6 A straight solenoid of length 46 cm is wound evenly with 900 turns of insulated wire. The solenoid has a circular cross-section of diameter 1.6 cm.

A flat coil having 95 turns of wire is wound tightly around the centre of the solenoid, as illustrated in Fig. 6.1.

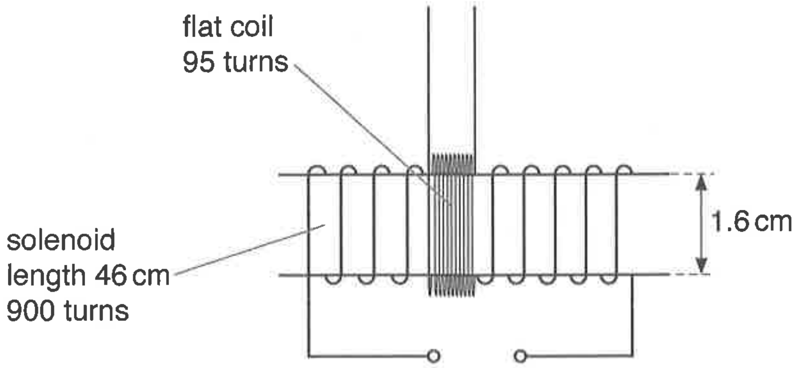

Fig. 6.1

The direct current in the solenoid is 2.4 A.

(a) **(i)** Calculate the magnetic flux density B at the centre of the solenoid.

B = ... T [2]

(ii) By reference to the flux pattern of the magnetic field in a solenoid, suggest the difference, if any, between the magnitude of the magnetic flux density at the ends of the solenoid compared with that at the centre.

....

....

.... [2]

(b) The current I in the solenoid is now made to vary with time t as shown in Fig. 6.2.

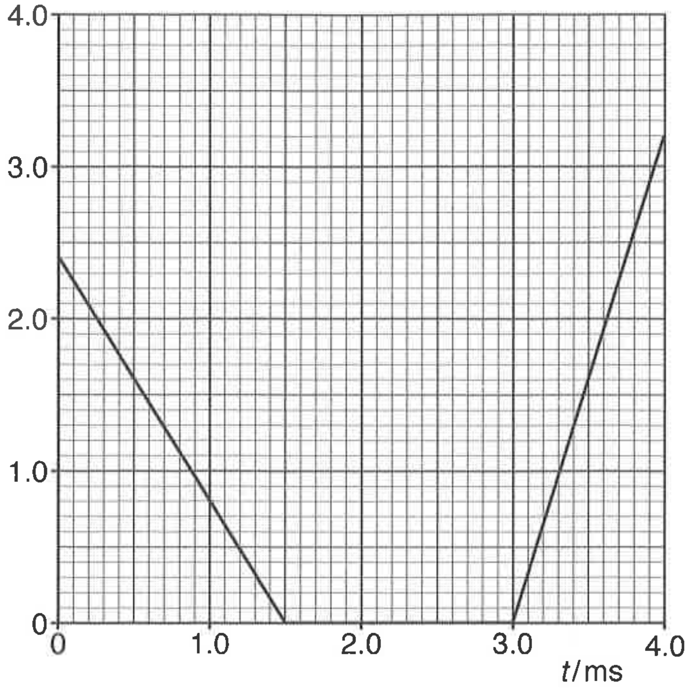

Fig. 6.2

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

....

....

.... [2]

(ii) Use your answer in **(a)(i)** to calculate the electromotive force (e.m.f.) induced in the flat coil during the time $t = 0$ to time $t = 1.5$ ms.

e.m.f. = ... V [2]

(iii) On Fig. 6.3, show the variation of the induced e.m.f. E with time t during the time $t = 0$ to time $t = 4.0$ ms.

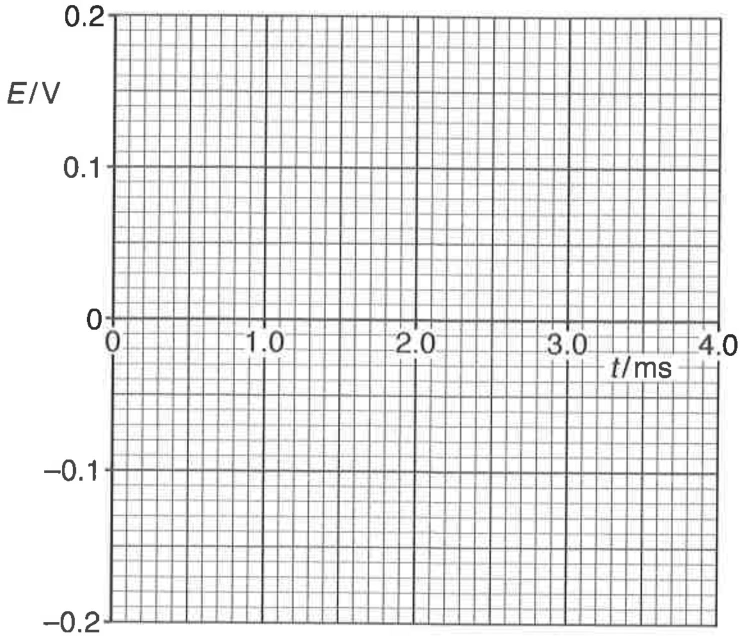

Fig. 6.3

[3]

[Total: 11]