

20.1 Concept of a magnetic field

Name: _____ Class: _____ Date: _____

Total: 20 marks

KEY WORDS magnetic field 磁场 • field line 场线 • force 力 • bar magnet 条形磁铁
• permanent magnet 永磁体

Objective

Build the skills to answer exam questions on the **magnetic field** — its sources and field lines.

You must be able to:

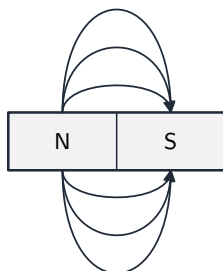
- state what produces a magnetic field
- represent a magnetic field with **field lines**

1 Worked examples

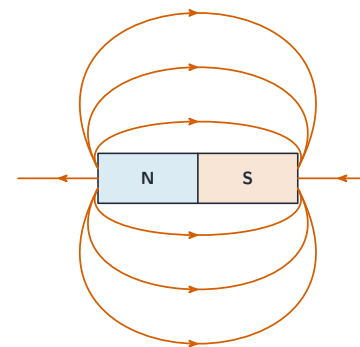
Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ Magnetic fields

A **magnetic field** is a region where a moving charge or current feels a force. It is produced by **moving charges (currents)** or **permanent magnets**.



field lines run from **N** to **S** outside the magnet



The field of a bar magnet

- field lines run **N to S** outside a magnet (closed loops);
- they **never cross**; **closer lines** → **stronger field**.

2 Practice

Now apply the methods above.

2.1 State **two** things that can produce a magnetic field. [1]

2.2 State the direction of the field lines **outside** a bar magnet. [1]

2.3 State what **closer** field lines indicate. [1]

3 Exam-style questions

3.1 Magnetic field lines **outside** a bar magnet point from: [1]

- | | |
|---|---|
| A | B |
| C | D |
- A S to N
B N to S
C N to N
D nowhere

3.2 Sketch the magnetic field lines around a bar magnet. [2]

3.3 State **two** ways a magnetic field can be produced. [2]

3.4 A long, straight vertical wire carries a current of 5.0 A **into** the page. A second parallel wire, 0.040 m away, carries 3.0 A in the **same** direction. The flux density produced by the first wire at the position of the second is 2.5×10^{-5} T.

(a) **State** what is meant by a **magnetic field**. [2]

(b) In the space below, **draw** four field lines to represent the magnetic field around the first wire, and **mark** the direction of the field. [3]

(c) **Calculate** the magnetic force per unit length exerted on the second wire. [2]

(d) **State**, with a reason, the direction of that force. [2]

(e) The flux density produced by the **second** wire at the position of the first is 1.5×10^{-5} T. **Determine** the force per unit length on the first wire, and **explain** your reasoning. [3]