

Exercise walk-through

Magnetic Fields ■ 12.1

eXercise

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

Method — 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.

Method — No monopoles

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

Method — Magnetic materials

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

Practice 2.1 ■ 1 mark

State the shape of magnetic field lines.

Solution 2.1

Method: The magnetic field

Worked steps

closed loops **B1**.

Practice 2.2 ■ 1 mark

State why magnetic field lines never begin or end.

Solution 2.2

Method: No monopoles

Worked steps

because there are no magnetic monopoles for them to start or end on **B1**.

Practice 2.3 ■ 1 mark

Name the type of material that is strongly magnetic, like iron.

Solution 2.3

Method: Magnetic materials

Worked steps

ferromagnetic **B1**.

Exam-style 3.1 ■ 1 mark

Magnetic field lines form

A open curves

B closed loops

C straight lines only

D isolated dots

Solution 3.1

Method: The magnetic field

A open curves

B closed loops



C straight lines only

D isolated dots

Worked steps

B.

Exam-style 3.2 ■ 1 mark

Iron is an example of a _____ material.

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

Solution 3.2

A diamagnetic

B paramagnetic

C ferromagnetic



D non-magnetic

Worked steps

C.

Exam-style 3.3 ■ 1 mark

A bar magnet is cut in half.

- (a) State what each piece becomes.
- (b) Explain your answer in terms of magnetic monopoles.

Solution 3.3

Method: No monopoles

Worked steps

(a) each piece is a complete magnet with its own north and south pole **B1**. (b) magnetic poles only exist in pairs — no monopoles — so a new north-south pair forms at the cut **B1 B1**.