5 **(a)** Define the *tesla*.

For Examiner's Use

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..... [2]

(b) Two long straight vertical wires X and Y are separated by a distance of 4.5 cm, as illustrated in Fig. 5.1.

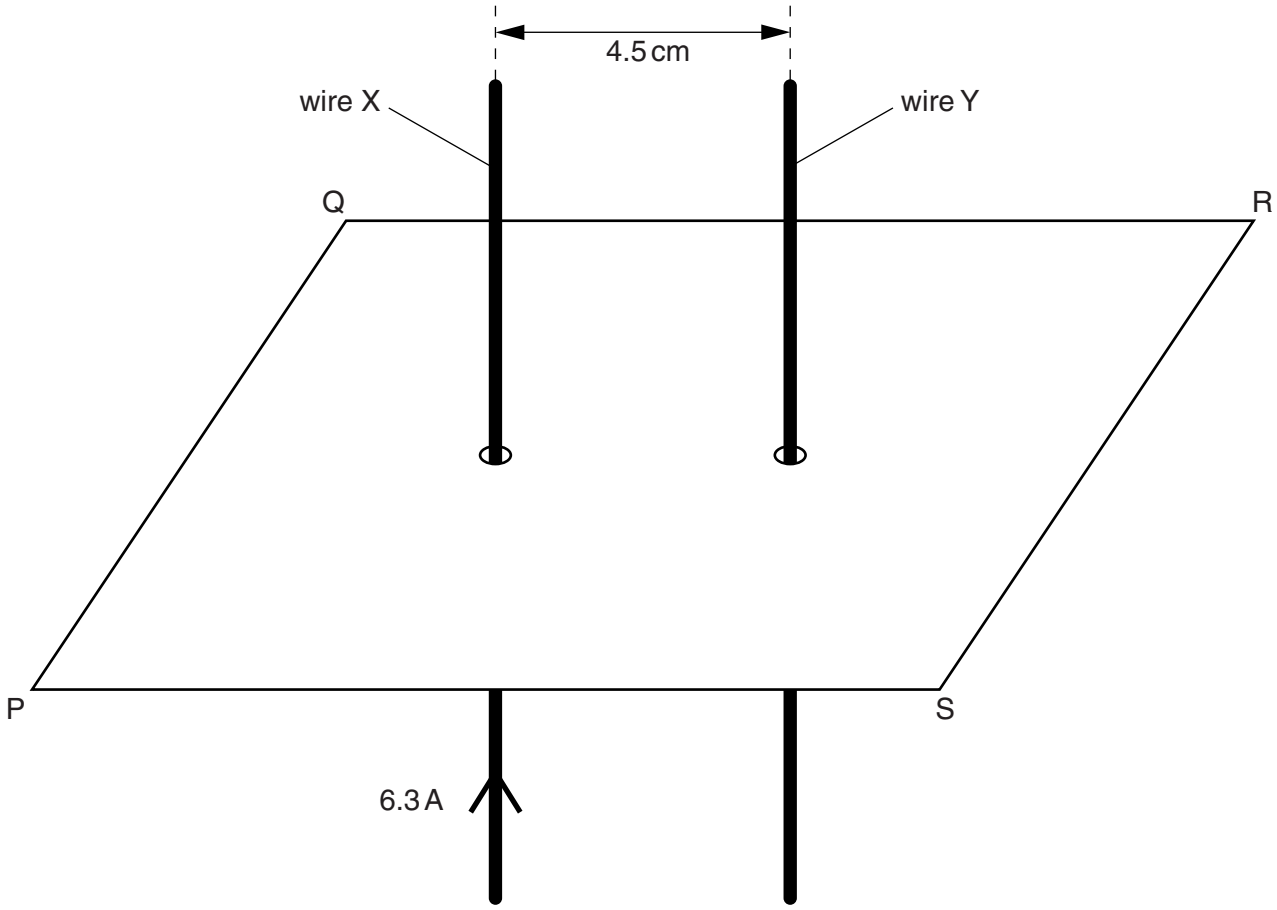

Fig. 5.1

The wires pass through a horizontal card PQRS.
The current in wire X is 6.3 A in the upward direction. Initially, there is no current in wire Y.

(i) On Fig. 5.1, sketch, in the plane PQRS, the magnetic flux pattern due to the current in wire X. Show at least four flux lines. [3]

(ii) The magnetic flux density B at a distance x from a long straight current-carrying wire is given by the expression

$$B = \frac{\mu_0 I}{2\pi x}$$

where I is the current in the wire and μ_0 is the permeability of free space.

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

flux density = ... T [2]

(iii) A current of 9.3 A is now switched on in wire Y. Use your answer in **(ii)** to calculate the force per unit length on wire Y.

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

(c) The currents in the two wires in **(b)(iii)** are not equal.
Explain whether the force per unit length on the two wires will be the same, or different.

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..... [2]