

- 2 A light spring hangs from a fixed point. A 0.850 kg mass is then attached to the free end of the spring, which eventually comes to a rest at an equilibrium position 0.220 m below its original position, as shown in Fig. 2.1.

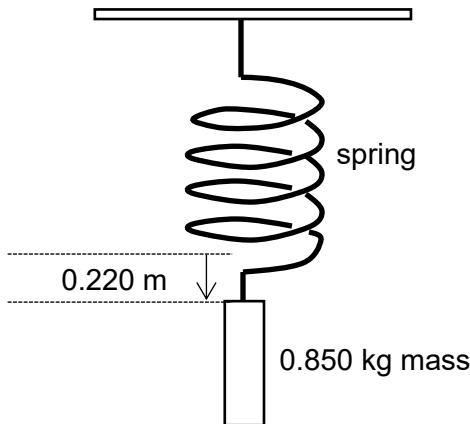


Fig. 2.1

- (a) Show that the force constant,  $k$  is  $37.9 \text{ N m}^{-1}$ .

[1]

- (b) The mass is pulled vertically down a distance of 0.110 m from its equilibrium position. When the mass is released, it performs a simple harmonic motion.

- (i) Calculate the acceleration of the mass just after it is released at the bottom.

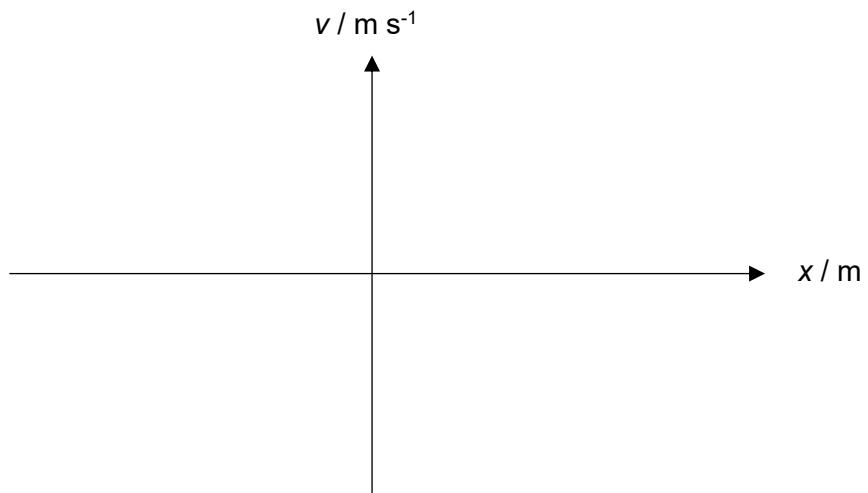
acceleration = .....  $\text{m s}^{-2}$  [2]

(ii) Calculate the frequency of oscillation.

frequency = ..... Hz [2]

(iii) On the axes of Fig. 2.2, sketch a graph to show the variation of the velocity  $v$  of the mass with its vertical displacement  $x$ .

Label the axes with appropriate values.



**Fig. 2.2**

[2]

- (iv) On the axes of Fig. 2.3, sketch a graph to show the variation with time of the kinetic energy of the mass for one complete oscillation after the mass was released at the bottom.

Include appropriate values on the axes.



[2]

**Fig. 2.3**

- (v) If the system undergoes light damping, sketch on Fig. 2.2 the velocity-displacement graph expected. Assume the oscillation starts at  $x = +x_0$ .

[2]

