5 **(a)** State what is meant by *a magnetic field*.

……..

……..

…… [2]

(b) A ‘bus bar’ is a metal bar which can used to conduct a large electric current. In a test, two bus bars, X and Y, of length 0.90 m are clamped at either end parallel to each other on a base board, as shown in Fig. 5.1.

When a constant current of 12 kA is carried by each bus bar, they exert a force of 200 N on each other.

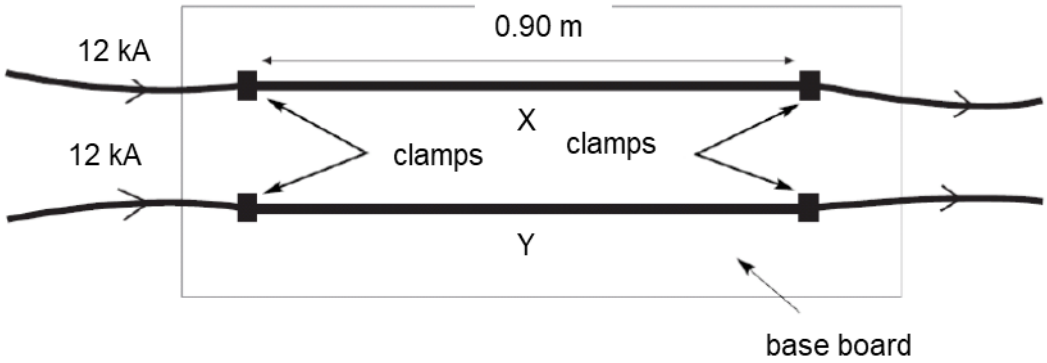

Fig. 5.1

(i) Calculate the magnetic flux density due to the current in one bus bar at the position of the other bus bar.

magnetic flux density = …… T [2]

(ii) Calculate the magnitude of the force on each bus bar if X carried a current of 6.0 kA and Y carried a current of 12 kA in the same direction.

magnetic force on X = …… N

magnetic force on Y = …… N [2]

(c) A small circular coil of cross sectional area 1.7×10^{-4} m^2 contains 250 turns of wire. The plane of the coil is placed parallel to and a distance *x* from the pole of a magnet as shown in Fig. 5.2.

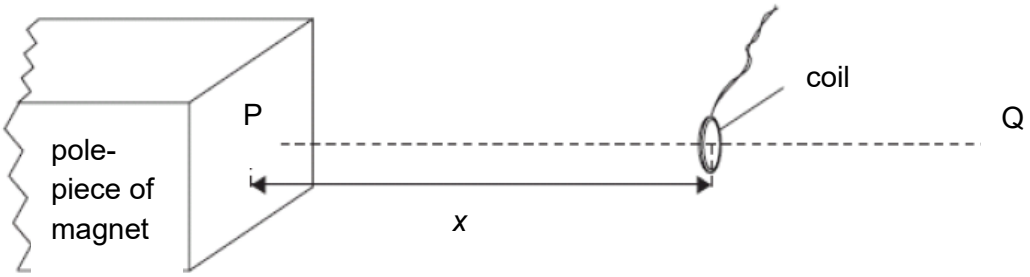

Fig. 5.2

PQ is a line that is normal to the pole piece. The variation with distance *x* along line PQ of the mean magnetic flux density *B* in the coil is shown in Fig. 5.3.

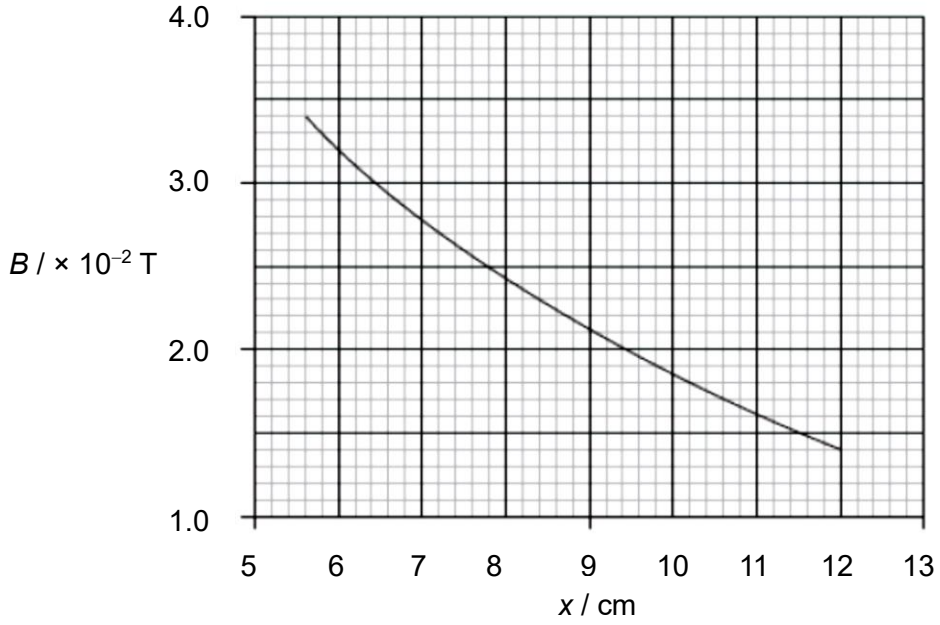

Fig. 5.3

(i) For the coil situated a distance 6.0 cm from the pole piece of the magnet,

1. State the mean magnetic flux density in the coil.

mean magnetic flux density = …… T [1]

2. Calculate the magnetic flux linkage through the coil.

magnetic flux linkage = …… Wb-turns [2]

(ii) The coil is moved along PQ so that the distance *x* changes from 6.0 cm to 12.0 cm in a time of 0.35 s.

1. Determine the change in magnetic flux linkage through the coil.

change in magnetic flux linkage = …… Wb-turns [2]

2. State Faraday's law of electromagnetic induction and hence calculate the mean e.m.f. induced in the coil.

……

……

……

mean e.m.f. induced = …… V [2]

(iii) Use Lenz's law to explain why work has to be done to move the coil along the line PQ.

……

……

……

……

……. [2]