Unit 16 · Magnetic Fields

WORKSHEET

Full marks 34

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 34

1 Key words [4]

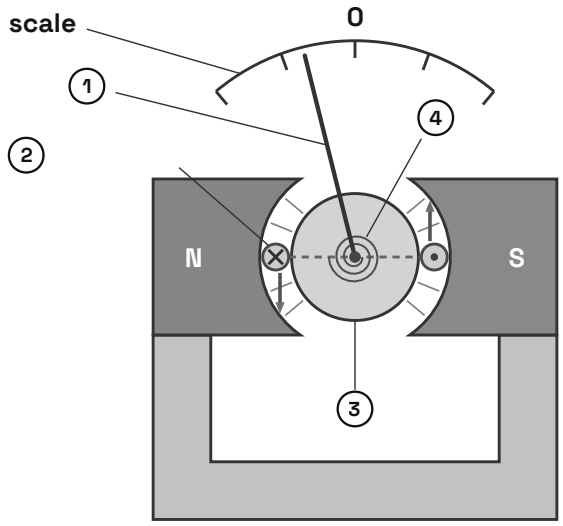
Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

gauss	**Hall voltage**	**helix**	**Lorentz**	**neutral point**	**Peltier effect**	**permeability**	**teslas**
toroid	**webers**						

The magnetic flux through a surface is measured in _____, and the flux per unit area at right angles to the field, the flux density, in _____. A point where a magnet's field cancels the horizontal component of the Earth's field is a _____. The force $q(\vec{v} \times \vec{B})$ on a moving charge is the _____ force. A charge moving at an angle to a uniform magnetic field follows a _____. The voltage across a current-carrying slab placed in a magnetic field, at right angles to both, is the _____. A solenoid bent round into a ring is a _____. The constant μ_0 is the _____ of free space.

2 Label the diagram [2]

The diagram shows a moving-coil galvanometer from the front. Write the label that belongs in place of 1 to 4. Each carries 0.5 mark.



magnet (pole pieces N and S)

1. _____ **2.** _____

3. _____ **4.** _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. A coil of 200 turns, each of area 25 cm^2, is in a uniform field of 0.4 T. Its plane makes an angle of 60° with the field. The flux linked with it is about: [1]

a. 0.10 Wb **b.** 0.17 Wb
c. 0.20 Wb **d.** 0.0017 Wb

ii. A charged particle moves along the lines of a uniform magnetic field. The magnetic force on it is: [1]

a. Bqv, along its motion **b.** Bqv, at right angles to its motion
c. zero **d.** Bqv/2

iii. Two particles with the same charge enter a uniform magnetic field at the same speed, at right angles to it. One has four times the mass of the other. Compared with the lighter one, the heavier one goes round a circle of: [1]

a. the same radius, in a quarter of the time
b. four times the radius, in four times the time
c. four times the radius, in the same time
d. a quarter of the radius, in the same time

iv. A long straight wire carries 6 A. The magnetic field 4 cm from it is: [1]

a. 15 μT **b.** 30 μT
c. 60 μT **d.** 300 μT

v. Two long parallel wires carry currents in the same direction. They: [1]

a. attract each other **b.** repel each other
c. feel no force **d.** turn to be at right angles

4 Short answers [6]

Write short answers to the following questions.

a. A magnetic field does no work on a moving charge, yet it can change the charge's motion. Explain. [2]

b. Using Ampère's law, explain why the field of a toroid is zero outside its windings and in the hole in its middle. [2]

c. Doubling the number of turns of a galvanometer's coil, with the same wire, doubles its current sensitivity but leaves its voltage sensitivity about the same. Why? **[2]**

5 Long answer **[4]**

Write a long answer to the following question.

A slab of conductor of thickness t (along the field) carries a current I at right angles to a uniform magnetic field B. It has n free electrons per unit volume, each of charge e. Explain how a Hall voltage is set up across it, and show that $V_H = \frac{BI}{net}$.

6 Numerical problems **[10]**

Solve the following problems. Show your working. Take $\mu_0 = 4\pi \times 10^{-7}$ H/m, $e = 1.6 \times 10^{-19}$ C and the mass of an electron 9.1×10^{-31} kg.

a. An electron moves at 2.0×10^7 m/s at right angles to a uniform magnetic field of 1.5 mT. Find the radius of its circle and the time for one round. **[3]**

Answer:

b. A rectangular coil of 150 turns, 4 cm × 5 cm, carries 0.5 A in a uniform field of 0.25 T. Find i. its magnetic moment, ii. the torque on it when its plane makes 30° with the field, iii. the largest torque it can feel, and iv. the work needed to turn it from its stable position through 180°. **[4]**

Answer: _____

c. A solenoid 50 cm long has 800 turns and carries 2.5 A. Find the magnetic field inside it, well away from its ends, and on its axis at one end. **[3]**

Answer: _____

7 Think **[3]**

A beam of electrons passes straight through crossed electric and magnetic fields, undeflected. Without changing the fields, what happens to i. electrons moving faster, ii. protons moving at the same speed as the first electrons? Explain.

8 Activity: A swinging wire (Activity 16.4) (not marked)

Hang a bare copper wire so that it can swing between the poles of a U-shaped magnet. Pass a current for a moment each time.

	Which way the wire moves
Current one way	
Current reversed	
Current reversed, magnet turned over	

What decides the direction of the force on the wire?