Week 19

IGCSE Physics

Homework bundle for this week

本周作业合集

exercises.lol

Contents 目录

4. Electricity and magnetism

Starter Quiz · 课前小测

IGCSE Physics Name: _____ Score: _____

1. Two north poles are brought close together. They:

   ☐ repel (push apart)

   ☐ attract (pull together)

   ☐ do nothing

   ☐ swap to become south poles

2. Two negative charges attract each other.

   ☐ True ☐ False

3. A charge of 30 C flows past a point in 10 s. What is the current, in A?

   _____ A

4. A component has 12 V across it and a current of 3.0 A through it. What is its resistance, in Ω?

   _____ Ω

5. What happens to the resistance of a thermistor as it gets hotter?

   ☐ it falls

   ☐ it rises

   ☐ it stays the same

   ☐ it becomes infinite

6. Select **all** of these that are electrical hazards.

   ☐ damaged insulation (bare wires)

   ☐ overloading a socket

   ☐ damp conditions

   ☐ switching a lamp off

   Tick every correct option.

7. The magnetic field of a solenoid (a long coil carrying current) looks like the field of:

   ☐ a bar magnet

   ☐ a single point charge

   ☐ no field at all

   ☐ a flat sheet

8. How can you induce a current in a coil with a magnet?

   ☐ move the magnet in or out of the coil

   ☐ hold the magnet still inside the coil

   ☐ warm the magnet up

   ☐ paint the coil

9. A transformer works with a steady direct current (d.c.).

   ☐ True ☐ False

10. Which of these is a magnetic material (attracted by a magnet)?

    ☐ iron

    ☐ copper

    ☐ plastic

    ☐ wood

IGCSE Physics

1. **repel (push apart)**

   Like poles repel. Only different poles (N and S) attract.

2. **False**

   Like charges repel; only different charges (+ and −) attract.

3. **3 A**

   $I = \dfrac{Q}{t} = \dfrac{30}{10} = 3.0$ A.

4. **4 Ω**

   $R = \dfrac{V}{I} = \dfrac{12}{3.0} = 4.0\ \Omega$.

5. **it falls**

   A thermistor's resistance falls as temperature rises — useful in temperature-sensing circuits.

6. **damaged insulation (bare wires); overloading a socket; damp conditions**

   Bare wires, overloading and damp all raise the risk of shock or fire. Switching a lamp off is normal, safe use.

7. **a bar magnet**

   A solenoid produces a bar-magnet-like field, with a north pole at one end and a south at the other.

8. **move the magnet in or out of the coil**

   A current is induced only when the field through the coil is changing — for example by moving the magnet.

9. **False**

   A transformer needs a changing magnetic field, so it works on a.c. only. A steady d.c. makes no change and induces nothing.

10. **iron**

    Iron (also steel, cobalt, nickel) is magnetic. Copper, plastic and wood are not.

IGCSE PHYSICS • EXERCISE SHEET

4.1 Simple phenomena of magnetism

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

KEY WORDS magnet 磁体 • magnetic field 磁场 • magnetic material 磁性材料 • permanent magnet 永磁体 • magnetism 磁学

Objective

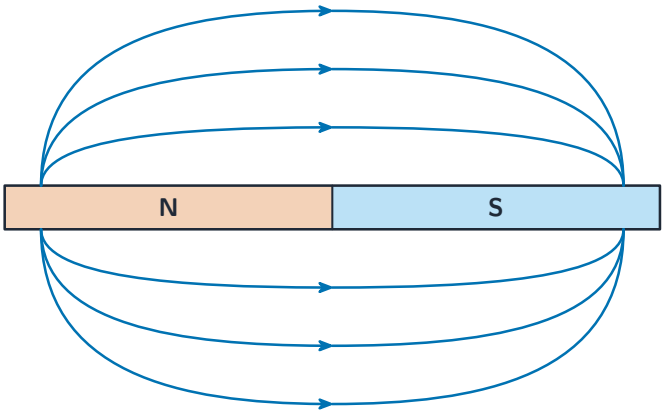
Build the skills to answer exam questions on **magnetism** 磁学 — poles and forces, **induced magnetism** 感应磁性, soft iron vs steel, and **magnetic fields** 磁场.

