

8 (a) Define magnetic flux.

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- (b) A student carries out an experiment in which a flat, square coil of 300 turns is moved through a region where there is a uniform magnetic field of magnetic flux density 4.2 mT , as shown in Fig. 8.1.

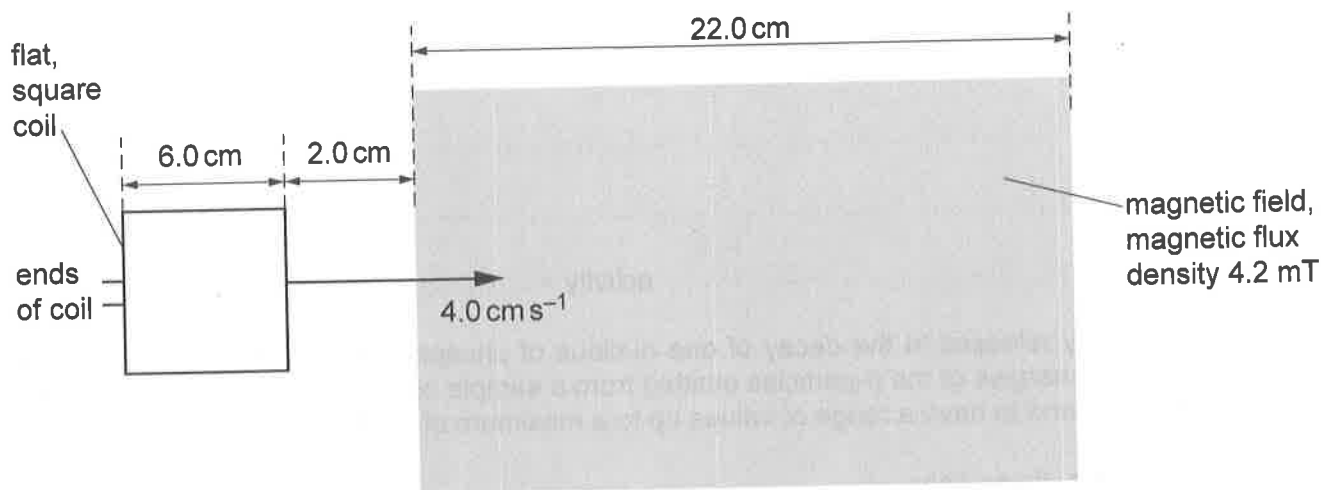


Fig. 8.1 (not to scale)

The magnetic field is perpendicular to the plane of the coil.

The coil has sides of length 6.0 cm and is moved at a constant velocity of 4.0 cm s^{-1} with its leading edge parallel to the edge of the magnetic field. The leading edge of the coil is 2.0 cm from the edge of the field at time $t = 0$.

The length of the region of the magnetic field is 22.0 cm .

- (i) Show that the electromotive force (e.m.f.) induced across the ends of the coil has a magnitude of 3.0 mV .

[2]



- (ii) On Fig. 8.2, sketch the variation of the induced e.m.f. across the ends of the coil with t from $t = 0$ to $t = 8.0$ s.

