Electromagnetic Induction - 2021 A2

1. June/2021/Paper_41/No.10

(a) State Lenz's law.

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..... [2]

(b) A metal ring is suspended from a fixed point P by means of a thread, as shown in Fig. 10.1.

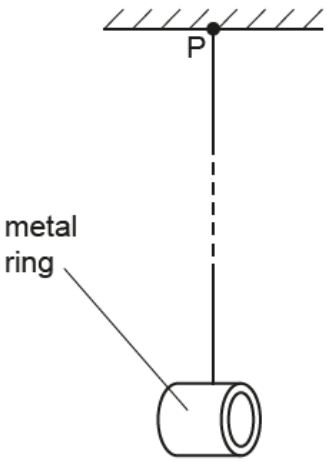

Fig. 10.1

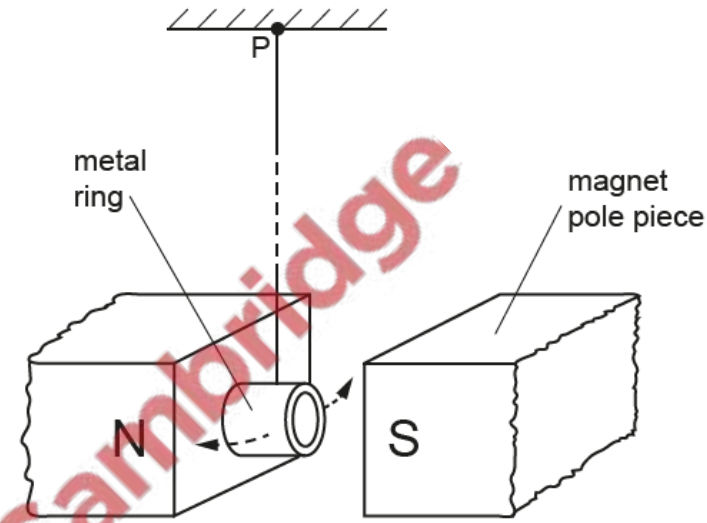

Fig. 10.2

The ring is displaced a distance *d* and then released. The ring completes many oscillations before coming to rest.

The poles of a magnet are now placed near to the ring so that the ring hangs midway between the poles of the magnet, as shown in Fig. 10.2.

The ring is again displaced a distance *d* and then released.
Explain why the ring completes fewer oscillations before coming to rest.

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..... [4]

(c) The ring in **(b)** is now cut so that it has the shape shown in Fig. 10.3.

Fig. 10.3

Explain why, when the procedure in **(b)** is repeated, the cut ring completes more oscillations than the complete ring when oscillating between the poles of the magnet.

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..... [3]

[Total: 9]

2. June/2021/Paper_42/No.9

(a) State **two** situations in which a charged particle in a magnetic field does **not** experience a force.

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2. .....

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[2]

(b) A loosely coiled metal spring is suspended from a fixed point, as shown in Fig. 9.1.

