**2** A light spring of force constant $k$ hangs vertically from a fixed point. A block of mass $m$ is attached to the free end of the spring, as shown in Fig. 2.1.

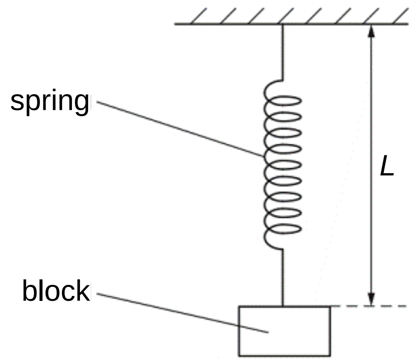


**Fig. 2.1**

The block is displaced downwards from its equilibrium position and then released at time $t = 0$ s.

**(a)** The acceleration $a$ of the block is related to its displacement $x$ from the equilibrium position by the equation

$$a = -\frac{k}{m}x.$$

Explain why the equation leads to the conclusion that the block is performing simple harmonic motion.

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

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

**(b)** The variation with time $t$ of the length $L$ of the spring is shown in Fig. 2.2.

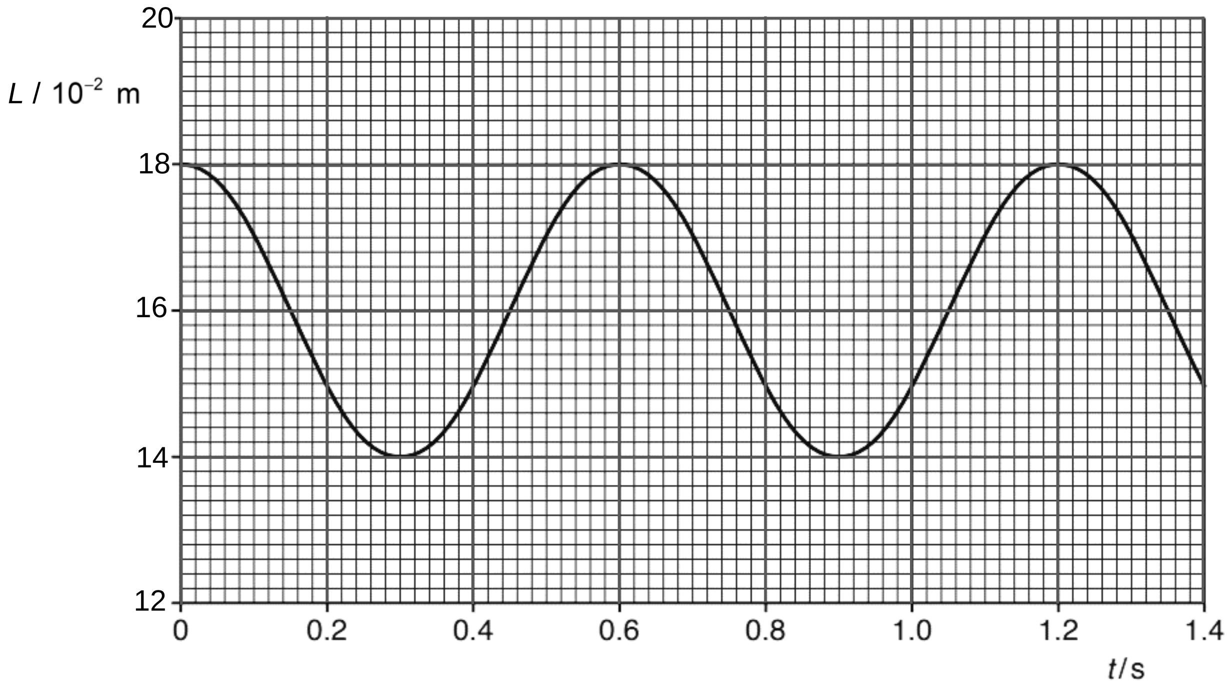


**Fig. 2.2**

**(i)** Determine the maximum speed of the block.

speed = .................................... m $s^{-1}$ [2]

