5 A bar magnet is suspended vertically from the free end of a helical spring, as shown in Fig. 5.1.

For Examiner's Use

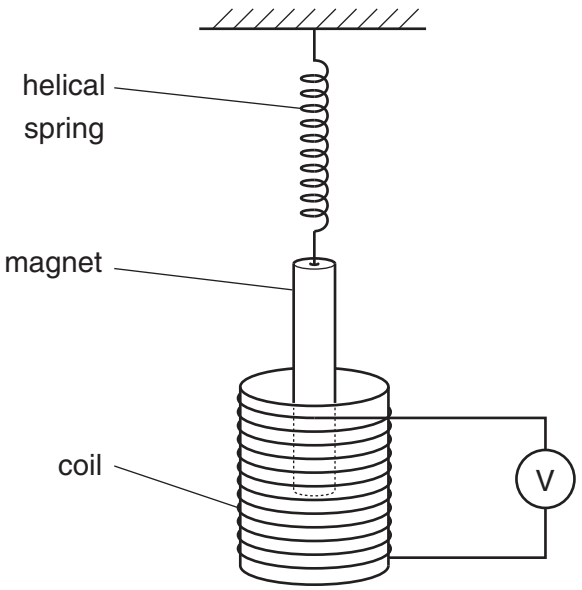

Fig. 5.1

One pole of the magnet is situated in a coil. The coil is connected in series with a high-resistance voltmeter.
The magnet is displaced vertically and then released.
The variation with time t of the reading V of the voltmeter is shown in Fig. 5.2.

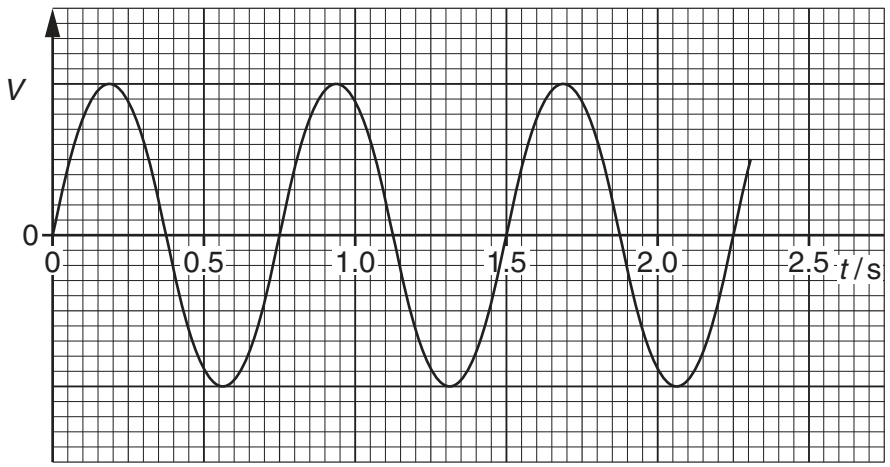

Fig. 5.2

(a) (i) State Faraday's law of electromagnetic induction.

.....

.....

..... [2]

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(ii) Use Faraday's law to explain why

1. there is a reading on the voltmeter,

.....

..... [1]

2. this reading varies in magnitude,

.....

..... [1]

3. the reading has both positive and negative values.

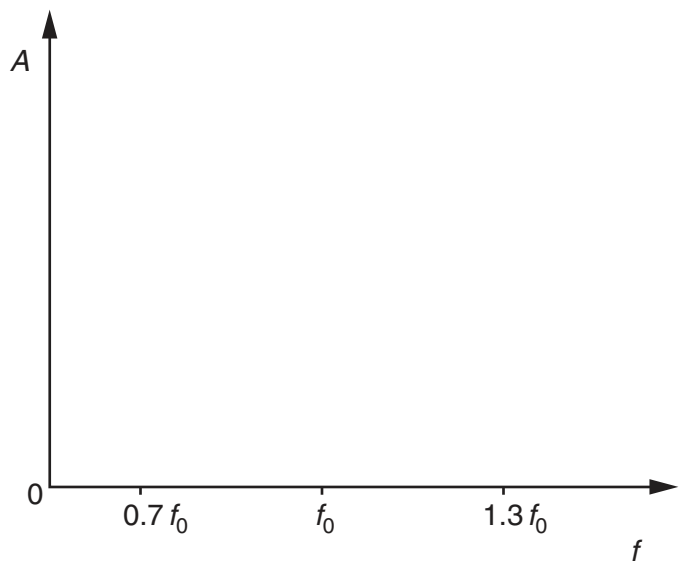
.....

..... [1]

(b) Use Fig. 5.2 to determine the frequency f_0 of the oscillations of the magnet.

f_0 = ... Hz [2]

(c) The magnet is now brought to rest and the voltmeter is replaced by a variable frequency alternating current supply that produces a constant r.m.s. current in the coil.
The frequency of the supply is gradually increased from $0.7\,f_0$ to $1.3\,f_0$, where f_0 is the frequency calculated in **(b)**.
On the axes of Fig. 5.3, sketch a graph to show the variation with frequency f of the amplitude A of the new oscillations of the bar magnet.



[2]

Fig. 5.3

(d) (i) Name the phenomenon illustrated on your completed graph of Fig. 5.3.

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..... [1]

(ii) State one situation where the phenomenon named in **(i)** is useful.

.....

..... [1]

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Please turn over for Question 6.