8 A slice of a conducting material has its face QRLK normal to a uniform magnetic field of flux density *B*, as illustrated in Fig. 8.1.

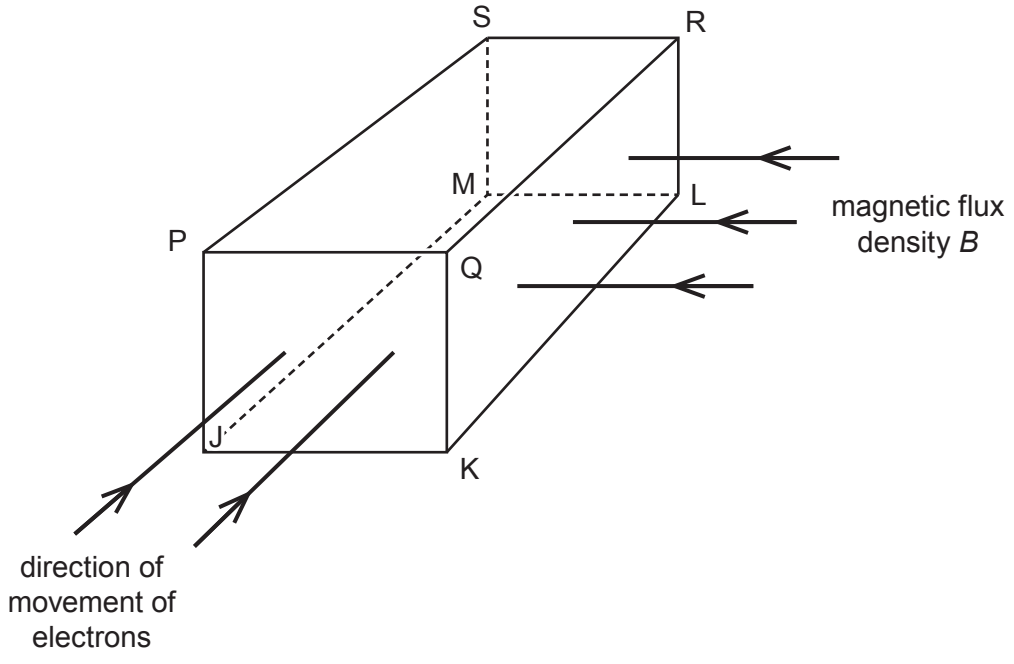

Fig. 8.1

Electrons enter the slice travelling perpendicular to face PQKJ.

(a) For the free electrons moving in the slice:

(i) state the direction of the force on an electron due to movement of the electron in the magnetic field

.....

..... [1]

(ii) identify the faces, using the letters on Fig. 8.1, between which a potential difference is developed.

face ..... and face ..... [1]

(b) Explain why the potential difference in **(a)(ii)** reaches a maximum value.

.....

.....

..... [2]

(c) The number of free electrons per unit volume in the slice of material is $1.3 \times 10^{29}\,m^{-3}$.
The thickness PQ of the slice is 0.10 mm.
The magnetic flux density B is $4.6 \times 10^{-3}\,T$.

Calculate the potential difference across the slice for a current of $6.3 \times 10^{-4}\,A$.

potential difference = ... V [2]

(d) The slice in **(c)** is a metal.

By reference to your answer in **(c)**, suggest why Hall probes are usually made using semiconductors rather than metals.

.....

.....

..... [2]

[Total: 8]