Electricity and magnetism

OxfordAQA International GCSE Physics 9203, topic 3.5: circuits, V-I characteristics, series and parallel, magnetism

Charge on the move

> Current is charge flowing; p.d. drives it; resistance opposes it; every current makes a field.

- OxfordAQA International GCSE Physics 9203, topic 3.5.
- (P) statements are Paper-2-only.

Current, charge and energy

1. **Time** $t = 2.0\ \text{min} = 120\ \text{s}$
2. **Charge** $Q = It = 0.50 \times 120 = 60\ \text{C}$
3. **Energy** $E = VQ = 9.0 \times 60 = 540\ \text{J}$

Decision

60 C of charge carries 540 J from the battery.

Circuit symbols

Draw circuits with the standard symbols.

- Also: switch, fuse, battery, variable resistor, LDR, LED.
- Ammeter in series; voltmeter across the component.

Ohmic or not

A resistor at constant temperature gives a straight line; a lamp curves.

- $V = IR$ at every point on the graph.
- Lamp: hotter filament, more resistance.

A diode: one way

> A diode conducts in the forward direction only.

- An LED is a diode that emits light.
- LEDs waste less energy than filament lamps.

(P) Thermistors and LDRs

Hotter thermistor, lower resistance; brighter LDR, lower resistance.

- Thermistor: thermostats.
- LDR: resistance falls in bright light (automatic lights).

Series: one loop

> The bigger resistor takes the bigger share of the p.d.

- Same current everywhere in the loop.
- The p.d.s add up to the battery p.d.

Parallel: branches

> Adding a branch lowers the total resistance.

- Every branch has the full p.d.
- Branch currents add; combined R is less than either.

Same resistors, two ways

Two 4 Ω resistors on 12 V: 1.5 A in series, 6 A in parallel.

- Series: $R = 4 + 4 = 8\ \Omega$.
- Parallel: $R = 2\ \Omega$, half of one.

Magnetic fields

> Field lines run from N to S outside a magnet.

- Like poles repel; unlike poles attract.
- Magnetic forces are non-contact forces.

A uniform field

> Between opposite poles the field is uniform.

- A plotting compass points along the field.
- The Earth's field lets a compass navigate.

Current makes a field

Coil the wire and add an iron core: an **electromagnet**.

- Stronger current, stronger field; reverse it, reverse the field.
- An electromagnet can be switched off.

A stronger electromagnet

> More turns, more current, an iron core.

- Required practical: count paper clips lifted.
- Uses: scrapyard cranes, relays, door locks.

Permanent or induced?

Permanent magnet	Induced magnet
its own field	magnetic only in a field
attracts and repels	always attracts

Common mistakes

Mistake	**Fix**
minutes in $Q = It$	use seconds
adding resistors in parallel	combined R is less than either
voltmeter in series	voltmeter across; ammeter in series
(P) hot thermistor: R rises	R falls

Check yourself

Question	**Answer**
Charge: 2 A for 30 s?	60 C
R for 12 V and 0.5 A?	24 Ω
(P) Thermistor heated?	R falls
Two ways to strengthen an **electromagnet**?	more turns; more current