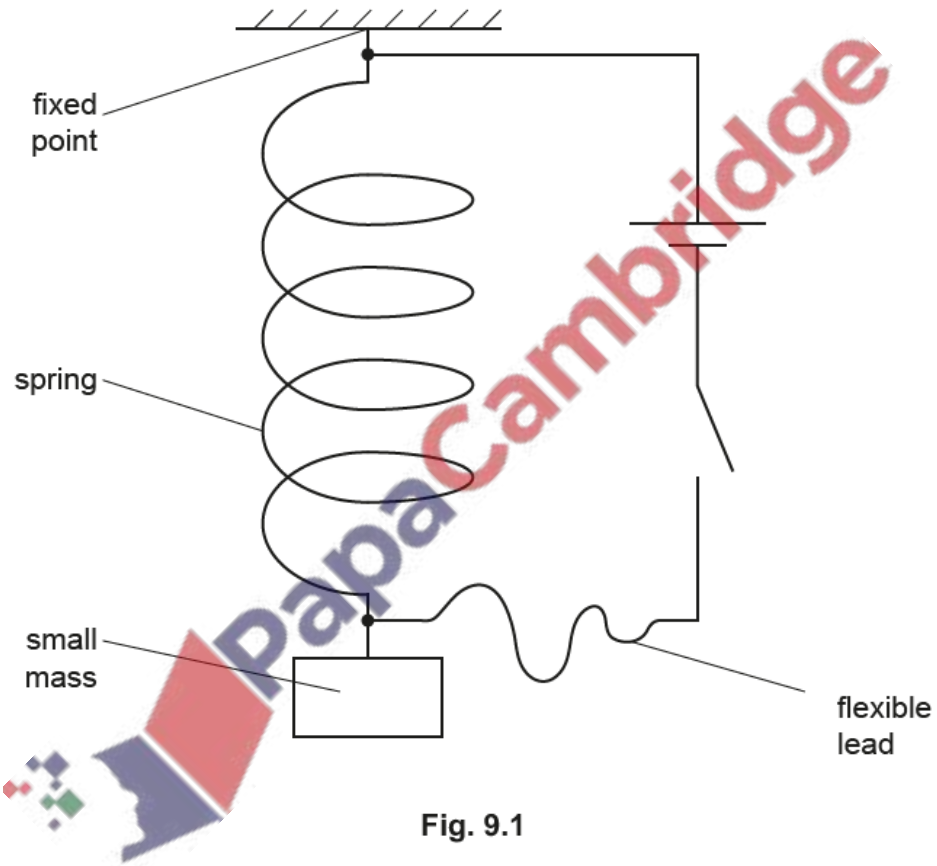

Fig. 9.1

Electrical connections are made to the ends of the spring by means of a flexible lead.

The length of the spring is measured before the switch is closed and then again after the switch is closed.

When the switch is closed, a magnetic field is set up around each coil of the spring.

By reference to these magnetic fields, explain why there is a change in length of the spring. State whether the spring extends or contracts.

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..... [4]

(c) With the switch in **(b)** closed, the small mass on the free end of the spring is now made to oscillate vertically.

Use the principles of electromagnetic induction to explain why small fluctuations in the current in the spring are found to occur.

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..... [3]

[Total: 9]

3. March/2021/Paper_42/No.9

(a) Define *magnetic flux linkage*.

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..... [2]

(b) A solenoid of diameter 6.0 cm and 540 turns is placed in a uniform magnetic field as shown in Fig. 9.1.

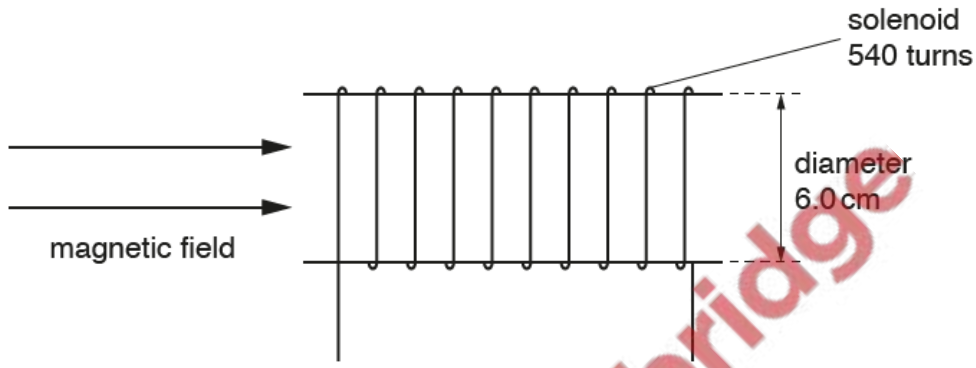

Fig. 9.1

The variation with time *t* of the magnetic flux density is shown in Fig. 9.2.

