Section B

Answer **one** question from this Section in the spaces provided.

7 **(a)** Fig. 7.1 shows two identical coils mounted next to each other and passing through a horizontal board. The currents in the two coils are equal.

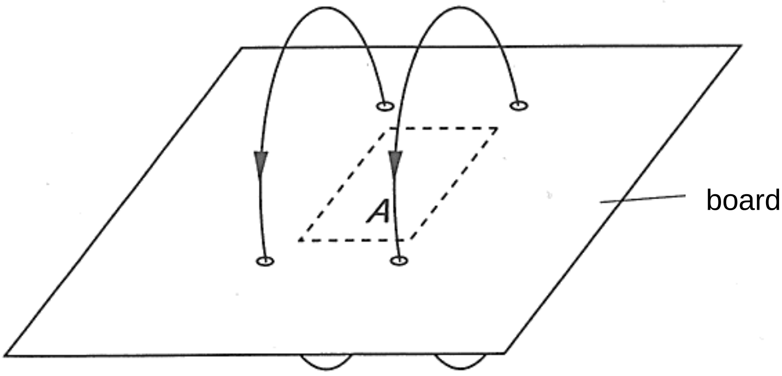

Fig. 7.1

The separation of the two coils is equal to their radii and the magnetic field in the area labelled A is uniform.

On Fig. 7.2 draw the magnetic field pattern due to the currents over the whole area of the board.

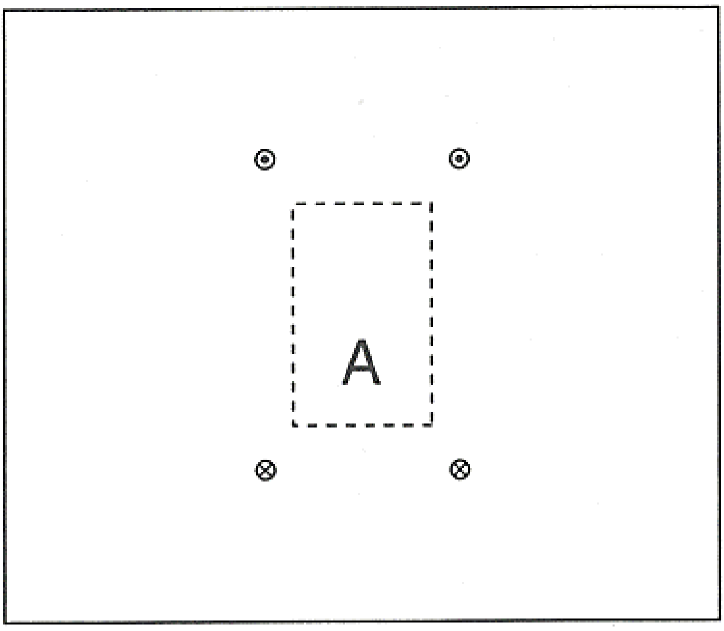

Fig. 7.2 [3]

(b) Two long parallel identical wires, wire X and Y are held with one directly above the other on a table.

The current in wire X is 90 A. The current in wire Y is 60 A and is in opposite direction to the current in wire X. Wire Y is held in suspension magnetically at a distance of 5.0 cm above the wire X as shown in Fig. 7.3.

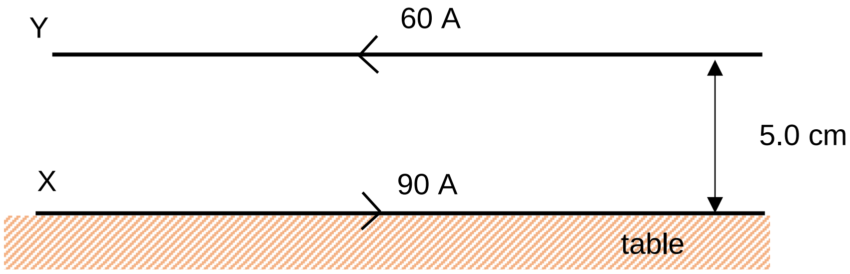

Fig. 7.3

(i) Calculate the magnetic flux density at wire Y due to the current in wire X.

magnetic flux density = …………………………….T [2]

(ii) Hence, determine the mass per unit length of the wire.

mass per unit length = …………………. kg m^{-1} [2]

(c) A moving charged particle may experience a force in an electric field and in a magnetic field.