You must be able to:

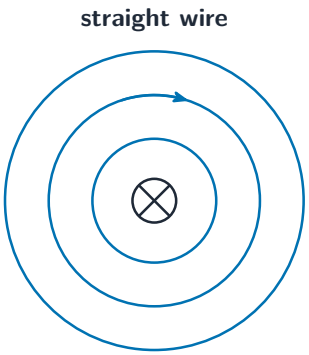
- use the rule of poles (like repel, unlike attract)
- compare soft iron (temporary) and steel (permanent) magnets
- draw and describe magnetic field lines

1 Worked examples

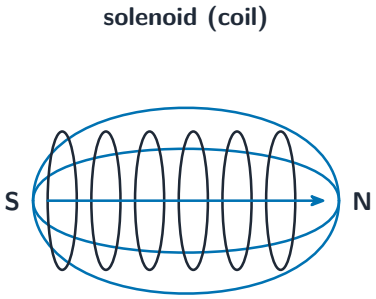
Fields and materials



Field lines come out of the N pole and into the S pole; closer lines = stronger field



current into page;
field is circles round it



field like a bar magnet

Soft iron magnetises easily but loses it (temporary); steel keeps its magnetism (permanent)

- **like poles repel; unlike poles attract.**
- magnetic materials: iron, steel, cobalt, nickel.

2 Practice

2.1 State what happens when the N pole of one magnet is brought near the N pole of another. [1]

2.2 State which is better for a permanent magnet: soft iron or steel. [1]

3 Exam-style questions

3.1 Magnetic field lines around a bar magnet point: [1]

- **A** from S to N outside the magnet
- **B** from N to S outside the magnet
- **C** into both poles
- **D** out of both poles

3.2 A piece of soft iron is placed next to a magnet.

(a) Explain why the iron becomes magnetised. [2]

(b) State why soft iron, not steel, is used for the core of an electromagnet. [2]

3.3 Describe how you could show the magnetic field pattern of a bar magnet using iron filings. [2]

Solutions

2.1 they repel (push apart).

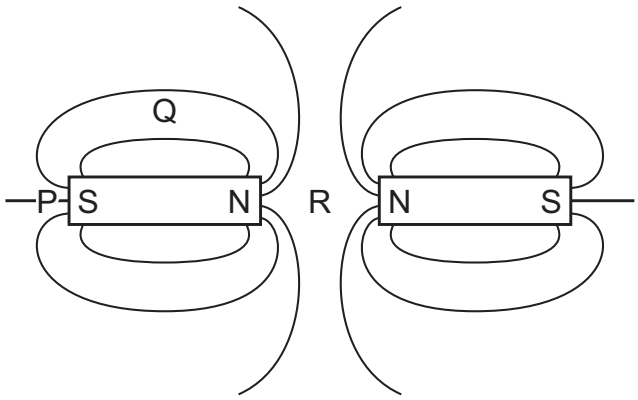
2.2 steel.

3.1 B. Field lines run from N to S outside the magnet.

3.2 (a) the magnet's field induces magnetism in the iron; the near end gains the opposite pole, so the two attract.
(b) soft iron magnetises and demagnetises easily; so the electromagnet can be switched on and off (loses its magnetism when the current stops).

3.3 place paper over the magnet and sprinkle iron filings on top; tap gently — the filings line up along the field lines, showing the pattern.

24 The diagram shows part of the magnetic field around two magnets.



Which list gives the order of magnetic field strengths at the positions P, Q and R, from weakest to strongest?

A P → Q → R

B P → R → Q

C Q → P → R

D R → Q → P

24 Which statements about magnets are correct?

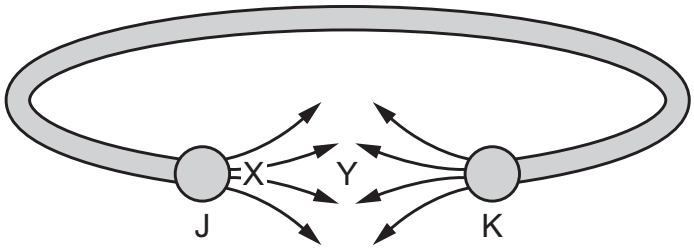
1 Permanent magnets are made of steel.

