Poles of a magnet

4.7.1.1 · Magnetism and electromagnetism · revision notes

The poles of a magnet are the places where its magnetic forces are strongest. You need to describe how like and unlike poles affect each other, and the difference between a permanent magnet and an induced magnet. Expect 1 to 3 mark recall, 'describe' and 'explain' questions, often about magnets, nails or paper clips.

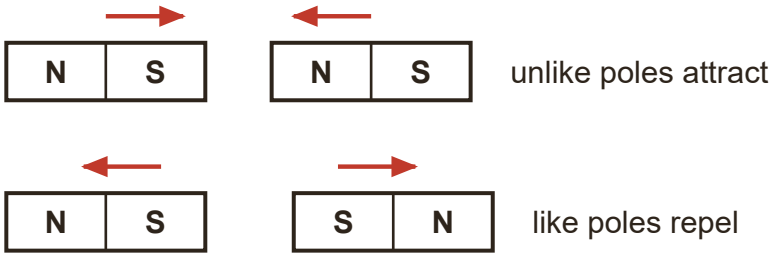
Key facts

- Poles: north (seeking) and south (seeking); forces are strongest at the poles
- Magnetic attraction and repulsion are non-contact forces
- Induced magnet: becomes a magnet only when placed in a magnetic field
- An induced magnet loses most or all of its magnetism quickly when removed from the field
- Only repulsion proves an object is a permanent magnet
- Like poles repel; unlike poles attract
- Permanent magnet: produces its own magnetic field
- Induced magnetism always causes attraction
- Magnetic materials: iron, steel, cobalt and nickel

Notes

Poles and forces

- Every magnet has two poles: a **north (seeking) pole** and a **south (seeking) pole**.
- The magnetic forces are **strongest at the poles**.
- When two magnets are brought close together, they exert a force on each other.
- **Like poles repel** (N and N, or S and S). **Unlike poles attract** (N and S).

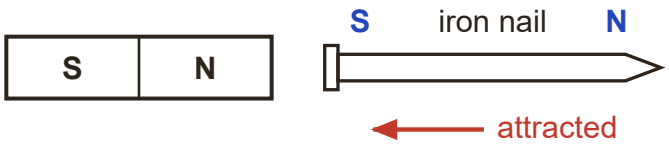


The red arrows show the forces on each magnet.

- The magnets do not have to touch, so magnetic attraction and repulsion are **non-contact forces**.
- The forces get weaker as the magnets are moved further apart.

Permanent and induced magnets

- A **permanent magnet** produces its own magnetic field all the time, e.g. a steel bar magnet.
- An **induced magnet** is a material that becomes a magnet when it is placed in a magnetic field, e.g. an iron nail held near a bar magnet.
- Induced magnetism **always causes a force of attraction**.
- This is because the end of the material nearest the magnet becomes the **opposite** pole: a nail near a north pole gets a south pole at its near end. Grade 6+ only



The near end of the nail becomes the opposite pole, so induced magnetism always attracts.

Grade 6+ only

- When it is taken out of the magnetic field, an induced magnet loses most or all of its magnetism quickly.
- Iron loses its induced magnetism quickly, which is why it is used for the core of an electromagnet that must switch off. Steel keeps its magnetism, so it is used for permanent magnets.

Testing for a magnet

- A magnetic material (iron, steel, cobalt or nickel) is attracted to **either** pole of a magnet, because the magnet induces magnetism in it.
- A non-magnetic metal, such as aluminium or copper, is not attracted to either pole.
- So attraction does not prove that an object is a magnet.
- Only **repulsion** proves it: bring each end of the object up to one pole of a known magnet. If one end is repelled, the object is a permanent magnet.

How to answer each type of question

State whether two magnets attract or repel 1 to 2 marks **Grade 3**

1. Find which two poles are facing each other.
2. Like poles repel; unlike poles attract.
3. If one object is only a magnetic material (not a magnet), the answer is always attract.

