CAMBRIDGE IGCSE™ PHYSICS 0625 | TOPICS 4.1 · 4.5

FREE SAMPLE

Magnetism & Electromagnetism

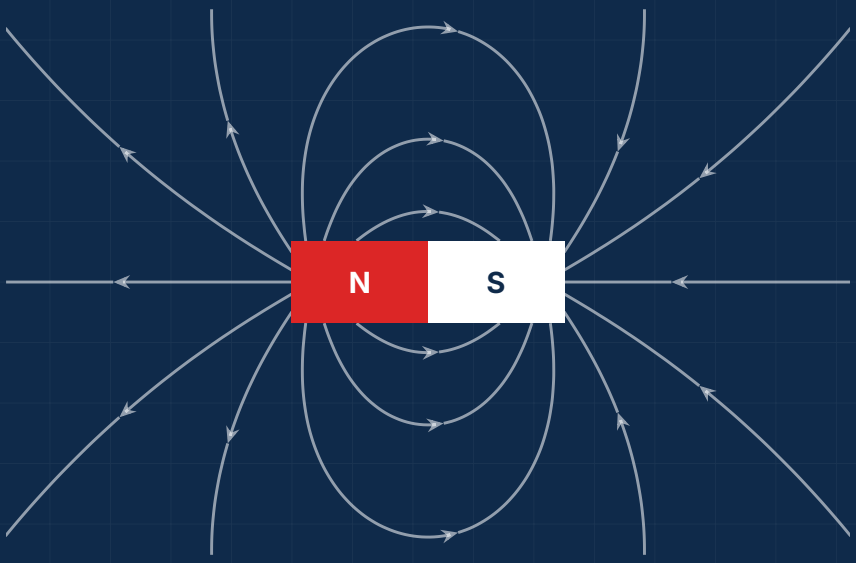
Free sample: knowledge organiser and Worksheet 1 with answers

Magnets | Electromagnets | Motor effect | Induction | Transformers

Exam-style questions

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

$$I_p V_p = I_s V_s$$



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Free sample

Full pack: worksheets, exam paper, answers

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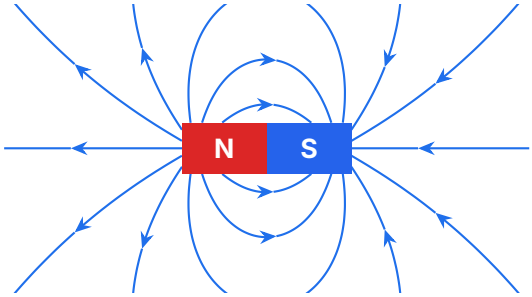
Knowledge organiser

ON ONE PAGE

Magnets and fields

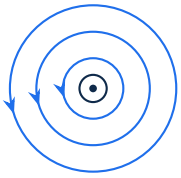
Like poles **repel**; unlike poles **attract**. A magnet attracts **magnetic materials** (iron, steel, nickel, cobalt) by **induced magnetism**.
Soft iron: temporary magnet. **Steel:** permanent magnet.
Field: region where a magnetic pole feels a force. Its direction is the force on a **N pole**. Plot it with a compass or iron filings.
SUPPLEMENT Closer lines = stronger field. Forces come from interacting fields.

Field of a bar magnet

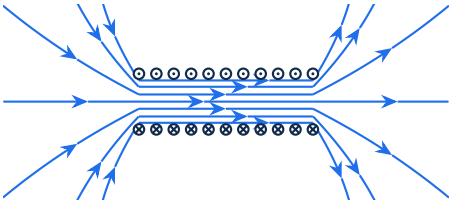


Outside the magnet: from **N to S**. Lines never cross.

Magnetic effect of a current



current out of page: field anticlockwise



solenoid: like a bar magnet, N end on the right

Right-hand grip rule: thumb along the current, fingers curl the way the field goes.
Electromagnet: coil on a soft-iron core; stronger with more current or more turns. Used in relays, loudspeakers, cranes.
SUPPLEMENT Weaker further from a wire; strong and uniform inside a solenoid. More current: stronger field. Reverse the current: field reverses.

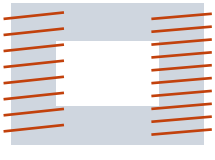
Motor effect and d.c. motor

A current in a magnetic field feels a **force**. Reverse the current **or** the field: the force reverses.
A coil in a field turns. Bigger turning effect: **more turns**, **more current**, **stronger field**.
SUPPLEMENT **Left-hand rule:** **F**irst finger **F**ield, se**C**ond **C**urrent, thu**M**b **M**otion. For electrons, current is opposite to their motion.
SUPPLEMENT The **split-ring commutator** reverses the coil current every half turn, so the coil keeps turning one way.

Electromagnetic induction

An **e.m.f. is induced** when a conductor **cuts** field lines or the field through a coil **changes**. Bigger e.m.f.: **faster** movement, **stronger** magnet, **more turns**.
SUPPLEMENT The induced e.m.f. **opposes the change** causing it. **Right-hand rule** gives the current direction.
SUPPLEMENT **a.c. generator:** coil, **slip rings**, brushes. e.m.f. is largest when the coil plane is **parallel** to the field, zero when **perpendicular**.