2 Electromagnets are temporary magnets.

3 A magnet can be used to induce magnetism in an iron bar.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

24 The diagram shows a bracelet containing two magnets. The arrows represent the pattern and the direction of the magnetic field due to the magnets.



Which row identifies the magnetic pole at J, the magnetic pole at K and where the magnetic field is the strongest?

	magnetic pole at J	magnetic pole at K	where the magnetic field is the strongest
A	N	N	X
B	N	N	Y
C	S	S	X
D	S	S	Y

6 Fig. 6.1 shows a person using a magnetic window cleaner. The part on the outside of the window is attracted to the inside part through the glass window.

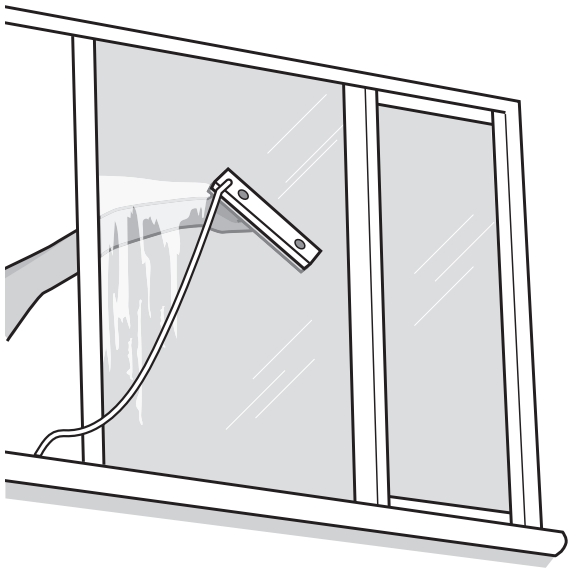


Fig. 6.1

Each part of the window cleaner contains two magnets. Fig. 6.2 shows the magnetic field between the parts of the window cleaner.

