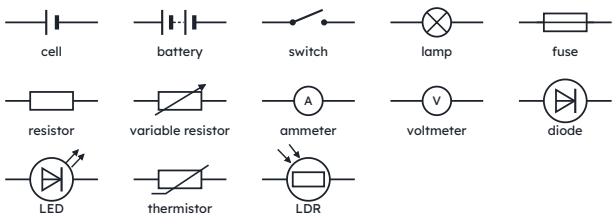
4.2 Electricity

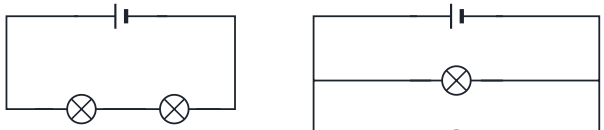
CIRCUIT SYMBOLS



CURRENT, P.D. AND RESISTANCE

- **Current** is the rate of flow of electrical charge. In a single closed loop the current is the same at every point.
- A current needs a closed circuit and a source of potential difference.
- The greater the **resistance**, the smaller the current for a given p.d.
- **Ohmic conductor:** current is directly proportional to p.d. at constant temperature.
- **Thermistor:** resistance decreases as temperature increases. **LDR:** resistance decreases as light intensity increases.
- Ammeter in **series**; voltmeter in **parallel**.

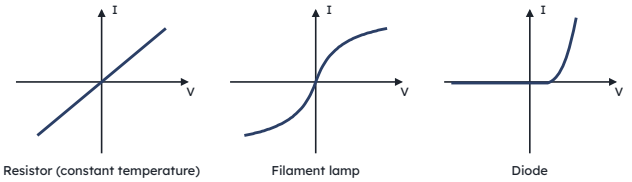
SERIES AND PARALLEL



Series: one loop
same current everywhere
p.d. shared; R total = $R_1 + R_2$

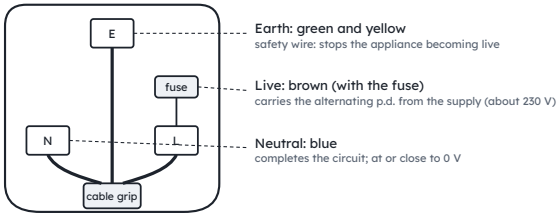
Parallel: separate branches
same p.d. across each branch; currents add
total R less than the smallest resistor

I–V CHARACTERISTICS



Filament lamp: resistance increases as temperature increases. Diode: current flows in one direction only; very high resistance in reverse.

MAINS ELECTRICITY



- UK mains: a.c., about 230 V, 50 Hz. Batteries give d.c.
- Touching the live wire: your body is at 0 V, so a large p.d. drives a current through you.

THE NATIONAL GRID



Step-up transformers increase the p.d. and reduce the current, so less energy is wasted heating the cables. Step-down transformers make it safe for homes.

STATIC ELECTRICITY (PO)

- Rubbing insulators transfers **electrons**: one gains negative charge, the other is left positive.
- Like charges repel; unlike charges attract.
- A charged object creates an **electric field**; field is strongest closest to the object. Sparks jump when the p.d. is high enough.

EXAM TIPS

- Series: current same, p.d. shared. Parallel: p.d. same, currents add.
- Brown = live, blue = neutral, green and yellow = earth.

MODEL EXPLANATIONS (GRADE 7+ ANSWERS)

Explain why the resistance of a filament lamp increases as the current increases.

As the current increases, the filament gets hotter. Its resistance increases as its temperature increases. The ions in the metal vibrate more, so the electrons collide with them more often and their flow is reduced.

Explain how an LDR can switch on a street lamp at night.

When it gets dark, the resistance of the LDR increases. So the p.d. across the LDR increases. In series, the p.d. is shared in proportion to resistance; the bigger p.d. across the LDR can be used to switch on the lamp circuit.

Explain why a person can get an electric shock from a faulty appliance.

The live wire is at 230 V and the person is at 0 V, so a large p.d. drives a current through the person. If the appliance is earthed, a large current flows down the earth wire instead, which melts the fuse and cuts off the live wire.

