

- 4 (a) State two ways to increase the magnetic field strength of a solenoid.

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.....

[2]

- (b) The magnetic flux density in a solenoid is measured using a current balance. The current balance is a U-shaped piece of stiff wire ABCDEF pivoted at BE, as shown in Fig. 4.1.

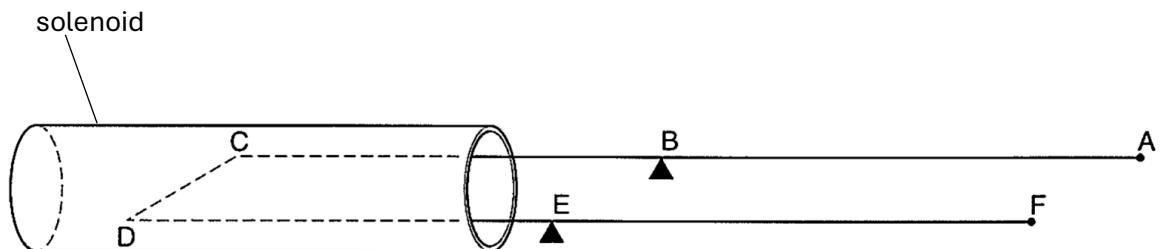


Fig. 4.1

When in use, there is a turning force on the stiff wire caused by a current in CD. CD has length 25 mm, CB and DE each have length 106 mm.

The stiff wire is first balanced when there is no current in it. A current of 4.9 A is then passed through CD and, in order to rebalance the stiff wire, a force of 5.7×10^{-4} N is applied at a distance of 77 mm from the pivot, as shown in Fig. 4.2. which is the side view of the balance.

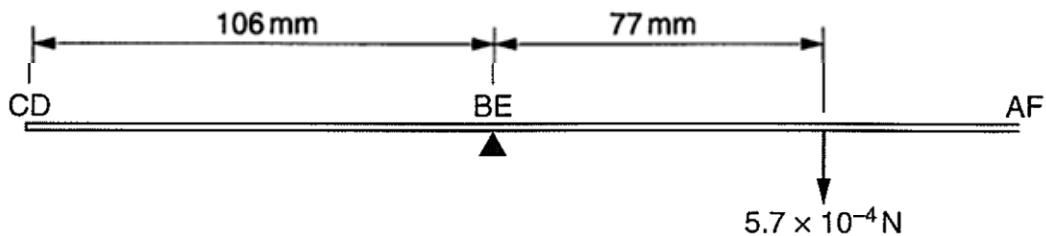




Fig. 4.2 (side view)

- (i) On Fig. 4.1, indicate the direction of the current in CD. [1]
- (ii) Calculate the magnetic flux density in the solenoid.

magnetic flux density =

full name of unit = [4]

- (c) Fig. 4.3 shows a rectangular coil placed at the centre of a solenoid with its plane perpendicular to the axis of the solenoid.

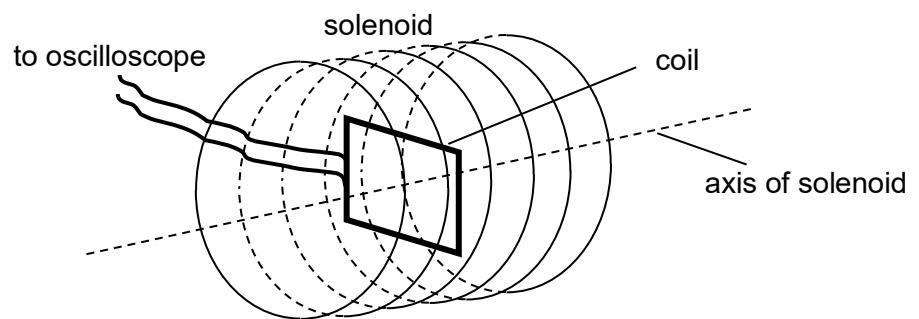


Fig. 4.3

The solenoid has 400 turns, a cross-sectional area of 0.0050 m^2 and a length of 50 cm. An alternating current of 50 Hz is passed through the solenoid. The rectangular coil has nine turns with dimensions of 0.010 m by 0.018 m. The ends of the coil are connected to a cathode ray oscilloscope.

Fig. 4.4 shows the variation with time of the current through the solenoid.

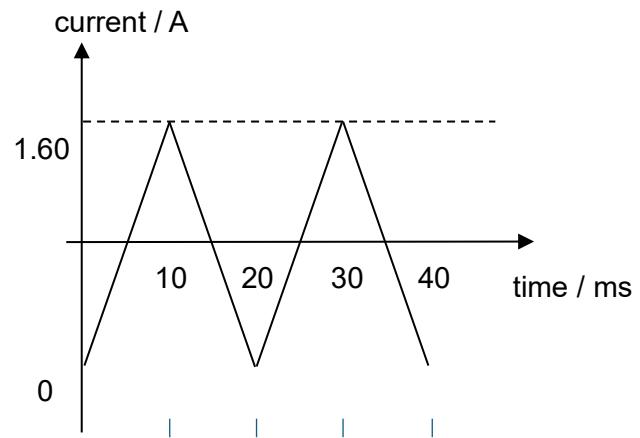


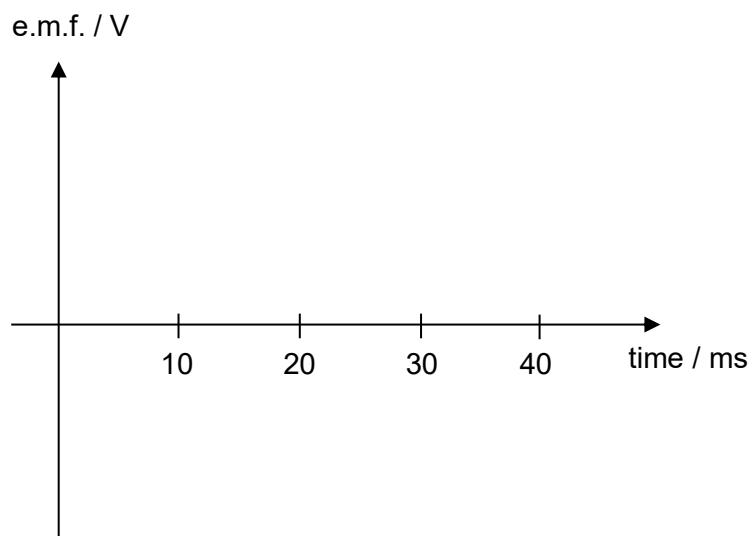
Fig. 4.4

- (i) The flux density of the solenoid is given by $B = \mu_0 n I$, where μ_0 is the permeability of free space, n is the number of turns per unit length of the solenoid and I is the current through the solenoid.

Determine the magnitude of the e.m.f. induced in the coil.

$$\text{e.m.f.} = \dots \text{V} \quad [2]$$

- (ii) On Fig. 4.5, sketch a labelled graph to show the variation with time of the induced e.m.f. in the coil over two cycles of current change.



[2]

Fig. 4.5

[Total: 11]