State a difference between the forces experienced in the two types of field.

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……[1]

(d) A thin metal foil is placed in a magnetic field.

A negatively charged particle enters the region of the magnetic field. It loses kinetic energy as it passes through the foil. The particle follows the path shown in Fig. 7.4.

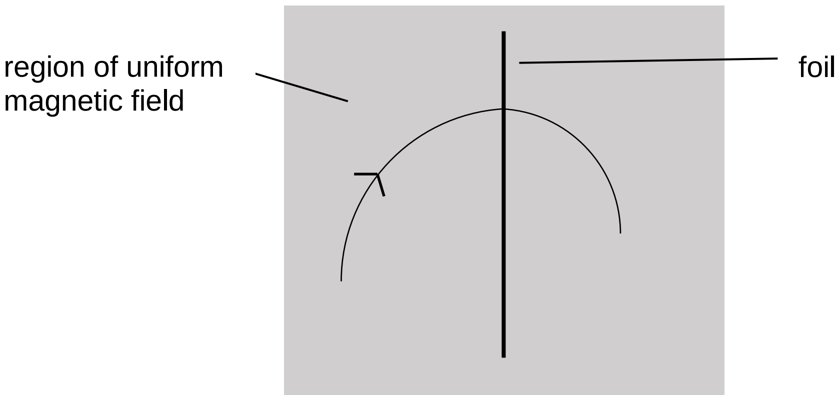

Fig. 7.4

(i) State the direction of the magnetic field.

…………………………………………………………………………………………………[1]

(ii) The path of the particle has different radii on each side of the foil. The radii are 7.4 cm and 5.7 cm.

Determine the ratio $\dfrac{\text{final momentum of particle}}{\text{initial momentum of particle}}$

for the particle as it passes through the foil. Explain your working.

ratio = ……………………………..[3]

(e) A pair of concentric coils is shown in Fig. 7.5.

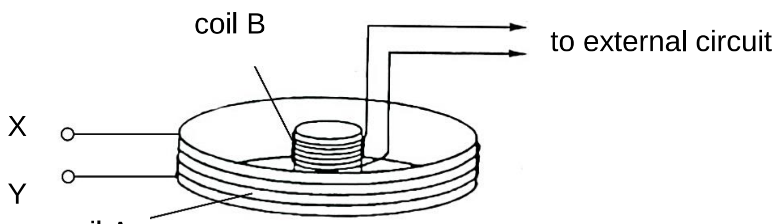

Fig. 7.5

The outer coil A is connected to a variable power supply by the terminals XY. The variation with time t of the current I in coil A is shown in Fig. 7.6.

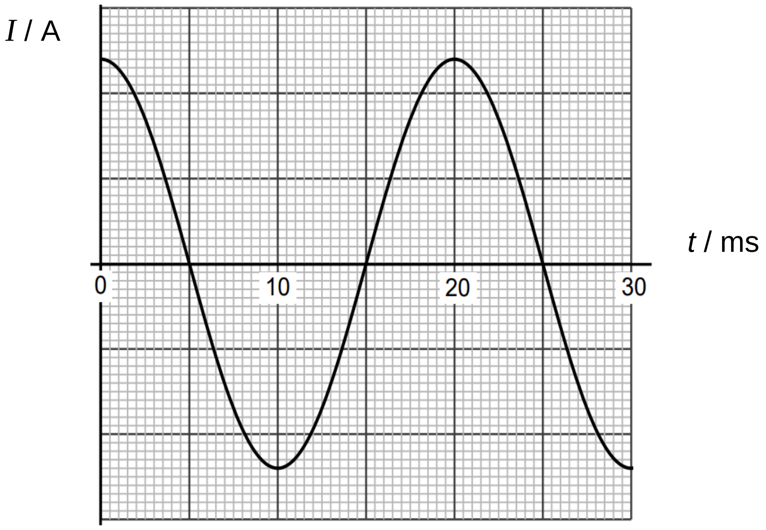

Fig. 7.6

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

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(ii) Using Faraday's law, explain why an e.m.f. is induced in coil B.

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(iii) State an instant where the induced e.m.f. in coil B is a maximum value.

t = ……………………………ms [1]

(iv) Explain your choice of answer for **(e)(iii).**

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(v) State and explain whether the induced current in coil B is in the same or opposite direction as the current in coil A from t = 10 ms to t = 15 ms.

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[Total: 20]