3 A steel sphere of mass 0.30 kg is suspended in equilibrium from a vertical spring. The centre of the sphere is 8.5 cm from the top of the spring, as shown in Fig. 3.1.

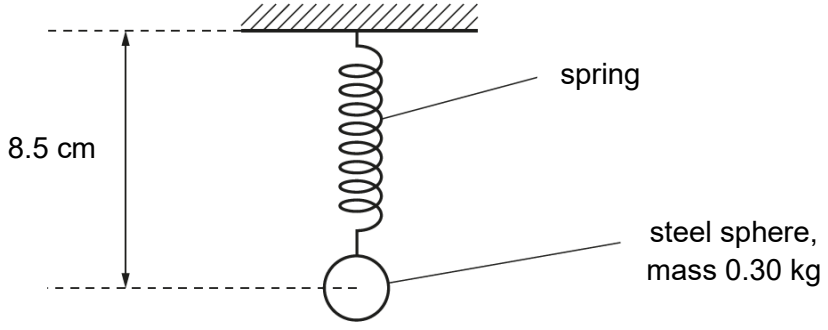

Fig. 3.1

The sphere is now set in motion so that it is moving in a horizontal circle at constant speed, as shown in Fig. 3.2.

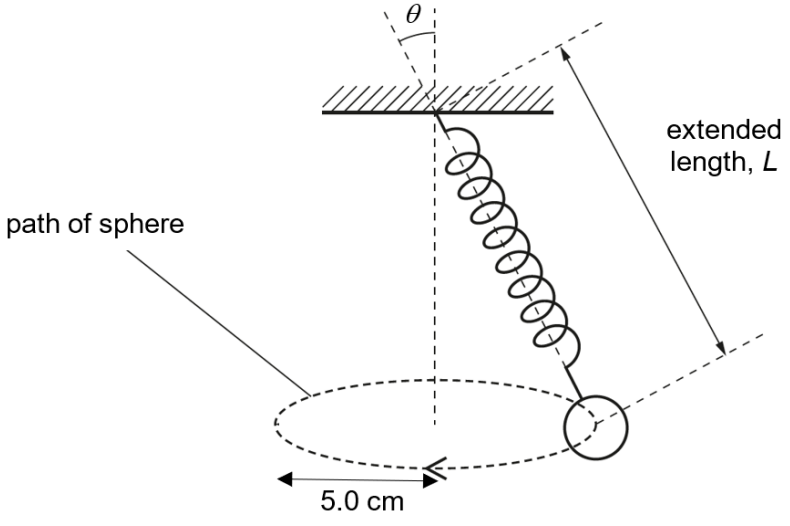

Fig. 3.2

The spring stretches to a new extended length L, and the radius of the circular motion is 5.0 cm. The angle between the linear axis of the spring and the vertical is θ. The period of the circular motion is 0.60 s.

(a) Explain, with reference to the forces acting on the sphere, why the length of the spring in Fig. 3.2 is greater than in Fig. 3.1.

.....

.....

.....

.....

.....[3]

(b) **(i)** Calculate the centripetal acceleration of the sphere.

centripetal acceleration = ... m s^{-2} [1]

(ii) Show that the angle θ is 29°.

[2]

(iii) Calculate the tension in the spring in Fig. 3.2.

tension in spring = ... N [2]

(iv) Calculate the spring constant of the spring.

spring constant = ... N m^{-1} [3]

[Total: 11]