8 Electrons enter a rectangular slice PQRSEFGH of a semiconductor material at right-angles to face PQFE, as shown in Fig. 8.1.

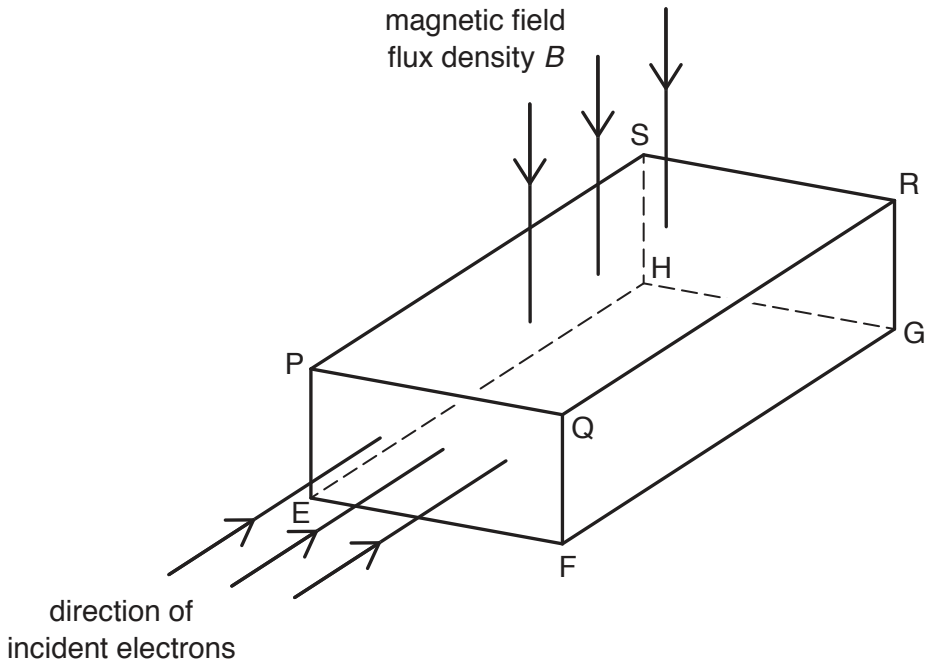

Fig. 8.1

A uniform magnetic field of flux density B is directed into the slice, at right-angles to face PQRS.

(a) The electrons each have charge $-q$ and drift speed v in the slice.

State the magnitude and the direction of the force due to the magnetic field on each electron as it enters the slice.

.....

.....

..... [2]

(b) The force on the electrons causes a voltage V_H to be established across the semiconductor slice given by the expression

$$V_H = \frac{BI}{ntq}$$

where I is the current in the slice.

(i) State the two faces between which the voltage V_H is established.

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

(ii) Use letters from Fig. 8.1 to identify the distance t.

..... [1]

(c) Aluminium ($^{27}_{13}Al$) has a density of 2.7 g cm^{-3}. Assume that there is one free electron available to carry charge per atom of aluminium.

(i) Show that the number of charge carriers per unit volume in aluminium is 6.0×10^{28} m^{-3}.

[2]

(ii) A sample of aluminium foil has a thickness of 0.090 mm. The current in the foil is 4.6 A.

A uniform magnetic field of flux density 0.15 T acts at right-angles to the foil.

Use the value in **(i)** to calculate the voltage V_H that is generated.

V_H = ... V [2]

[Total: 8]