2 A long, straight wire W carrying a direct current of 3.0 A flows in the direction as shown in Fig. 2.1.

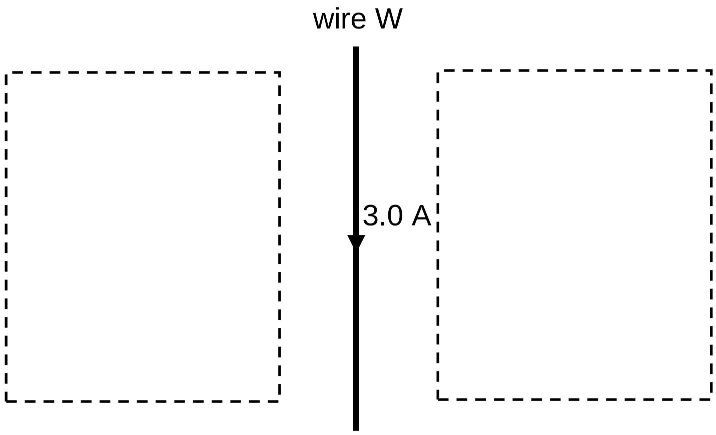

Fig. 2.1

(a) Draw on Fig. 2.1, the pattern of the magnetic field produced by wire W in the regions indicated by the dotted boxes. Use the symbol x to represent magnetic field directed into the page and use the symbol • to represent magnetic field directed out of the page. [3]

(b) A similar wire Y is placed parallel to wire W, separated by a distance of 40.0 cm as shown in Fig. 2.2. Initially, there is no current in wire Y.

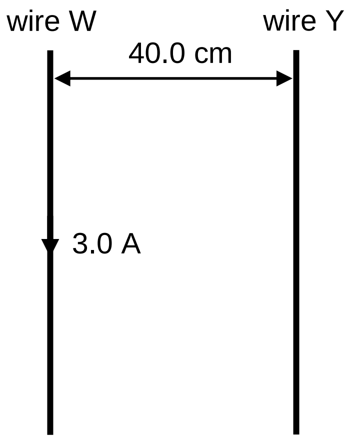

Fig. 2.2

(i) Show that the magnetic flux density at wire Y due to the current in wire W is 1.5×10^{-6} T.

[1]

(ii) A current of 1.0 A is now switched on in wire Y and flows in the opposite direction as the direction of current flow in wire W.

Use your answer in **(b)(i)** to calculate the force per unit length acting on wire Y.

force per unit length = ………………………..…….. N m^{-1} [2]

(iii) Explain why the force that the two wires exert on each other is repulsive.

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(iv) Determine a possible position, other than at infinity, where the resultant magnetic flux density due to the magnetic fields of both wires is zero.

position: ……………………………………….…………………… [3]

[Total: 12]