8 **(a)** A long straight vertical wire carries a current I. The wire passes through a horizontal card EFGH, as shown in Fig. 8.1 and Fig. 8.2.

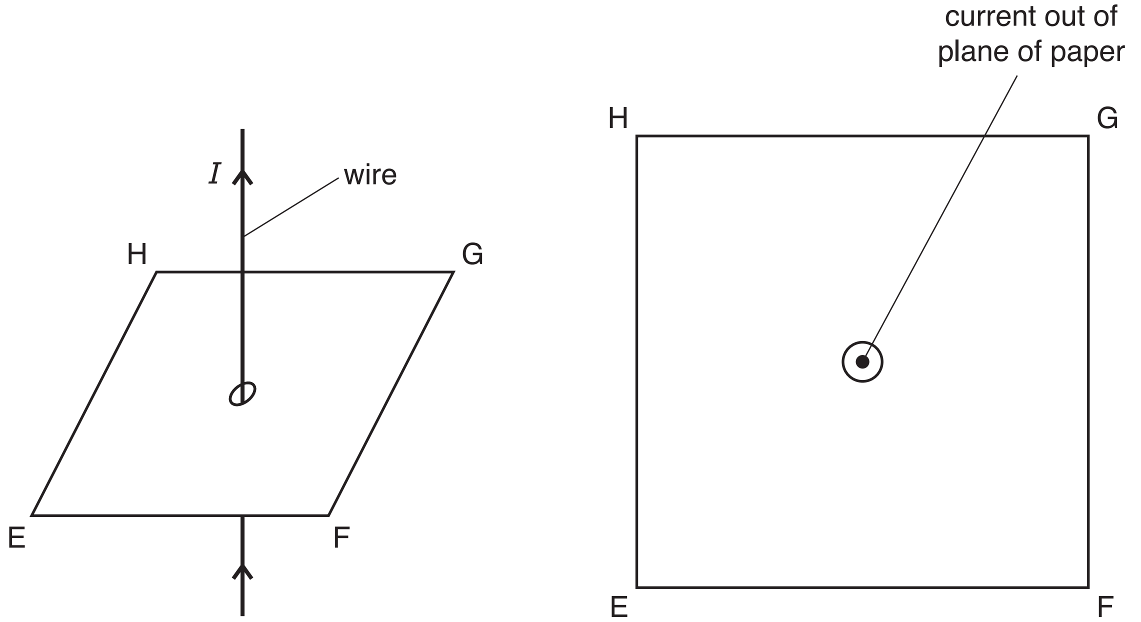

Fig. 8.1 **Fig. 8.2** (view from above)

On Fig. 8.2, draw the pattern of the magnetic field produced by the current-carrying wire on the plane EFGH. [3]

(b) Two long straight parallel wires P and Q are situated a distance 3.1 cm apart, as illustrated in Fig. 8.3.

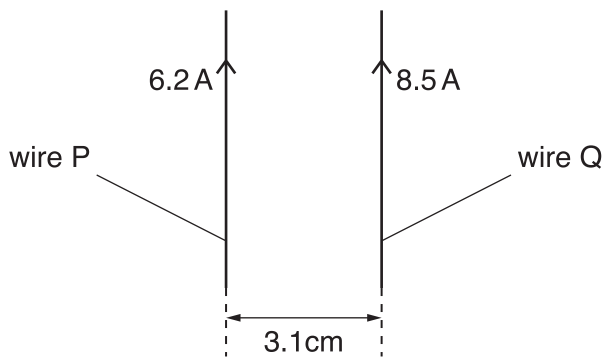

Fig. 8.3

The current in wire P is 6.2 A. The current in wire Q is 8.5 A.

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

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

where μ_0 is the permeability of free space.

Calculate:

(i) the magnetic flux density at wire Q due to the current in wire P

flux density = ... T [2]

(ii) the force per unit length, in $N m^{-1}$, acting on wire Q due to the current in wire P.

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

(c) The currents in wires P and Q are different in magnitude.

State and explain whether the forces per unit length on the two wires will be different.

....

....

.... [2]

[Total: 9]

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