3 A pendulum consists of a metal sphere P suspended from a fixed point by means of a thread, as illustrated in Fig. 3.1.

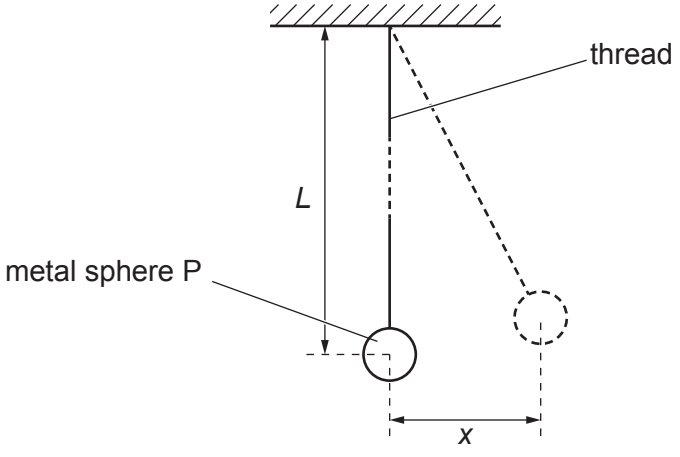

Fig. 3.1

The centre of gravity of sphere P is a distance *L* from the fixed point.

The sphere is pulled to one side and then released so that it oscillates. The sphere may be assumed to oscillate with simple harmonic motion.

(a) State what is meant by *simple harmonic motion*.

.....

.....

..... [2]

(b) The variation of the velocity *v* of sphere P with the displacement *x* from its mean position is shown in Fig. 3.2.

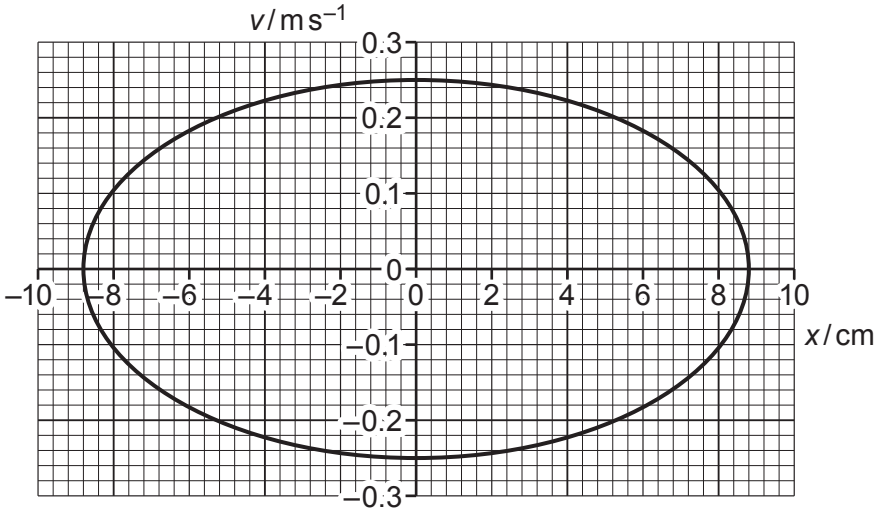

Fig. 3.2

Use Fig. 3.2 to determine the frequency f of the oscillations of sphere P.

f = ... Hz [3]

(c) The period T of the oscillations of sphere P is given by the expression

$$T = 2\pi\sqrt{\left(\frac{L}{g}\right)}$$

where g is the acceleration of free fall.

Use your answer in **(b)** to determine the length L.

L = ... m [2]

(d) Another pendulum consists of a sphere Q suspended by a thread. Spheres P and Q are identical. The thread attached to sphere Q is longer than the thread attached to sphere P.

Sphere Q is displaced and then released. The oscillations of sphere Q have the same amplitude as the oscillations of sphere P.

On Fig. 3.2, sketch the variation of the velocity v with displacement x for sphere Q. [2]

[Total: 9]