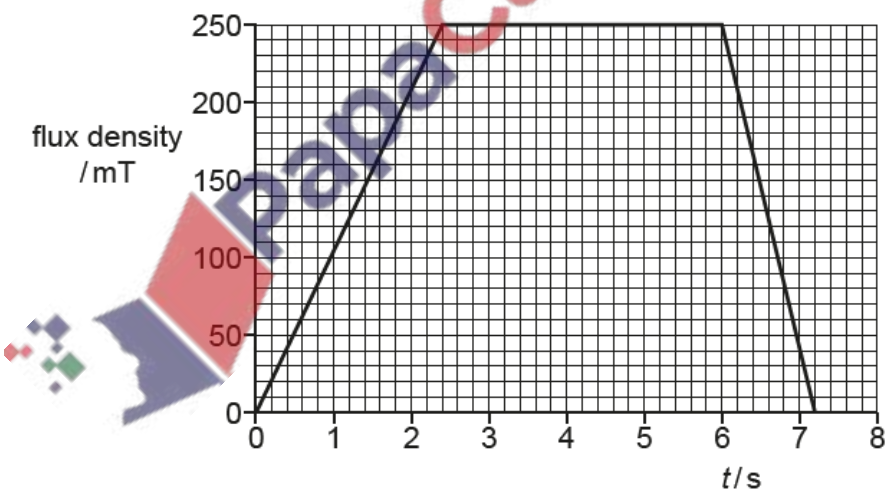

Fig. 9.2

Calculate the maximum magnitude of the induced electromotive force (e.m.f.) in the solenoid.

e.m.f. = ... V [3]

(c) A thin copper sheet X is supported on a rigid rod so that it hangs between the poles of a magnet as shown in Fig. 9.3.

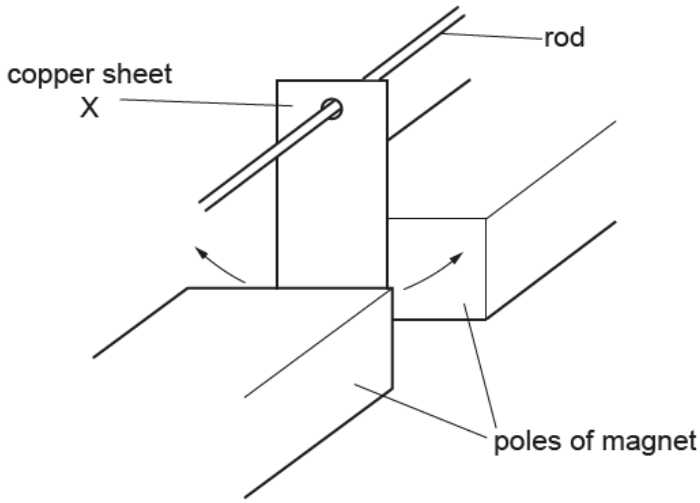

Fig. 9.3

Sheet X is displaced to one side and then released so that it oscillates. A motion sensor is used to record the displacement of X.

A second thin copper sheet Y replaces sheet X. Sheet Y has the same overall dimensions as X but is cut into the shape shown in Fig. 9.4.

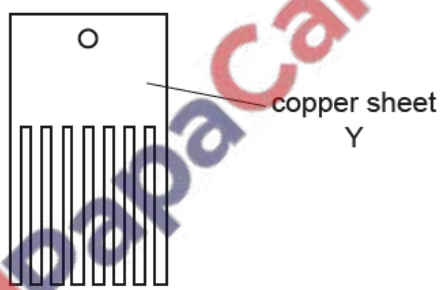

Fig. 9.4

The motion sensor is again used to record the displacement.

The graph in Fig. 9.5 shows the variation with time *t* of the displacement *s* of each copper sheet.

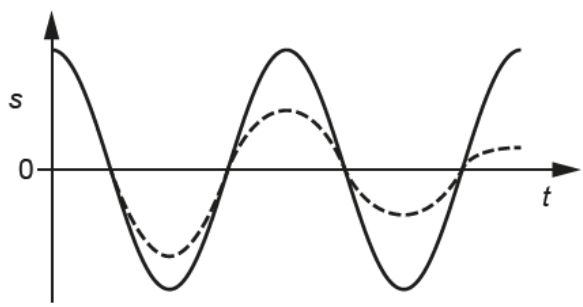

Fig. 9.5

(i) State the name of the phenomenon illustrated by the gradual reduction in the amplitude of the dashed line.

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(ii) Deduce which copper sheet is represented by the dashed line. Explain your answer using the principles of electromagnetic induction.

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..... [4]

[Total: 10]