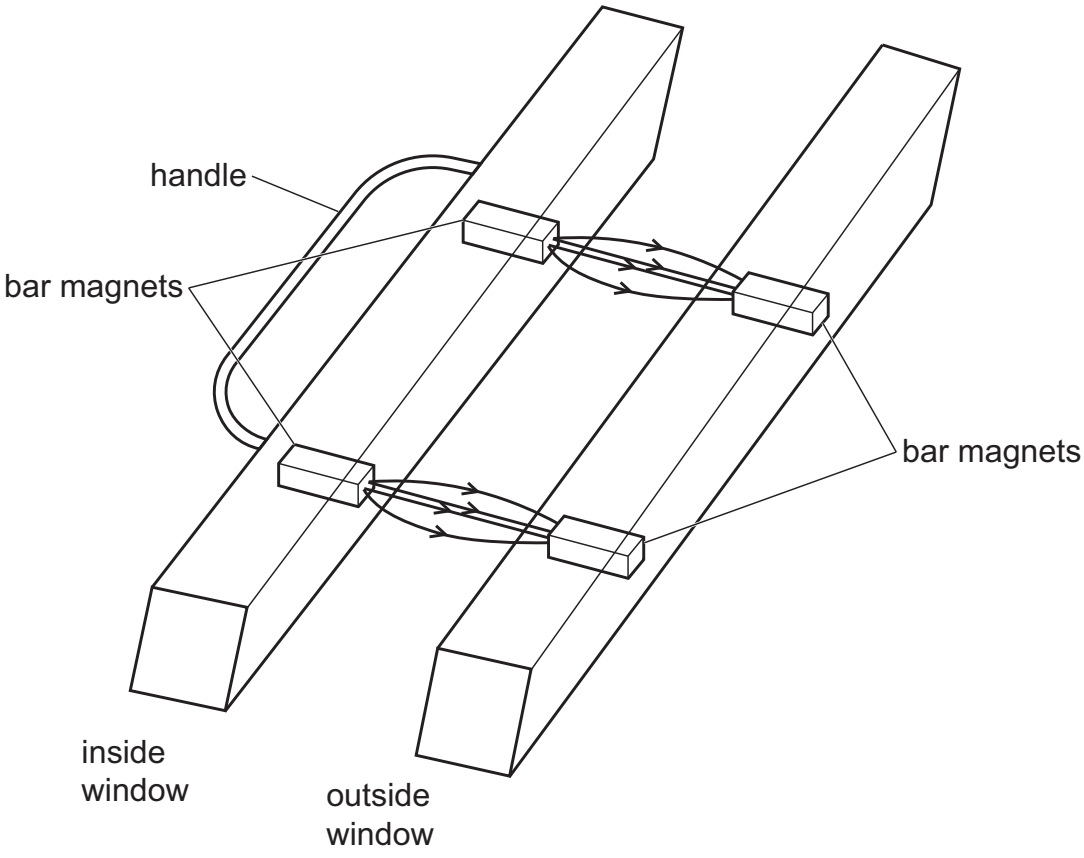


Fig. 6.2

(a) Glass is **not** a magnetic material.

State the difference between magnetic and non-magnetic materials.

.....

..... [1]

(b) Suggest a suitable material for the magnets in the window cleaner. Explain your answer.

.....

..... [1]

(c) Label the poles of the magnets in Fig. 6.2. [1]

(d) State how the field lines in Fig. 6.2 show different strengths of the magnetic field between the magnets.

.....

..... [1]

[Total: 4]

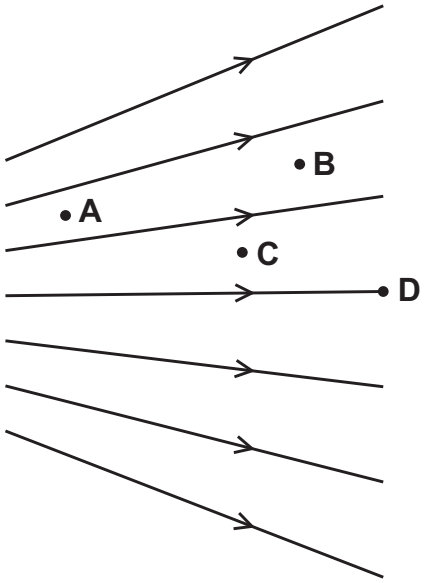
IGCSE Physics: **s24 21**

24 Which row describes suitable materials for use in a temporary magnet and in a permanent magnet?

	temporary magnet	permanent magnet
A	soft iron	soft iron
B	soft iron	steel
C	steel	soft iron
D	steel	steel

25 A magnetic field is represented in the diagram by magnetic field lines.

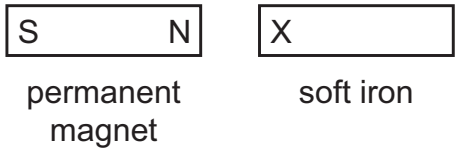
At which point is the magnetic field strongest?



24 Which metal could be used for a permanent magnet and which metal could be used for the core of an electromagnet?

	permanent magnet	core of electromagnet
A	iron	copper
B	iron	steel
C	steel	copper
D	steel	iron

23 An unmagnetised piece of soft iron is placed close to a strong permanent magnet, as shown.



What is the induced polarity of end X of the soft iron and in which direction does the magnetic force act on the soft iron?

	polarity of end X	direction of force on the soft iron
A	N	to the left
B	N	to the right
C	S	to the left
D	S	to the right

IGCSE PHYSICS • EXERCISE SHEET

4.2 Electrical quantities

Name: _____ Class: _____ Date: _____ **Total: 11 marks**

KEY WORDS current 电流 • resistance 电阻 • volt 伏特 • electrical power 电功率 • electrical quantities 电学量

Objective

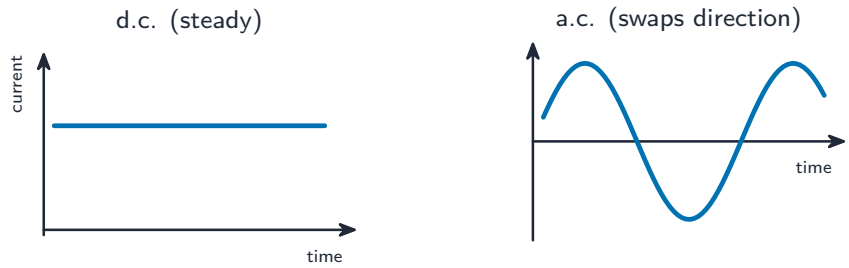
Build the skills to answer exam questions on **electrical quantities** 电学量 — **current** 电流 ($I = \frac{Q}{t}$), **e.m.f./p.d.** 电动势/电势差, **resistance** 电阻 ($R = \frac{V}{I}$), and **electrical power** 电功率 ($P = IV$).

