2 **(a)** State Hooke's law.

....

....

....[1]

(b) A vertical spring supports a load, as shown in Fig. 2.1. The spring is compressed by the load.

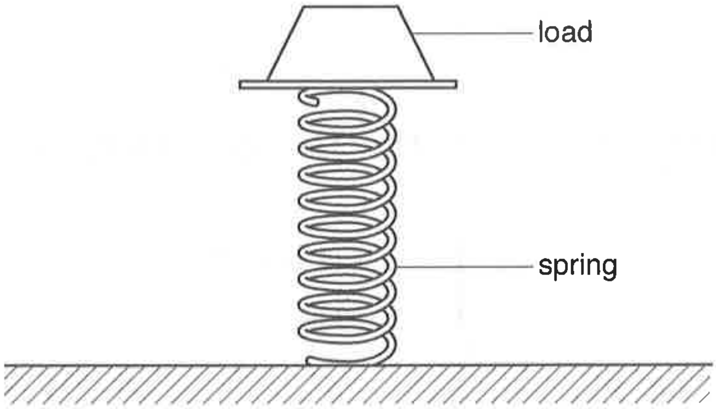

Fig. 2.1

The variation of the compression of the spring with the applied load is shown in Fig. 2.2.

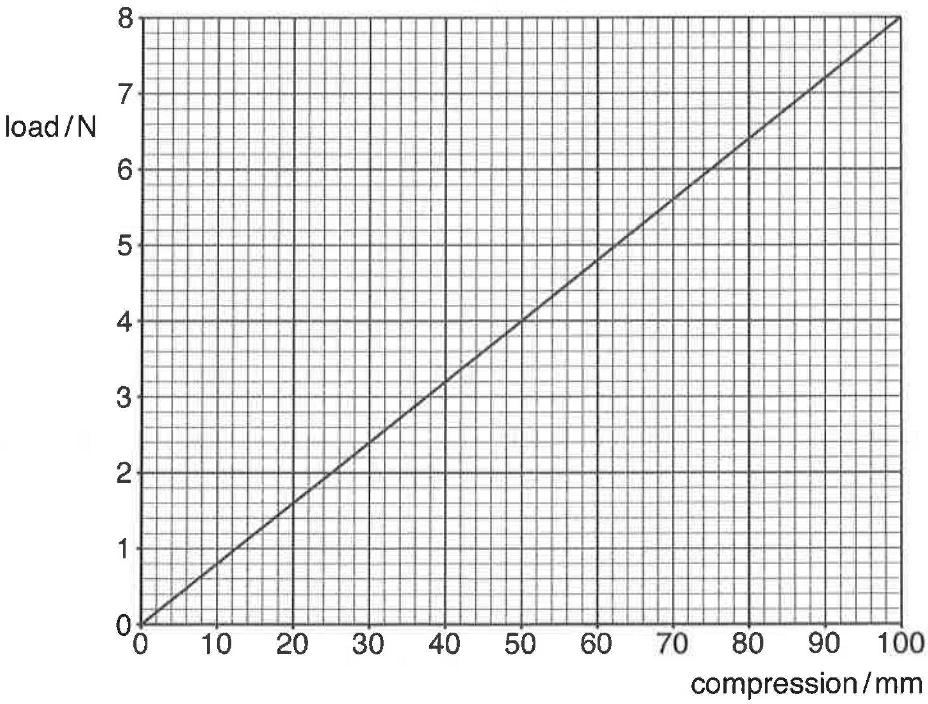

Fig. 2.2

Calculate the elastic potential energy stored in the spring for a compression of 85 mm.

energy stored = ... J [2]

(c) The spring in **(b)** is now used to propel a steel ball along a circular frictionless track, as shown in Fig. 2.3.

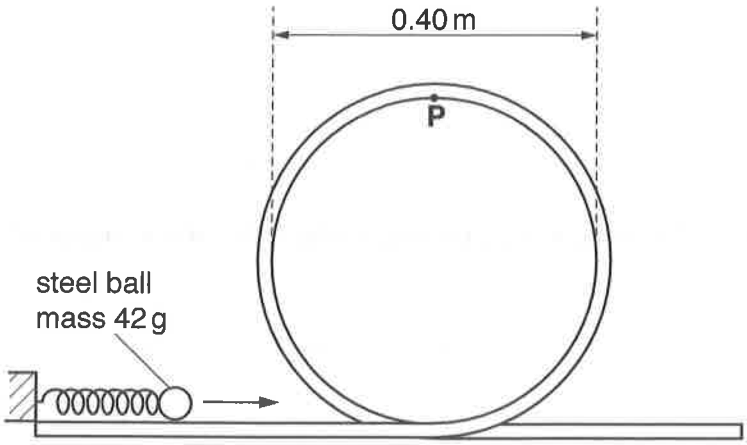

Fig. 2.3

The track loops around to form a vertical circle of diameter 0.40 m. Point **P** is at the top of the track.

The spring is compressed by 85 mm. The ball of mass 42 g is placed next to the end of the compressed spring. The spring is then released so that the ball is fired horizontally on the track.

It may be assumed that all of the elastic potential energy stored in the spring is converted into kinetic energy of the ball.

Use your answer in **(b)** to calculate the speed *v* of the ball at point **P**.

v = ... m s^{-1} [3]

(d) (i) Determine the minimum speed v_{min} of the ball in **(c)** at point **P** shown in Fig. 2.3 such that it just completes the vertical circle without falling off the track.

Explain your working.

v_{min} = ... $m s^{-1}$ [3]

(ii) State and explain how v_{min} changes when the ball is replaced with one of a greater mass.

....

....

....[1]

[Total: 10]