5 A Hall probe is placed a distance *d* from a long straight current-carrying wire, as illustrated in Fig. 5.1.

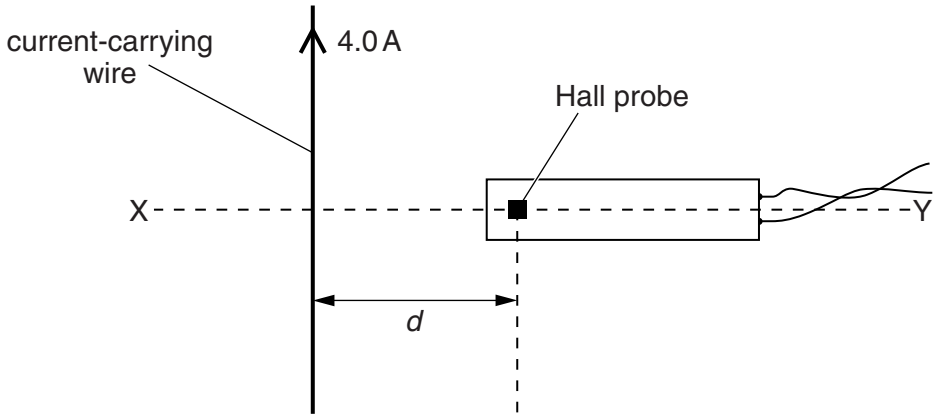

Fig. 5.1

The direct current in the wire is 4.0 A. Line XY is normal to the wire.

The Hall probe is rotated about the line XY to the position where the reading V_H of the Hall probe is maximum.

(a) The Hall probe is now moved away from the wire, along the line XY.
On the axes of Fig. 5.2, sketch a graph to show the variation of the Hall voltage V_H with distance *x* of the probe from the wire. Numerical values are not required on your sketch.

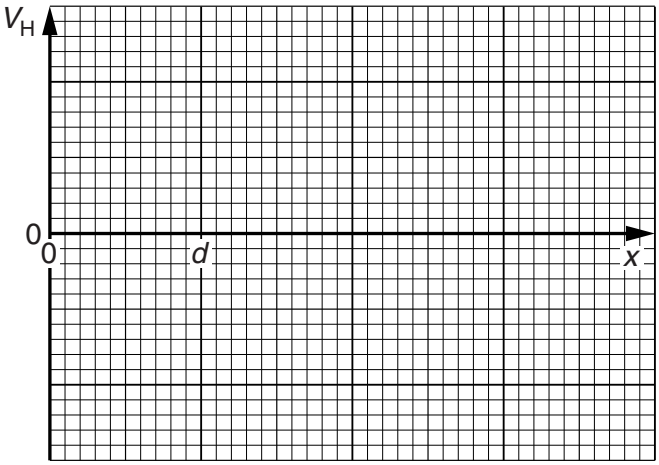

Fig. 5.2

[2]

(b) The Hall probe is now returned to its original position, a distance *d* from the wire.
At this point, the magnetic flux density due to the current in the wire is proportional to the current.

For a direct current of 4.0 A in the wire, the reading of the Hall probe is 3.5 mV.
The direct current is now replaced by an alternating current of root-mean-square (r.m.s.) value 4.0 A. The period of this alternating current is *T*.

On the axes of Fig. 5.3, sketch the variation with time *t* of the reading of the Hall voltage V_H for two cycles of the alternating current. Give numerical values for V_H, where appropriate.

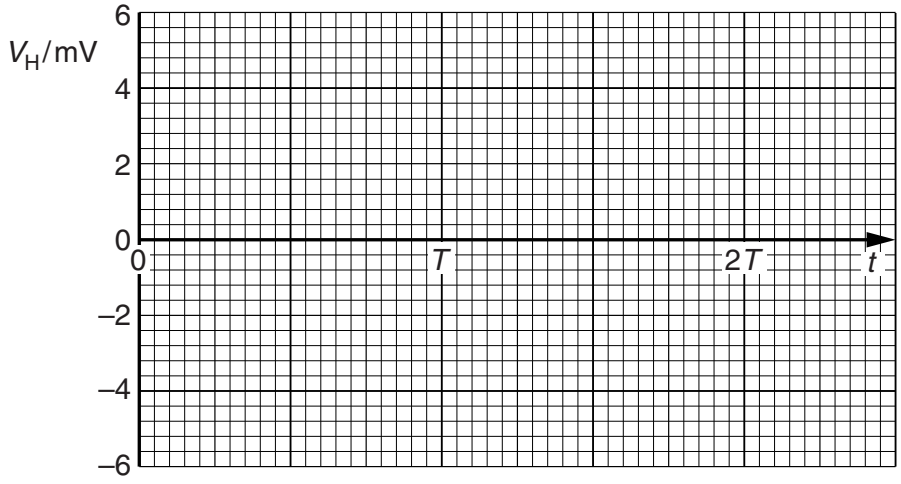

Fig. 5.3

[3]

(c) A student suggests that the Hall probe in **(a)** is replaced with a small coil connected in series with a millivoltmeter. The constant current in the wire is 4.0 A.
In order to obtain data to plot a graph showing the variation with distance *x* of the magnetic flux density, the student suggests that readings of the millivoltmeter are taken when the coil is held in position at different values of *x.*

Comment on this suggestion.

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..... [2]