

Section A

Answer **all** the questions in the spaces provided.

- 1** A light spring is suspended from a fixed point. A bar magnet is attached to the end of the spring, as shown in Fig. 1.1.

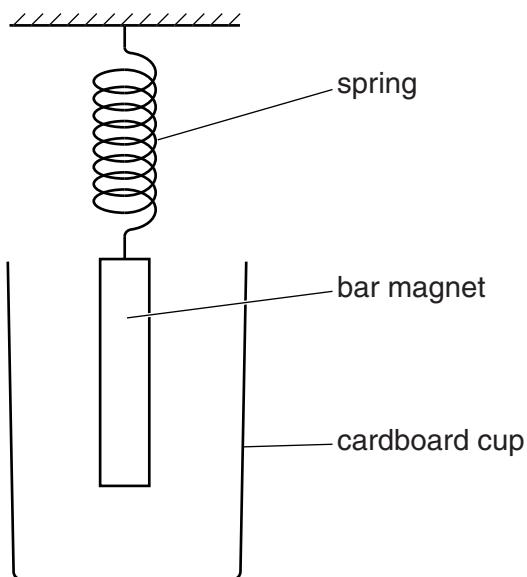


Fig. 1.1

In order to shield the magnet from draughts, a cardboard cup is placed around the magnet but does not touch it.

The magnet is displaced vertically and then released. The variation with time t of the vertical displacement y of the magnet is shown in Fig. 1.2.

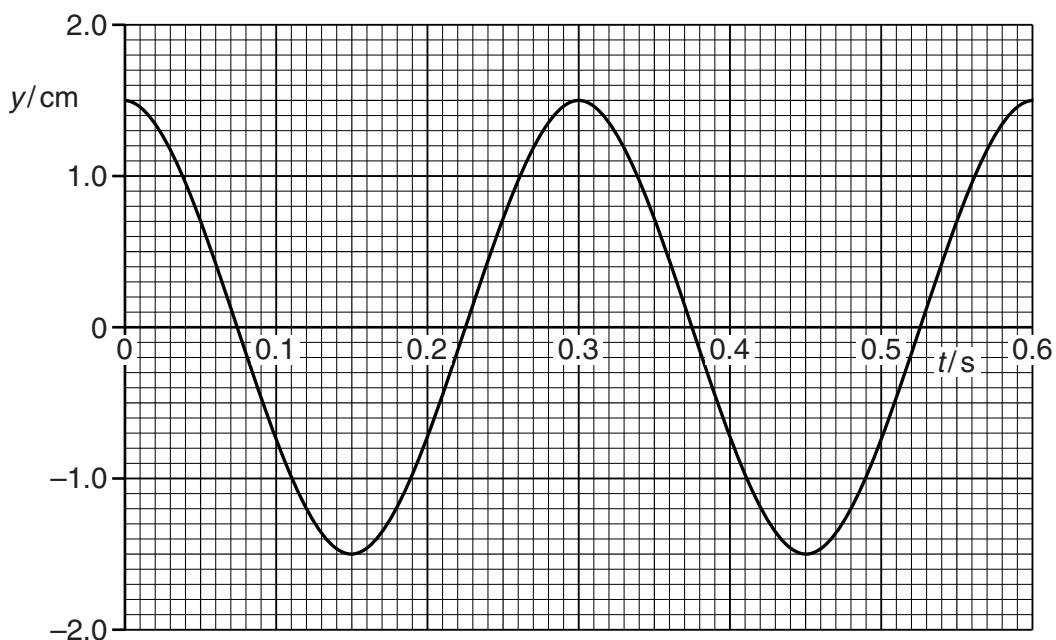


Fig. 1.2

The mass of the magnet is 130 g.

- (a) For the oscillations of the magnet, use Fig. 1.2 to

- (i) determine the angular frequency ω ,

$$\omega = \dots \text{ rad s}^{-1} [2]$$

- (ii) show that the maximum kinetic energy of the oscillating magnet is 6.4 mJ.

[2]

- (b) The cardboard cup is now replaced with a cup made of aluminium foil.

During 10 complete oscillations of the magnet, the amplitude of vibration is seen to decrease to 0.75 cm from that shown in Fig. 1.2. The change in angular frequency is negligible.

- (i) Use Faraday's law of electromagnetic induction to explain why the amplitude of the oscillations decreases.

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[3]

- (ii) Show that the loss in energy of the oscillating magnet is 4.8 mJ.

[2]

- (c) The mass of the aluminium cup in (b) is 6.2 g. The specific heat capacity of aluminium is $910 \text{ J kg}^{-1} \text{ K}^{-1}$.

The energy in (b)(ii) is transferred to the cup as thermal energy.
Calculate the mean rise in temperature of the cup.

temperature rise = K [2]

Please turn over for Question 2.