Transformers and transmission



Two coils on a **soft-iron core**; works only with **a.c.**

$\frac{V_p}{V_s} = \frac{N_p}{N_s}$ step-up: $N_s > N_p$

SUPPLEMENT 100 % efficient: $I_p V_p = I_s V_s$

High-voltage transmission: small current in the cables, so less energy is wasted as heat and thinner, cheaper cables can be used.
SUPPLEMENT Power lost in a cable: $P = I^2R$

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Magnets and magnetic fields

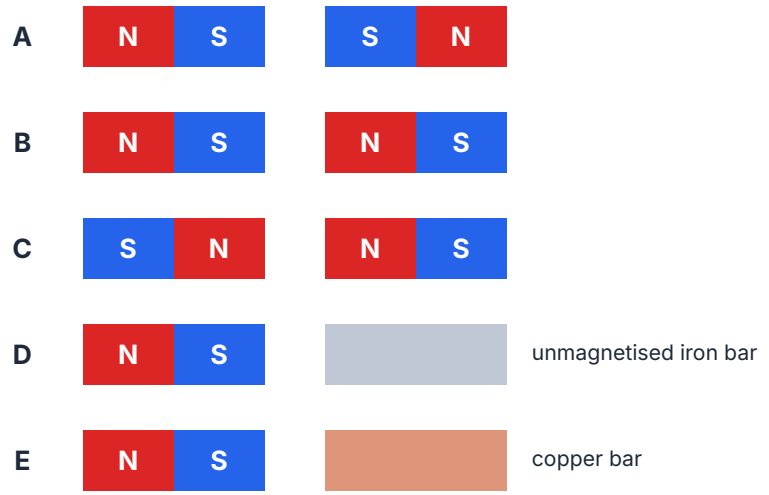
WORKSHEET 1

CORE SUPPLEMENT

You will: describe the forces between magnets and magnetic materials, compare temporary and permanent magnets, draw the field pattern of a bar magnet and describe how to plot it, and (Extended) explain what the spacing of field lines shows.

CORE all students SUPPLEMENT Extended (Supplement) students CHALLENGE stretch question

1 CORE Each diagram shows two objects placed close together. For each pair, state whether they **attract**, **repel** or have **no force** between them. [5]



A _____ B _____ C _____

D _____ E _____

2 CORE Here is a list of materials.

aluminium cobalt copper iron nickel plastic steel wood

(a) Write down all the **magnetic** materials in the list. [2]

.....

(b) State the difference between a magnetic material and a non-magnetic material. [1]

.....

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3 CORE A student hangs an iron nail from the N pole of a magnet. A second nail then hangs from the bottom of the first nail.



(a) Explain why nail 2 is attracted to nail 1, even though nail 1 is not a permanent magnet. [2]

.....

.....

(b) State which pole is at the top of nail 1. [1]

pole = _____

(c) The nails are made of soft iron. The student pulls nail 1 away from the magnet. Describe and explain what happens to nail 2. [2]

.....

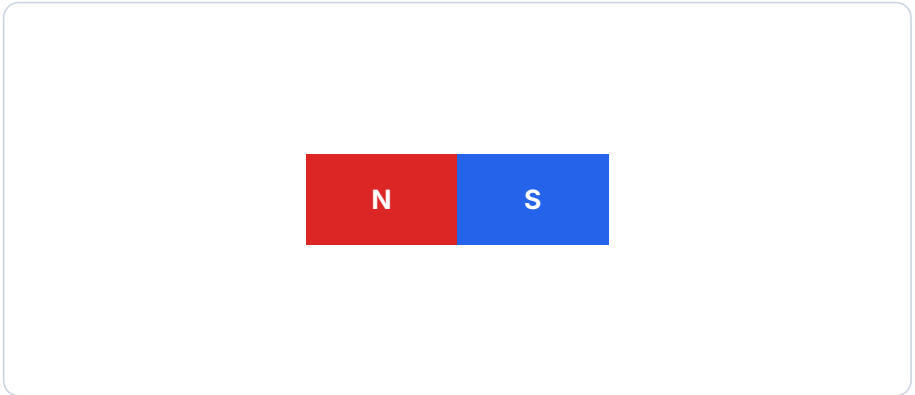
.....

(d) The experiment is repeated with steel pins instead of iron nails. State how the result of (c) is different. [1]

.....

4 CORE A magnetic field is a region in which a magnetic pole experiences a force.

(a) On the diagram, draw at least **six** field lines to show the pattern of the magnetic field around the bar magnet. Add arrows to show the direction of the field. [3]

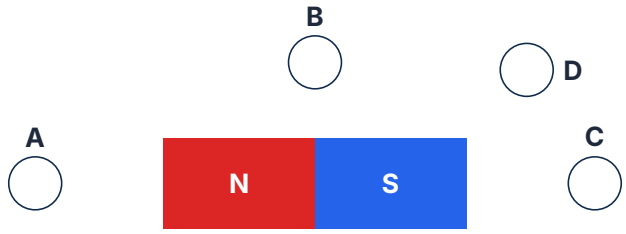


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(b) State how the direction of a magnetic field at a point is defined. [1]

.....