Example. Two bar magnets, A and B, lie end to end on a table. The north pole of magnet A faces the south pole of magnet B.
(a) State whether the magnets attract or repel each other.
(b) Magnet B is turned round, so that its north pole faces magnet A. State whether the magnets now attract or repel.

Model answer.

(a) Attract (1)
(b) Repel (1)

Describe the difference between a permanent and an induced magnet 2 to 4 marks **Grade 5**

1. Say what a permanent magnet does: it produces its own magnetic field.
2. Say what an induced magnet is: a material that only becomes a magnet when it is in a magnetic field.
3. If asked what happens when the magnet is taken away, say the induced magnet loses (most of) its magnetism quickly.

Example. A bar magnet picks up an iron nail. A second iron nail hangs from the bottom of the first nail.
(a) The first nail is an induced magnet. Describe the difference between a permanent magnet and an induced magnet. [2 marks]
(b) The bar magnet is carefully pulled away from the top of the first nail. Suggest what happens to the second nail. Give a reason for your answer. [2 marks]

Model answer.

(a) A permanent magnet produces its own magnetic field (1). An induced magnet only becomes a magnet when it is placed in a magnetic field (1).
(b) The second nail falls off (1) because the first nail loses (most of) its magnetism quickly when it is no longer in the magnetic field (1).

Explain how to show whether an object is a permanent magnet 2 to 3 marks **Grade 5**

1. Explain why attraction is not enough: a magnetic material is attracted to either pole.
2. Describe the test: bring each end of the object up to the same pole of a known magnet.
3. Give the conclusion: repulsion means it is a permanent magnet.

Example. A student has a metal rod. She says: 'The rod is attracted to the north pole of my bar magnet, so the rod must be a magnet.'
Explain why she could be wrong, and describe a test that would show whether the rod is a permanent magnet. [3 marks]

Model answer. The rod could be a magnetic material, which is attracted to either pole because magnetism is induced in it (1). Bring each end of the rod in turn up to the north pole of the bar magnet (1). If one end is repelled, the rod is a permanent magnet (1).

Don’t lose marks

- Saying an induced magnet can repel a magnet: induced magnetism always causes attraction.
- Saying all metals are magnetic: copper, aluminium, gold and silver are not. Only iron, steel, cobalt and nickel are.
- Saying the forces are strongest in the middle of a magnet: they are strongest at the poles.
- Using attraction as proof that an object is a magnet.
- Calling the poles 'positive' and 'negative': magnetic poles are north and south.

More tips

Memory tricks

- Unlike poles attract, like poles repel: the same rule as for positive and negative electric charges.
- 'Attraction can fool you, repulsion proves it': only repulsion shows an object is a magnet.
- ICoNS: Iron, Cobalt, Nickel, Steel are the magnetic materials.
- 'Induced' means 'in a field': an induced magnet is only a magnet while it is in a magnetic field.

Exam technique

- Use the words 'attract' and 'repel'. Vague words such as 'react' or 'affect each other' do not get the mark.
- In 'describe the difference' questions, write about both types of magnet, not just one.
- If a question says an object becomes magnetised only while it is near a magnet, it is describing an induced magnet.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3 **State where a magnet's forces are strongest**
The magnetic forces are strongest at the poles: the north (seeking) pole and the south (seeking) pole.

Grade 3

Predict attraction or repulsion between two poles

Like poles (N and N, or S and S) repel; unlike poles (N and S) attract.

Grade 4

Identify magnetic forces as non-contact forces

Magnets attract or repel each other without touching, so these are non-contact forces.

Grade 5

Describe the difference between permanent and induced magnets

A permanent magnet produces its own magnetic field; an induced magnet only becomes a magnet when it is placed in a magnetic field.

Grade 5

Explain how to test for a magnet

Only repulsion proves an object is a permanent magnet, because a magnetic material is attracted to both poles.

Grade 6

Explain why induced magnetism always attracts

The end of the material nearest the magnet becomes the opposite pole to the magnet's pole, so there is always attraction.

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