You must be able to:

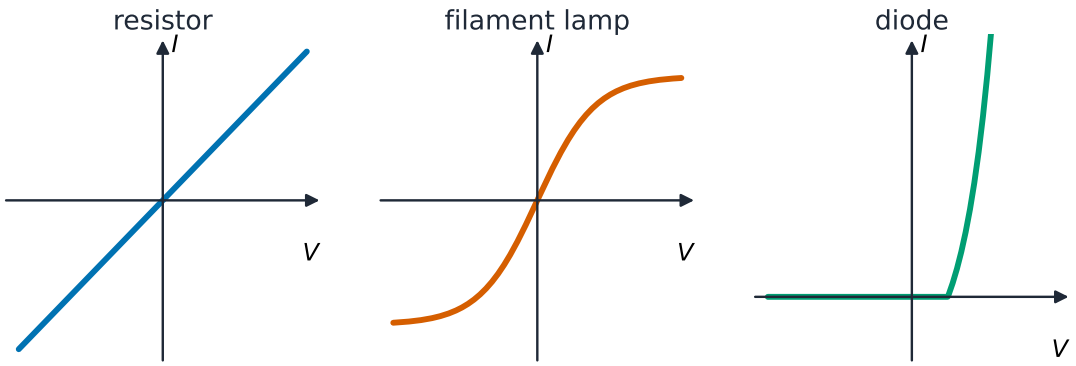
- use $I = \frac{Q}{t}$ and $Q = It$
- use $R = \frac{V}{I}$ and $P = IV$, $E = IVt$
- interpret current–voltage graphs

1 Worked examples

■ Charge, resistance, power



d.c. flows one way; a.c. keeps reversing — current $I = \frac{Q}{t}$ *either way*



resistor (ohmic): $V = IR$ straight · filament: resistance rises with heat · diode: one-way

Current-voltage graphs define resistance

3.0 **A for** 20 **s:** $Q = It = 3.0 \times 20 = 60$ C.

12 **V drives** 0.50 **A:** $R = \dfrac{V}{I} = \dfrac{12}{0.50} = 24\ \Omega$; $P = IV = 0.50 \times 12 = 6.0$ W.

2 Practice

2.1 A current of 2.0 A flows for 15 s. Find the charge that passes. [2]

2.2 State the equation linking power, current and voltage. [1]

3 Exam-style questions

3.1 The resistance of a component carrying 0.40 A at 6.0 V is: [1]

- **A** 2.4 Ω
- **B** 15 Ω
- **C** 0.067 Ω
- **D** 24 Ω

3.2 A lamp is rated 240 V, 60 W.

(a) Find the current through it. [2]

(b) Find the energy it transfers in 5.0 minutes. [3]

3.3 A cell does 36 J of work driving 9.0 C of charge round a circuit. Find its e.m.f. [2]

Solutions

2.1 $Q = It = 2.0 \times 15 = 30$ C.

2.2 $P = IV$.

3.1 B. $R = \dfrac{V}{I} = \dfrac{6.0}{0.40} = 15\ \Omega$.

3.2 (a) $I = \dfrac{P}{V} = \dfrac{60}{240} = 0.25$ A.
(b) $t = 5.0 \times 60 = 300$ s; $E = Pt = 60 \times 300 = 18\,000$ J.

3.3 $E = \dfrac{W}{Q} = \dfrac{36}{9.0} = 4.0$ V.