5 CORE A small plotting compass is placed at each of the points A, B, C and D near a bar magnet.



(a) On the diagram, draw an arrow inside each compass to show the direction in which the N pole of the compass needle points. [3]

(b) Describe how a student can use a plotting compass to plot the field lines around a bar magnet on a sheet of paper. [3]

.....

.....

.....

.....

(c) Name **one** other method of showing the pattern of a magnetic field. [1]

.....

6 CORE Magnets can be permanent magnets or electromagnets.

(a) Give **one** use of a permanent magnet. [1]

.....

(b) A crane in a scrapyard uses an electromagnet to lift old cars. Explain why an electromagnet is used rather than a permanent magnet. [2]

.....

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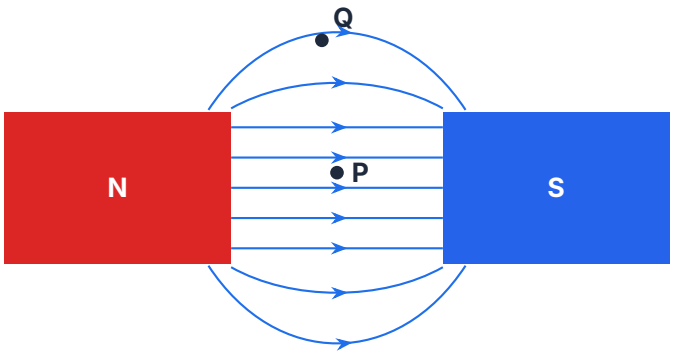
(c) State **one** difference between the material used for the core of an electromagnet and the material used for a permanent magnet. [1]

.....

Exam tip Field lines always point **away from N** and **towards S** outside a magnet, and they never cross. A compass needle lines up **along** the field line, with its N pole pointing in the field direction.

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7 SUPPLEMENT The diagram shows the magnetic field between the N pole of one magnet and the S pole of another magnet. P and Q are two points in the field.



(a) State whether the field is stronger at P or at Q. Explain how the diagram shows this. [2]

.....

.....

(b) The two magnets attract each other. State what causes the force between them, in terms of their magnetic fields. [1]

.....

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Answers: Worksheet 1

Mark codes: B1 independent mark C1 method mark, implied by a correct final answer A1 correct answer with unit. Accept answers that round correctly; allow error carried forward from earlier parts.

Worksheet 1 – Magnets and magnetic fields

1 A **repel** (S faces S) B1; B **attract** (S faces N) B1; C **repel** (N faces N) B1; D **attract** B1; E **no force** (copper is not magnetic) B1

2 **(a)** cobalt, iron, nickel, steel: all four B2; two or three with no wrong ones B1
(b) A magnetic material is attracted by a magnet (and can be magnetised); a non-magnetic material is not. B1

3 **(a)** Nail 1 is magnetised by the magnet (induced magnetism) B1; it then induces magnetism in nail 2, so it attracts nail 2. B1
(b) **S pole** (unlike poles attract) B1
(c) Nail 2 falls off B1; soft iron is a temporary magnet: it loses its induced magnetism when the magnet is removed. B1
(d) The steel pins stay magnetised, so the second pin stays attached. B1

4 **(a)** Lines leave the N pole and curve round to the S pole, symmetrical about the magnet B1; arrows from N to S outside the magnet B1; lines do not cross or touch and are closest together near the poles B1
(b) It is the direction of the force on a N pole placed at that point. B1

5 **(a)** A: to the left (away from N); B: to the right (parallel to the magnet, towards the S end); C: to the left (towards S); D: down and to the left, towards the S pole. All four B3; three B2; two B1
(b) Place the compass near the N pole and mark the position of the N end of the needle with a dot B1; move the compass so that the S end of the needle is over the dot, and mark a new dot B1; repeat, join the dots with a smooth line and add an arrow; start again from other points to draw more lines. B1
(c) Iron filings sprinkled on paper over the magnet (then tap the paper). B1

6 **(a)** Any one: fridge door seal, compass needle, loudspeaker, electric motor, magnetic catch or name badge. B1
(b) The electromagnet can be switched off to drop the car B1; it can be made very strong (and its strength can be changed by changing the current). B1
(c) The core is soft iron (a temporary magnet); a permanent magnet is made of steel (it keeps its magnetism). B1

7 **(a)** **P** B1; the field lines are closer together at P. B1
(b) The magnetic fields of the two magnets interact (combine). B1

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Get the full pack

You have just used Worksheet 1. The full Magnetism & Electromagnetism pack contains:

- **Worksheet 1:** Magnets and magnetic fields
- **Worksheet 2:** Magnetic effect of a current
- **Worksheet 3:** The motor effect and the d.c. motor
- **Worksheet 4:** Induction and the a.c. generator
- **Worksheet 5:** Transformers and transmission
- **Multiple-choice practice:** 10 Paper 1/2-style questions
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