**(ii)** On Fig. 2.3, show the variation with time $t$ of the velocity $v$ of the block from $t = 0$ s to $t = 1.4$ s.

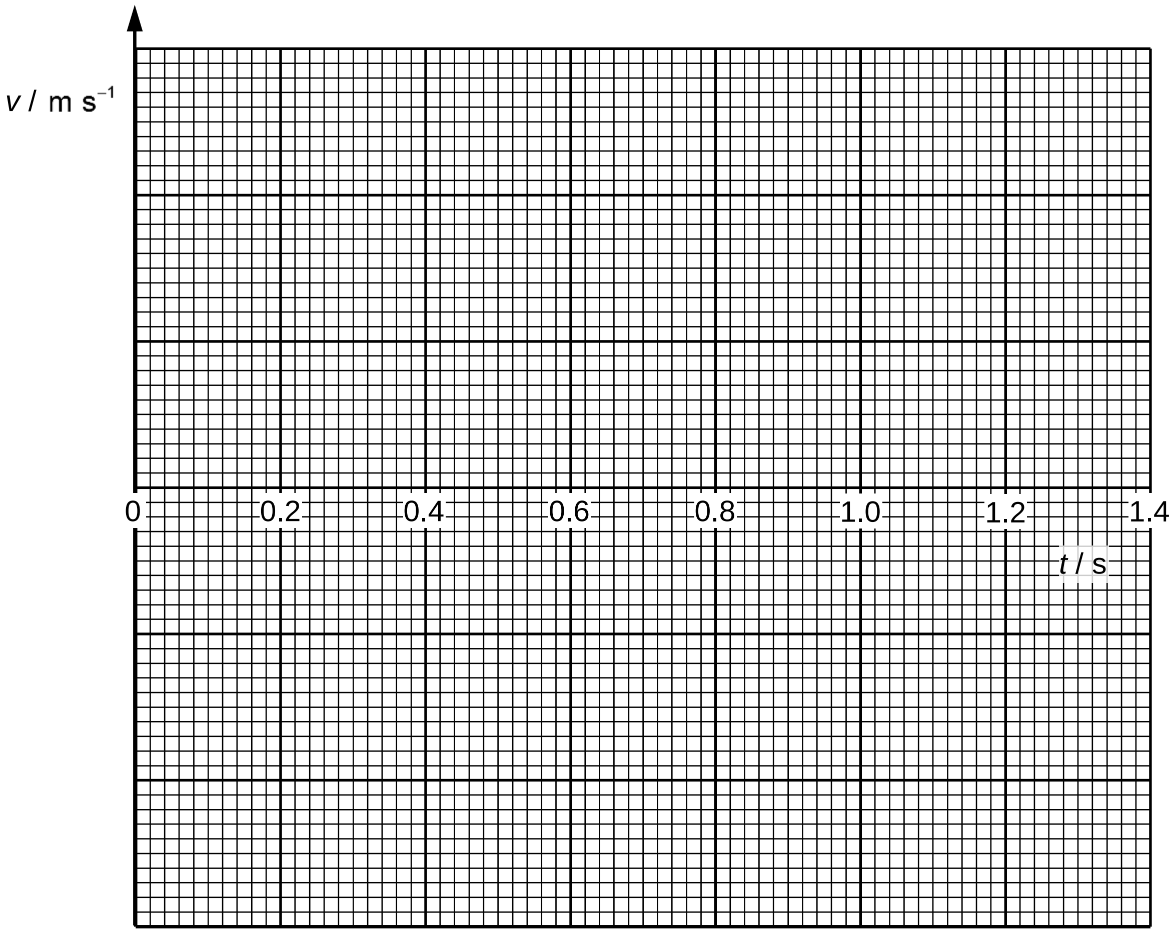


**Fig. 2.3**

[2]

**(iii)** Determine a value of $L$ at which the potential energy and kinetic energy of the oscillating system are equal.

The total potential energy of the oscillating system at equilibrium is taken to be zero.

$L$ = .................................... cm [2]

**(c)** The same block is suspended from two springs as shown in Fig. 2.4. Both springs are identical to that used in Fig. 2.1.

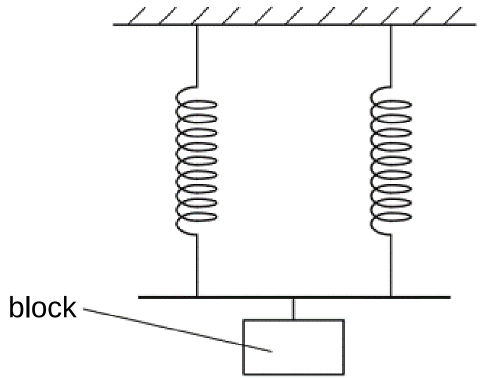


**Fig. 2.4**

The block is pulled down a small distance and released so that it oscillates.

By considering the extension at equilibrium of the spring combination in Fig. 2.4, state and explain how the period of these oscillations compares with the period of oscillations in **(a)**.

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

.................................................................................................................................... [3]

[Total: 11]