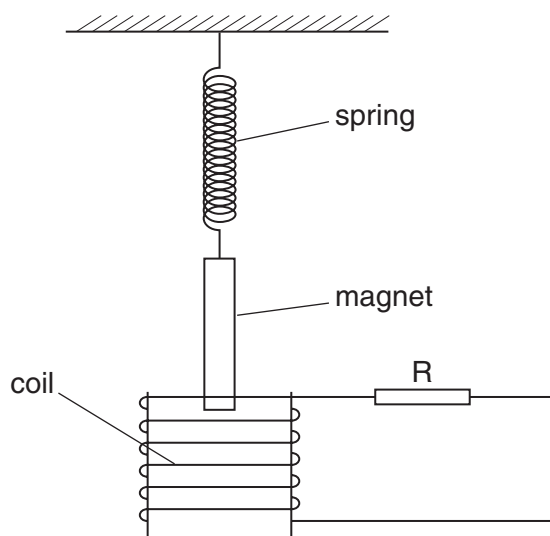**7** A magnet is suspended vertically from a fixed point by means of a spring, as shown in Fig. 7.1.

Fig. 7.1

One end of the magnet hangs inside a coil of wire. The coil is connected in series with a resistor R.

(a) The magnet is displaced vertically a small distance D and then released.
Fig. 7.2 shows the variation with time t of the vertical displacement d of the magnet from its equilibrium position.
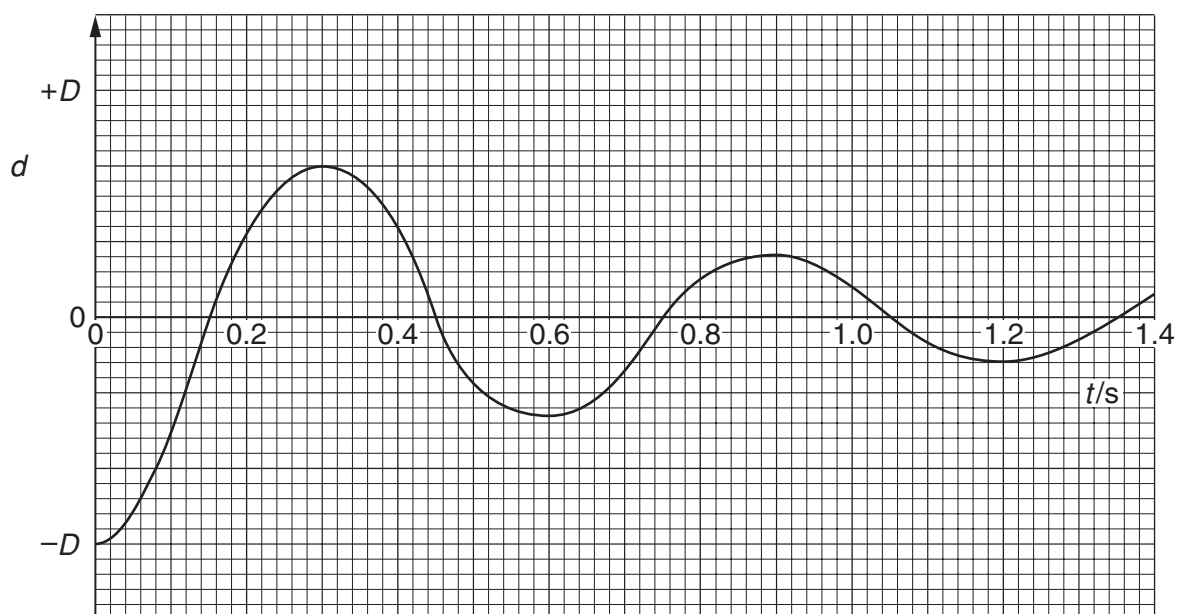
Fig. 7.2

(i) State and explain, by reference to electromagnetic induction, the nature of the oscillations of the magnet.

....

....

....

....

....

.... [5]

(ii) Calculate the angular frequency ω_0 of the oscillations.

ω_0 = ... rad s^{-1} [2]

(b) The resistance of the resistor R is increased.
The magnet is again displaced a vertical distance D and released.
On Fig. 7.2, sketch the variation with time t of the displacement d of the magnet.   [2]

   [Turn over

(c) The resistor R in Fig. 7.1 is replaced by a variable-frequency signal generator of constant r.m.s. output voltage.
The angular frequency ω of the generator is gradually increased from about $0.7\omega_0$ to about $1.3\omega_0$, where ω_0 is the angular frequency calculated in **(a)(ii)**.

(i) On the axes of Fig. 7.3, sketch a graph to show the variation with ω of the amplitude A of the oscillations of the magnet. [2]
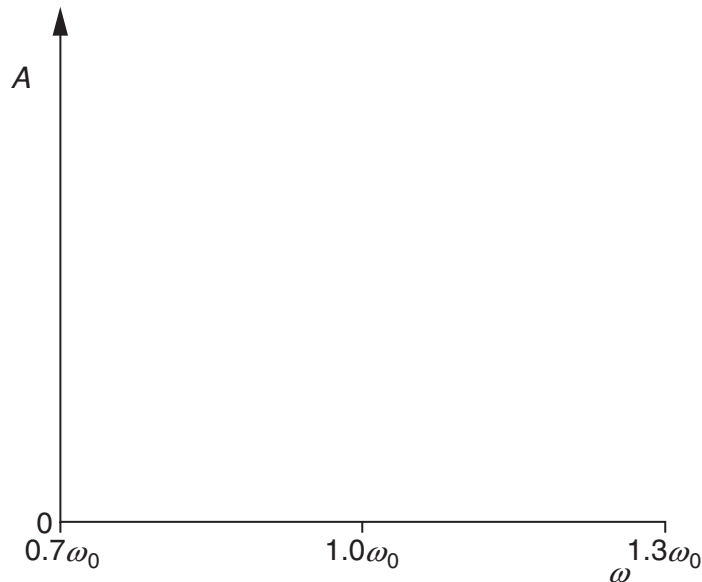
Fig. 7.3

(ii) State the name of the phenomenon illustrated in the graph of Fig. 7.3.

.... [1]

(iii) Briefly describe one situation where the phenomenon named in **(ii)** is useful and one situation where it should be avoided.

useful: ....

....

avoid: ....

.... [2]

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[Turn over