

- 3 An object is suspended from a spring that is attached to a fixed point as shown in Fig. 3.1.

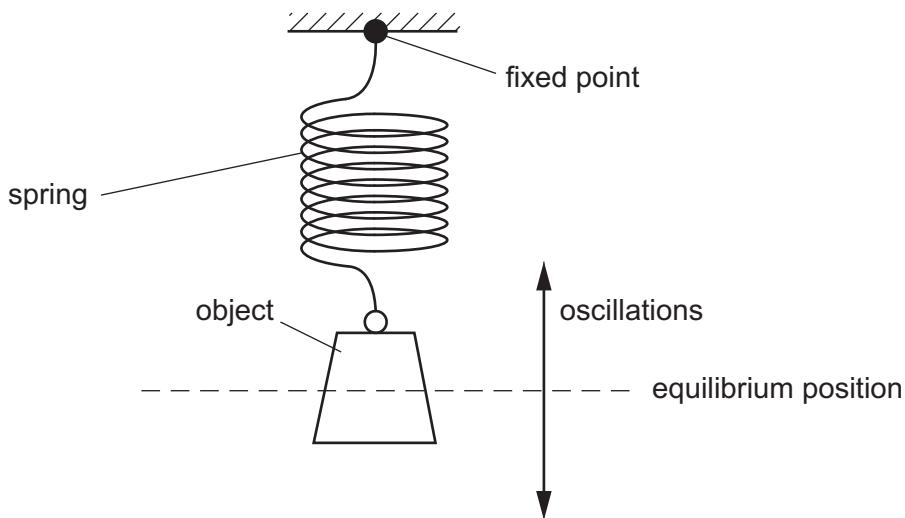


Fig. 3.1

The object oscillates vertically with simple harmonic motion about its equilibrium position.

- (a) State the defining equation for simple harmonic motion. Identify the meaning of each of the symbols used to represent physical quantities.

.....  
.....  
..... [2]

- (b) The variation with displacement  $x$  from the equilibrium position of the velocity  $v$  of the object is shown in Fig. 3.2.

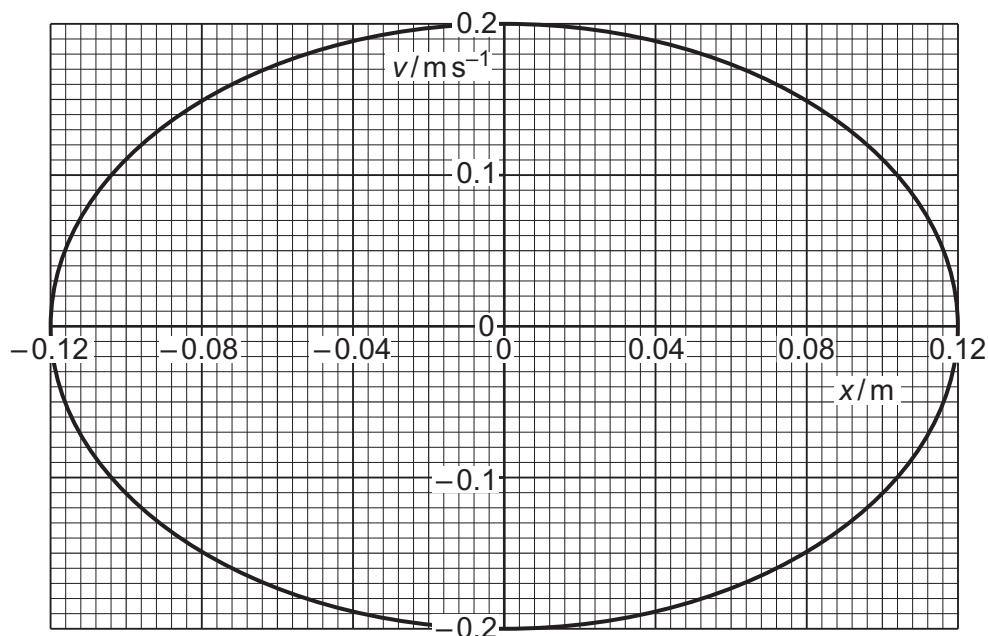
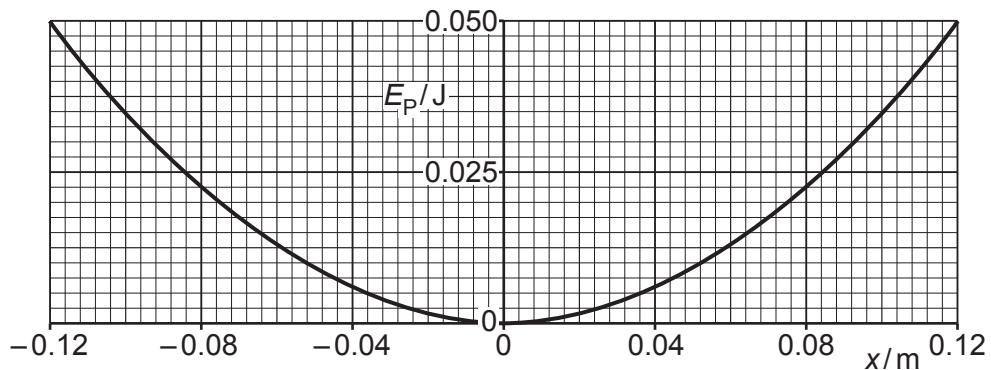


Fig. 3.2

The variation with  $x$  of the potential energy  $E_P$  of the oscillations of the object is shown in Fig. 3.3.



**Fig. 3.3**

Use Fig. 3.2 and Fig. 3.3 to:

- (i) determine the amplitude  $x_0$  of the oscillations

$$x_0 = \dots \text{ m} \quad [1]$$

- (ii) show that the angular frequency of the oscillations is  $1.7 \text{ rad s}^{-1}$

[2]

- (iii) determine the mass  $M$  of the object.

$$M = \dots \text{ kg} \quad [2]$$

**10**

(c) The oscillations of the object are now lightly damped.

(i) State what is meant by damping.

.....  
.....  
..... [2]

(ii) Assume that the damping does not change the angular frequency of the oscillations.

On Fig. 3.2, sketch the variation with  $x$  of  $v$  when the amplitude of the oscillations is 0.060 m. [2]