceleration of the sphere.

centripetal acceleration = .....  $\text{m s}^{-2}$  [2]

**(ii)** Calculate the period of the circular motion of the sphere.

period = ..... s [2]