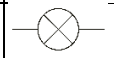
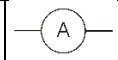
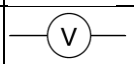
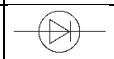
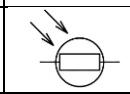
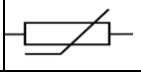
CP9 Electricity and Circuits

1 Circuit symbols

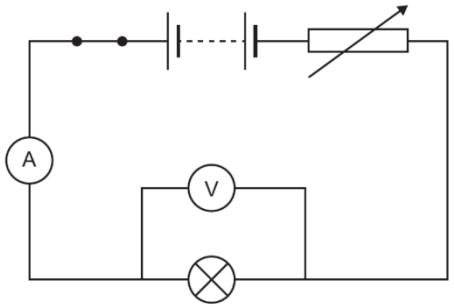
Switch	
Cell	
Battery	
Lamp	
Ammeter	
Voltmeter	
Resistor	
Variable resistor	
Diode	
LDR	
Thermistor	

2. Electrical circuits

Delocalised electrons	Electrons that are free to move between many different atoms, in a conductor.
Conductor	Material which conducts electricty
Series circuit	A circuit in which there is only one path for the current to follow.
Parallel circuit	A circuit with multiple paths for the current to follow.
Direct current	Current that flows in one direction.
Alternating current	Current that switches direction many times each second.

3. Current and Potential Difference

Ammeter	Used for measuring current. Connected in **series** to measure the current **passing through** a component or circuit.
Voltmeter	Used for measuring potential difference. Connected in **parallel** to measure the potential difference **across** a component or circuit.



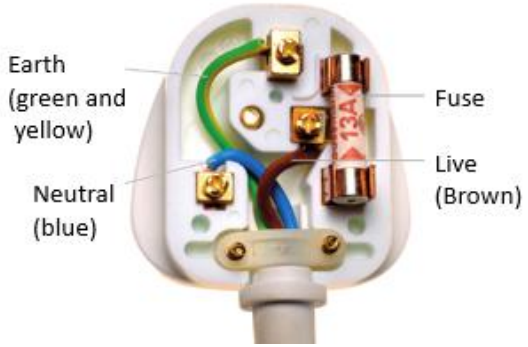
4 Mains electricity

Mains electricity	The electricity supplied from wall sockets. 230V, 50Hz, ac
National grid	The systems of power lines and sub-stations that distributes electricity from power stations to homes and businesses.
Live wire	Brown, bottom right, 230 V, connects the appliance to the power station.
Neutral wire	Blue, bottom left, 0 V, completes the circuit.
Earth wire	Green and yellow, top, 0 V. Connects the appliance to the ground so current can flow there in the event of a short circuit.
Fuse	A thin metal wire that melts and breaks the circuit if there is too much current.
Circuit breaker	Breaks the circuit if too much current flows.
Advantages of circuit breakers	Quicker than fuses, just need switching - not replacing.

Quantities and symbols

Charge	Q	Coulombs	C	
Current	I	Amps (amperes)	A	1 amp = 1 joule per second
Power	P	Watts	W	Rate of energy transfer. 1 watt = 1 joule per second
Potential difference	V	Volts	V	Energy transferred per coulomb I volt = 1 joule per coulomb
Resistance	R	Ohms	Ω	The difficulty with which current passes through a material
Energy	E	joules	J	

power = work done ÷ time taken	$P = \frac{E}{t}$
energy transferred = charge moved × potential difference	$E = Q \times V$
charge = current × time	$Q = I \times t$
potential difference = current × resistance	$V = I \times R$
power = energy transferred ÷ time taken	$P = \frac{E}{t}$
electrical power = current × potential difference	$P = I \times V$
electrical power = current squared × resistance	$P = I^2 \times R$

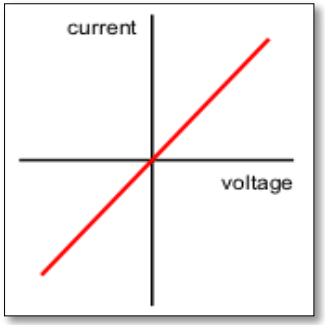


CP9 Electricity and Circuits: extra information

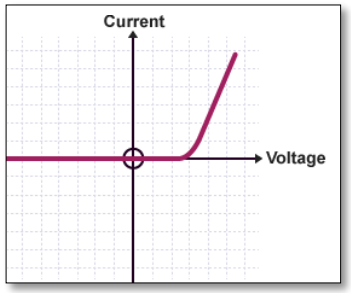
6. More about resistance	
LDR	Light-dependent resistor. High resistance in dark, low resistance in light.
Thermistor	High resistance when cold, low resistance when hot.
Diode	High resistance in one direction, low resistance in the other.
Filament lamp	High resistance causes the filament to heat up, producing light.

7. Current, resistance and potential difference	
Conventional current	The flow of charge from positive towards negative
Electron flow	Electrons flow from the negative terminal towards the positive terminal.
Resistors	Circuit components with differing resistance to control how much current flows to parts of a circuit.
Resistors in series	Total resistance is the sum of all of the resistors.
Voltage and resistors in series	Voltage is shared in proportion to the resistance. The resistor with more resistance takes more of the voltage. Calculate this using V=IR.
Resistors in parallel	Think about each branch of the circuit as a different series circuit. Resistors on different branches do not affect each other. The total resistance of resistors in parallel will always be **less** than resistors in series.

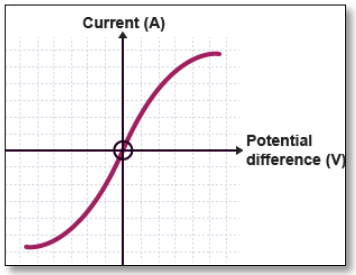
Resistor



Filament lamp



Diode



8. Core practical CP15 Investigating resistance	
CP15 - Aim	To explore how resistance changes in different circuits.
CP15 - Investigating resistance	Set up a circuit shown on page 1. Use the variable resistor to vary the voltage and record voltage and current. The circuit is shown testing a bulb, but this is replaced with other components to test them.
CP15 - Investigating series circuits	Set up a series circuit with an ammeter, two bulbs and voltmeters across each bulb and the power supply. Vary the voltage and record all readings
CP15 - Investigating parallel circuits	Set up a parallel circuit with two bulbs and ammeters on each branch and by the power supply, and voltmeters across each bulb and the powers supply. Vary voltage, record all readings.
Current in series circuits	The **same** at all points in the circuit.
Current in parallel circuits	**Less** on the branches than at the battery. Current on branches adds up to that at the battery.
Potential difference in series circuits	Potential difference is **shared** between the components on a circuit. It adds up to be the same as the battery.
Potential difference in parallel circuits	Potential difference is the **same** across each branch as it is across the battery.

9. Transferring energy	
Calculating energy transfer	Energy = current x potential difference x time E = I x V x t (do not need to recall this equation)
Resistance and energy transfer	Electrons flowing through wires collide with atoms and lose energy. This energy is transferred to heat.
Electrical energy dissipation	When electrical energy is transferred to the surroundings as wasted heat energy by resistance.
How to reduce resistance	Use thicker wires, use shorter wires, use lower-resistance metals, reduce the temperature.
Heaters	Transfer energy from electrical to thermal.
Motors	Transfer energy from electrical to kinetic.