

# 12.1 Magnetic Fields

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Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 8 marks

## Objective

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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

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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

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

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

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

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### 3 Exam-style questions

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3.1 Magnetic field lines form [1]

- A open curves
  - B closed loops
  - C straight lines only
  - D isolated dots
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3.2 Iron is an example of a \_\_\_\_\_ material. [1]

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

### 4 Go further

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- work through the **12.1 Magnetic Fields** lesson on the **Learn** page;
- read the **Magnetic Fields** section of the AP Physics C: E&M handout on the **Know** page.

## Solutions

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**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.