

Revision Sheet

A-Level Physics · Unit 20 Magnetic fields

10 vocabulary items · 38 marks of exam questions (4 questions)

Part 1 · Vocabulary review

(10 items). The terms this unit is examined on most. Mark it yourself

from the answer key.

Section A · Chinese to English

Write the English word.

- | | | |
|-----|-------|-----|
| 1. | _____ | [1] |
| 2. | _____ | [1] |
| 3. | _____ | [1] |
| 4. | _____ | [1] |
| 5. | _____ | [1] |
| 6. | _____ | [1] |
| 7. | _____ | [1] |
| 8. | _____ | [1] |
| 9. | _____ | [1] |
| 10. | _____ | [1] |

Part 2 · Exam questions

(38 marks, 4 questions) begins on the next page. They are ordered easy to

difficult and none of them has been set before.

- 11 Fig. 6.1 shows a thin slice of semiconducting material used in a Hall probe.

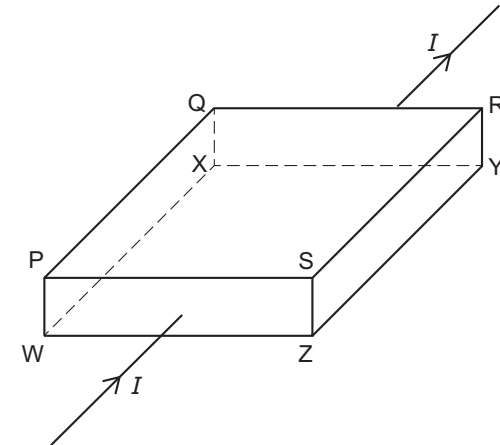


Fig. 6.1 (not to scale)

Current I passes through the slice in the direction shown.

The slice is placed in a uniform magnetic field of flux density B , so that two of its faces are perpendicular to the magnetic field.

A steady Hall voltage V_H is developed between face PQXW and face SRYZ.

- (a) (i) Use the letters in Fig. 6.1 to identify the faces that are perpendicular to the magnetic field.

..... and [1]

- (ii) Explain how the steady Hall voltage V_H is developed between faces PQXW and SRYZ.

.....
.....
.....
.....
..... [3]

(b) The magnitude of V_H is given by the equation

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

(i) State the meaning of the symbols n , t and q . You may refer to the letters in Fig. 6.1.

n :

t :

q : [3]

(ii) Suggest, with reference to the equation, why the slice of the material used in a Hall probe is thin.

.....

.....

..... [2]

[Total: 9]

12 (a) State, by reference to the power dissipated in a resistor, what is meant by the *root-mean-square* (r.m.s.) value of an alternating voltage.

.....

.....

.....

..... [2]

(b) A coil is rotating freely, on frictionless bearings, at constant speed in a uniform magnetic field. This rotation causes an induced alternating electromotive force (e.m.f.) across the open terminals of the coil. The induced e.m.f. has r.m.s. value 12 V and frequency 50 Hz.

The speed of rotation of the coil is now doubled.

(i) State and explain, with reference to the principles of electromagnetic induction, the effect of the increased speed of rotation on the r.m.s. value of the induced e.m.f.

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..... [2]

(ii) On Fig. 9.1, sketch the variation with time t of the induced e.m.f. E across the terminals of the coil at the **increased** speed of rotation. Your line should extend from time $t = 0$ to time $t = 20$ ms. Assume that $E = 0$ when $t = 0$.

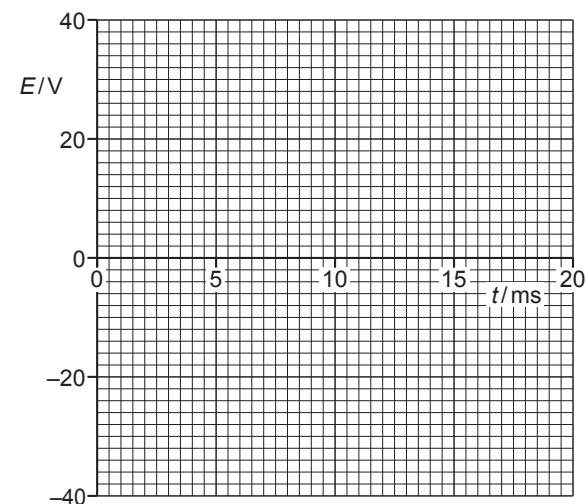


Fig. 9.1

- (c) State and explain the effect on the motion of the coil in (b) of connecting a load resistor across its terminals.

.....

.....

.....

..... [2]

[Total: 9]

- 13 (a) An object travels in a circle at constant speed.

State the names of **two** quantities that vary during the motion of the object.

1

2 [2]

- (b) A charged particle of mass m and with charge q enters a region of uniform magnetic field, perpendicular to the field lines. The magnetic flux density is B .

The particle travels in a circle with period T and radius r .

- (i) By considering the magnetic force acting on the particle, show that

$$B = \frac{2\pi m}{qT}.$$

[3]

- (ii) The particle is an alpha particle. The period of the circular motion is $2.5\text{ }\mu\text{s}$.

Calculate B .

$$B = \dots\dots\dots \text{T} \quad [2]$$

- (iii) A second alpha particle is in the same uniform field. It travels in a circle of radius $2r$.

State and explain how the periods of the motion of the two particles compare.

.....

.....

..... [1]

- (iv) The speed of the alpha particle in (b)(ii) is $1.1 \times 10^6 \text{ ms}^{-1}$. An electric field is applied so that this particle now moves with constant velocity.

Use your answer in (b)(ii) to calculate the electric field strength E . Give the unit with your answer.

$E =$ unit [2]

[Total: 10]

- 14 (a) State the **two** conditions that must be satisfied for a copper wire, placed in a magnetic field, to experience a magnetic force.

1

.....

2

.....

[2]

- (b) A long air-cored solenoid is connected to a power supply, so that the solenoid creates a magnetic field. Fig. 6.1 shows a cross-section through the middle of the solenoid.

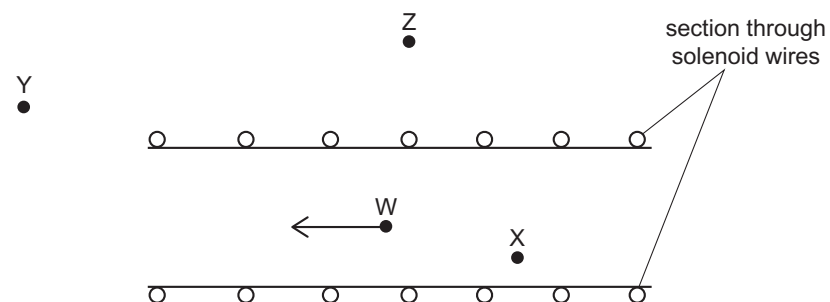


Fig. 6.1

The direction of the magnetic field at point W is indicated by the arrow. Three other points are labelled X, Y and Z.

- (i) On Fig. 6.1, draw arrows to indicate the direction of the magnetic field at each of the points X, Y and Z. [3]

- (ii) Compare the magnitude of the flux density of the magnetic field:

• at X and at W

.....

• at Y and at Z.

.....

[2]

(c) Two long parallel current-carrying wires are placed near to each other in a vacuum.

Explain why these wires exert a magnetic force on each other. You may draw a labelled diagram if you wish.

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..... [3]

[Total: 10]