IGCSE PHYSICS • EXERCISE SHEET

4.3 Electric circuits

Name: _____ Class: _____ Date: _____ **Total: 12 marks**

KEY WORDS series and parallel 串联与并联 • electric circuits 电路 • potential divider 分压器 • parallel 并联 • series 串联

Objective

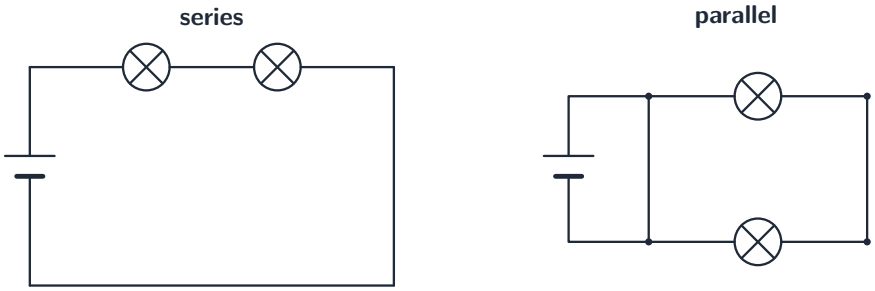
Build the skills to answer exam questions on **electric circuits** 电路 — **series and parallel** 串联与并联 rules, combining resistors, and **potential dividers** 分压器.

You must be able to:

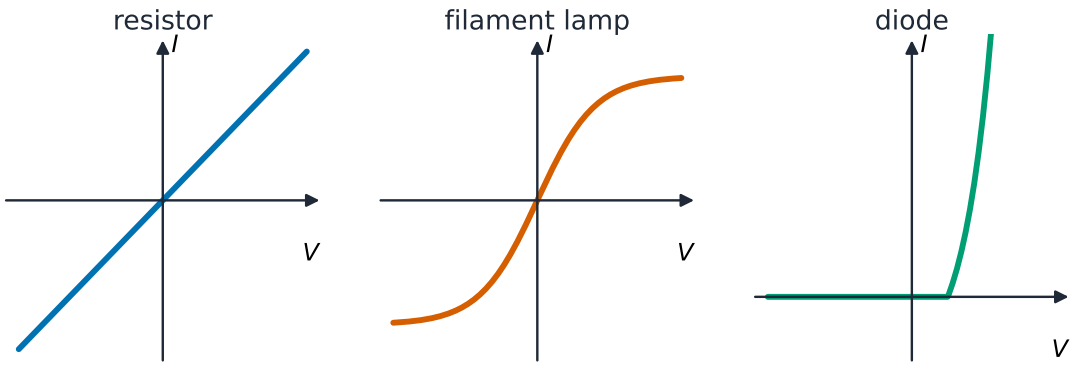
- use the current/p.d. rules for series and parallel circuits
- add series resistors and combine two parallel resistors
- use the potential-divider idea ($\frac{R_1}{R_2} = \frac{V_1}{V_2}$)

1 Worked examples

■ Combining resistors



Series: same current, shared p.d., $R_{total} = R_1 + R_2$. Parallel: same p.d., split current, smaller total R



resistor (ohmic): $V = IR$ straight · filament: resistance rises with heat · diode: one-way

A resistor gives a straight I–V line; a filament lamp curves as it heats

6 Ω and 3 Ω in parallel: $\frac{1}{R} = \frac{1}{6} + \frac{1}{3} = \frac{1}{2} \Rightarrow R = 2\ \Omega$.

2 Practice

2.1 Two resistors of 4 Ω and 6 Ω are in series. Find the total resistance. [1]

2.2 State how the current behaves at every point in a series circuit. [1]

3 Exam-style questions

3.1 Compared with the smallest single resistor, two resistors in parallel give a total resistance that is: [1]

- **A** larger
- **B** smaller
- **C** the same
- **D** zero

3.2 A 12 V supply is connected to a 4 Ω and an 8 Ω resistor in series.

(a) Find the total resistance and the current. [3]

(b) Find the p.d. across the 8 Ω resistor. [2]

3.3 A 6 Ω and a 12 Ω resistor are connected in parallel across a 6 V supply. Find the total resistance and the total current from the supply. [4]

Solutions

2.1 $R = 4 + 6 = 10\ \Omega$.

2.2 the current is the same at every point.

3.1 B. Two resistors in parallel give a total smaller than the smaller one.

3.2 (a) $R = 4 + 8 = 12\ \Omega$; $I = \dfrac{V}{R} = \dfrac{12}{12} = 1.0$ A.
(b) $V = IR = 1.0 \times 8 = 8.0$ V.