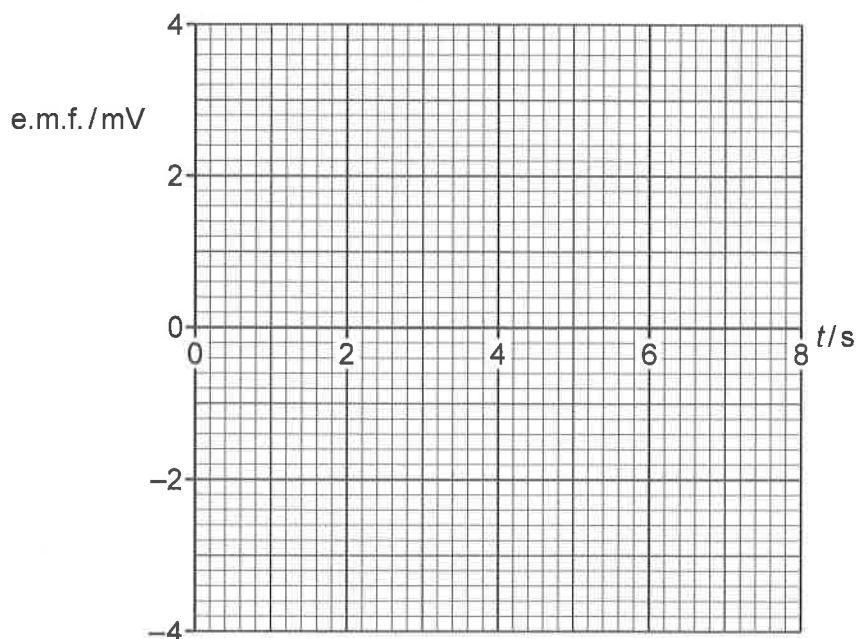


Fig. 8.2

[3]

- (c) The student repeats the experiment in (b) but replaces the flat, square coil with a flat, **circular** coil of diameter 6.0 cm.

On Fig. 8.3, sketch the variation of the induced e.m.f. across the ends of the circular coil with t from $t = 0$ to $t = 8.0$ s. Numerical values of e.m.f. are **not** required.

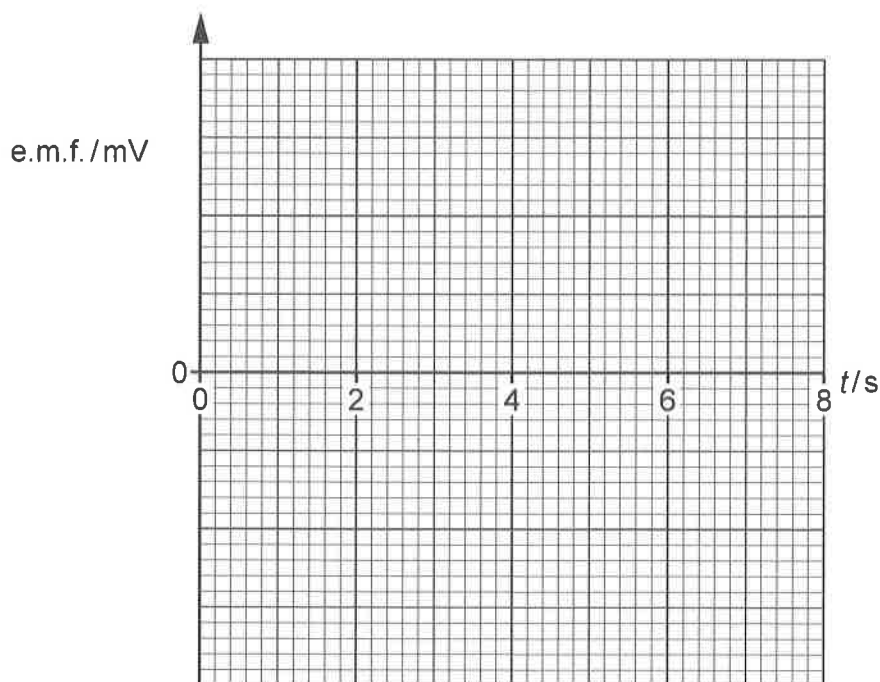


Fig. 8.3

[2]



- (d) The experiment in (b) is repeated with the ends of the coil connected together.

Explain why work is done to move the coil into the field at constant speed.

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- (e) A magnetic field is produced using a long solenoid.

An insulated wire of length 12 m and resistance $0.27 \, \Omega$ is wound around a hollow cardboard cylinder of diameter 3.0 cm to make the solenoid.

A cell of e.m.f. 1.2 V and negligible internal resistance is connected to the ends of the wire. This produces a magnetic field of magnetic flux density 4.2 mT at the centre of the solenoid.

- (i) Calculate the length of the solenoid.

length of solenoid = m [4]





- (ii) Suggest **two** reasons why the solenoid is **not** suitable for producing the magnetic field in (b).

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[2]

- (iii) The wire is made of a metal of resistivity $1.7 \times 10^{-8} \Omega \text{ m}$.

Calculate the diameter, in mm, of the wire.

diameter of wire = mm [2]