5 A uniform magnetic field of flux density B makes an angle θ with a flat plane PQRS, as shown in Fig. 5.1.

For Examiner's Use

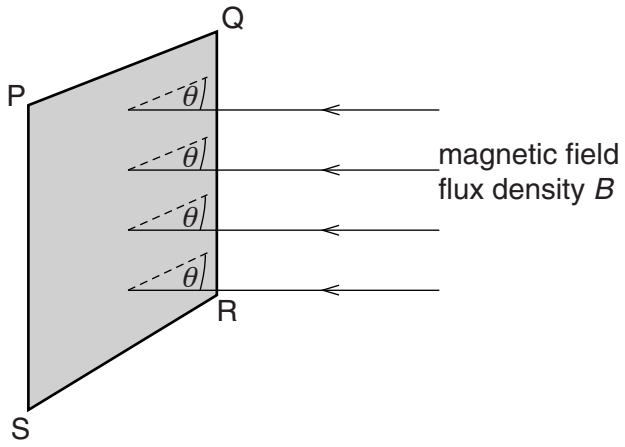

Fig. 5.1

The plane PQRS has area A.

(a) State

(i) what is meant by a *magnetic field*,

.....

.....[1]

(ii) an expression, in terms of A, B and θ, for the magnetic flux Φ through the plane PQRS.

.....[1]

(b) A vertical aluminium window frame DEFG has width 52 cm and length 95 cm, as shown in Fig. 5.2.

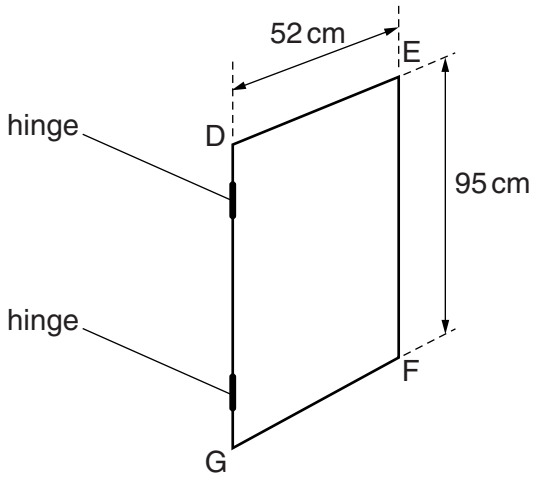

Fig. 5.2

The frame is hinged along the vertical edge DG.
The horizontal component B_H of the Earth's magnetic field is 1.8×10^{-5} T. For the closed window, the frame is normal to the horizontal component B_H.
The window is opened so that the plane of the window rotates through 90°.

(i) Explain why, when the window is opened, the change in magnetic flux linkage due to the vertical component of the Earth's magnetic field is zero.

.....

.....[1]

(ii) Calculate, for the window opening through an angle of 90°, the change in magnetic flux linkage.

change in flux linkage = ... Wb [2]

(c) (i) State Faraday's law of electromagnetic induction.

.....

.....

.....[2]

(ii) The window in **(b)** is opened in a time of 0.30 s.
Use your answer in **(b)(ii)** to calculate the average e.m.f. induced in the window frame.

e.m.f. = ... V [1]

(iii) State the sides of the window frame between which the e.m.f. is induced.

between side ..... and side ..... [1]