3.3 $\dfrac{1}{R} = \dfrac{1}{6} + \dfrac{1}{12} = \dfrac{3}{12} = \dfrac{1}{4} \Rightarrow R = 4\ \Omega$; $I = \dfrac{V}{R} = \dfrac{6}{4} = 1.5$ A.

IGCSE PHYSICS • EXERCISE SHEET

4.4 Electrical safety

Name: _____ Class: _____ Date: _____ **Total: 11 marks**

KEY WORDS earthing 接地 • live wire 火线 • earth wire 地线 • fuses 保险丝 • neutral wire 零线

Objective

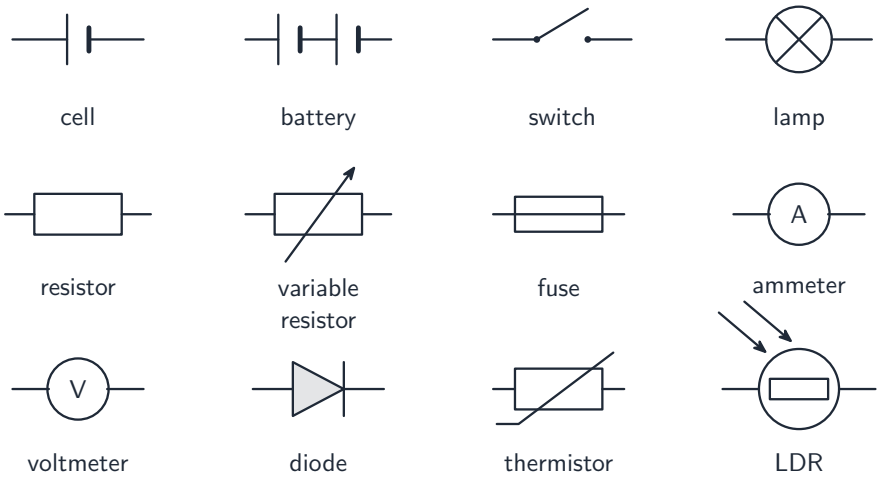
Build the skills to answer exam questions on **electrical safety** 电气安全 — mains **hazards** 危险, the live/neutral/earth wires, and **fuses** 保险丝 and **earthing** 接地.

You must be able to:

- state mains hazards (damaged insulation, overheating, damp, overloading)
- name the three mains wires and the role of each
- explain how a fuse and earthing protect the user

1 Worked examples

■ Fuses and earthing



A fuse is a thin wire that melts and breaks the circuit if the current is too large

- **wires:** live (high voltage), neutral (≈0 V), earth (safety wire to ground).
- the switch and fuse go in the **live** wire.
- **earthing:** if a live wire touches a metal case, a large current flows to earth and blows the fuse.
- choose a fuse rating just **above** the normal working current.

2 Practice

2.1 Name the three wires in a mains cable. [2]

2.2 State one hazard of using mains electricity in damp conditions. [1]

3 Exam-style questions

3.1 A fuse should be fitted in the: [1]

- **A** earth wire
- **B** neutral wire
- **C** live wire
- **D** casing

3.2 An appliance normally draws a current of 8 A. Fuses are available rated 3 A, 5 A, 10 A and 13 A.

(a) State which fuse should be used, and why. [2]

(b) Explain how the fuse protects the cable. [2]

3.3 Explain how earthing a metal-cased appliance keeps the user safe if a fault makes the case live. [3]

Solutions

2.1 live, neutral and earth.

2.2 water lets current pass into a person, increasing the risk of an electric shock.

3.1 C. The fuse (and switch) must be in the live wire.

3.2 (a) the 10 A fuse; it is just above the normal working current of 8 A, so it carries normal current but blows on a fault.
(b) if the current gets too large, the thin fuse wire melts and breaks the circuit before the cable overheats.

3.3 if a live wire touches the metal case, the earth wire provides a low-resistance path to the ground; a large current flows to earth; this blows the fuse, cutting off the supply so the case cannot give a shock.