UNITS AND PREFIXES

giga (G)	$\times 10^9$
mega (M)	$\times 10^6$
kilo (k)	$\times 10^3$
centi (c)	$\times 10^{-2}$
milli (m)	$\times 10^{-3}$
micro (μ)	$\times 10^{-6}$
nano (n)	$\times 10^{-9}$

Convert to the base unit (m, kg, s, J, W) before you calculate.

4.2 Electricity

AQA GCSE Physics 8463
Paper 1 · Physics only content marked (PO)
All equations are on the Physics Equations Sheet

KEY EQUATIONS (ALL ON THE PHYSICS EQUATIONS SHEET)

Equation	Quantities (units)	Watch out
Q = I t	charge flow (C), current (A), time (s)	Time in seconds
V = I R	potential difference (V), current (A), resistance (Ω)	Rearrange: R = V ÷ I
P = V I	power (W), potential difference (V), current (A)	Mains p.d. ≈ 230 V
P = I² R	power (W), current (A), resistance (Ω)	Square the current first
E = P t	energy transferred (J), power (W), time (s)	kW → W, minutes → s
E = Q V	energy transferred (J), charge flow (C), potential difference (V)	p.d. = energy per unit charge

KEY WORDS

Current: the rate of flow of electrical charge. Same at every point in a single closed loop.
Potential difference: the energy transferred per unit charge passed (E = QV).
Resistance: the greater it is, the smaller the current for a given p.d.
Ohmic conductor: current is directly proportional to p.d. at constant temperature.
Thermistor: resistance decreases as temperature increases.
LDR: resistance decreases as light intensity increases.
Direct current (d.c.): flows in one direction only (cells and batteries).
Alternating current (a.c.): keeps changing direction; UK mains is 230 V, 50 Hz.

RP3: RESISTANCE

Aim: Investigate how wire length affects resistance, and how resistors combine in series and parallel.

Change	Length of wire
Measure	Resistance (from V and I)
Control	Material and thickness of wire, temperature, current

Must include:
- Draw and use a correct circuit diagram
- Test resistors in series and in parallel and compare total resistance
- Ammeter in series, voltmeter in parallel
- Calculate R = V ÷ I
- Range of at least five lengths

Common mistake: Connecting the voltmeter in series or the ammeter in parallel.

RP4: I–V CHARACTERISTICS

Aim: Plot I–V graphs for a filament lamp, a resistor at constant temperature and a diode.

Change	Potential difference
Measure	Current
Control	Component being tested, temperature (for the resistor)

Must include:
- Correct circuit with a variable resistor
- Record pairs of V and I readings
- Reverse the connections for negative values
- Plot I against V for each component
- Describe the shape of each graph and explain the lamp's curve

Common mistake: Plotting the axes the wrong way round (AQA uses current on the y-axis).

MISCONCEPTIONS

× **Current gets used up round a circuit.**	✓ Current is the same at every point in a series loop; energy is transferred, not charge.
× **Adding resistors in parallel increases resistance.**	✓ It decreases the total resistance: more paths for the charge.
× **The fuse is in the neutral wire.**	✓ The fuse is in the live wire, so a fault disconnects the dangerous supply.

AIM FOR GRADE 7+

- Two-step calculations: I = P ÷ V, then R = V ÷ I.
- Explain the filament lamp's I–V curve using temperature and resistance.
- Explain why the National Grid uses high p.d.: P = I²R, so a lower current wastes less power.

COMMAND WORDS

State	a short answer, no explanation
Describe	say what happens, in order
Explain	say what and why: use "because" and "so"
Calculate	equation, substitution, answer, unit
Evaluate	both sides, then a justified conclusion

QUICK-FIRE QUIZ: COVER THE ANSWERS

Unit of charge?	**Coulomb (C)**
Unit of resistance?	**Ohm (Ω)**
UK mains p.d. and frequency?	**230 V, 50 Hz**
Colour of the neutral wire?	**Blue**
Series: what's the same everywhere?	**Current**
Parallel: what's the same across each branch?	**p.d.**