

12.1 Magnetic Fields

Name: _____ Class: _____ Date: _____ **Total: 8 marks**

KEY WORDS magnetic field 磁场 • ferromagnetic 铁磁性 • magnetic field lines 磁感线
• magnetic monopoles 磁单极子 • diamagnetic 抗磁性

Objective

Build the skills to answer exam questions on **magnetic fields**.

You must be able to:

- describe a **magnetic field** 磁场 $\vec{B}$ as a vector field acting on moving charges and magnets
- represent fields with **field lines** that form closed loops from north to south
- explain that **magnetic monopoles** 磁单极子 have never been observed
- compare **ferromagnetic**, **paramagnetic**, and **diamagnetic** materials

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ The magnetic field

$\vec{B}$ exerts forces on moving charges and magnets; its **field lines** form closed loops running from a north pole to a south pole.

■ No monopoles

Isolated poles have never been found, so field lines **never begin or end** — cutting a magnet just makes two smaller magnets.

■ Magnetic materials

Ferromagnetic (iron) — strongly magnetized; **paramagnetic** — weakly attracted; **diamagnetic** — weakly repelled. The behaviour reflects the alignment of atomic magnetic dipoles.

2 Practice

2.1 State the shape of magnetic field lines. [1]

2.2 State why magnetic field lines never begin or end. [1]

2.3 Name the type of material that is strongly magnetic, like iron. [1]

3 Exam-style questions

3.1 Magnetic field lines form [1]

- **A** open curves
- **B** closed loops
- **C** straight lines only
- **D** isolated dots

3.2 Iron is an example of a _____ material. [1]

- **A** diamagnetic
- **B** paramagnetic
- **C** ferromagnetic
- **D** non-magnetic

3.3 A bar magnet is cut in half.

(a) State what each piece becomes. [1]

(b) Explain your answer in terms of magnetic monopoles. [2]

Solutions

2.1 closed loops.

2.2 because there are no magnetic monopoles for them to start or end on.

2.3 ferromagnetic.

3.1 B.

3.2 C.

3.3 (a) each piece is a complete magnet with its own north and south pole. (b) magnetic poles only exist in pairs — no monopoles — so a new north-south pair forms at the cut.