IGCSE PHYSICS • EXERCISE SHEET

4.5 Electromagnetic effects

Name: _____ Class: _____ Date: _____ **Total: 11 marks**

KEY WORDS step-up 升压 • a.c. generator 交流发电机 • electromagnetic induction 电磁感应 • step-down 降压 • electromagnetic effects 电磁效应

Objective

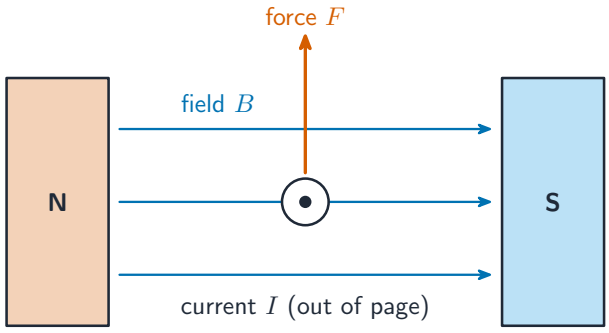
Build the skills to answer exam questions on **electromagnetic effects** 电磁效应 — the **motor effect** 电动机效应, **electromagnetic induction** 电磁感应, the a.c. generator, and **transformers** 变压器.

You must be able to:

- describe the force on a current-carrying wire (and how to reverse it)
- describe electromagnetic induction and the a.c. generator
- use $\frac{V_p}{V_s} = \frac{N_p}{N_s}$ for a transformer

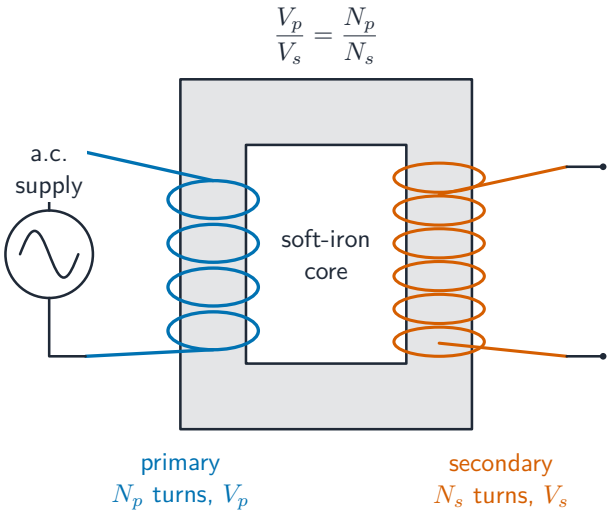
1 Worked examples

■ Motor effect & transformer



F, B and I are all at 90° (Fleming's left-hand rule)

A current-carrying wire in a magnetic field feels a force; reverse the current or field to reverse the force



$$\frac{V_p}{V_s} = \frac{N_p}{N_s} \quad \text{— } \textit{the voltage ratio equals the turns ratio}$$

$N_p = 1200$, $N_s = 100$, $V_p = 240$ **V:** $V_s = 240 \times \dfrac{100}{1200} = 20$ V (step-down).

2 Practice

2.1 State two ways to increase the force on a current-carrying wire in a magnetic field. [2]

2.2 State what a step-up transformer does to the voltage. [1]

3 Exam-style questions

3.1 Reversing the current in a wire in a magnetic field: [1]

- **A** removes the force
- **B** reverses the force
- **C** doubles the force
- **D** has no effect

3.2 A transformer has 200 turns on the primary and 1000 turns on the secondary. The primary voltage is 12 V.

(a) Find the secondary voltage. [3]

(b) State whether this is a step-up or step-down transformer. [1]

3.3 Describe how an e.m.f. is induced when a magnet is moved into a coil, and state two ways to make the induced e.m.f. larger. [3]

Solutions

2.1 increase the current; use a stronger magnetic field.

2.2 it increases (steps up) the voltage.

3.1 B. Reversing the current reverses the direction of the force.

3.2 (a) $\frac{V_p}{V_s} = \frac{N_p}{N_s}$: $\frac{12}{V_s} = \frac{200}{1000}$; $V_s = 12 \times 5$; $= 60$ V.
(b) step-up (more turns on the secondary).

3.3 moving the magnet changes the magnetic field through the coil, which induces an e.m.f.; make it larger by moving the magnet faster; use a stronger magnet or more turns on the coil.