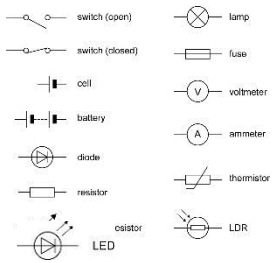
4.2.1.1	How to draw circuit symbols.	Circuit diagrams use standard symbols: 
4.2.1.2	Making an electric current flow.	For electrical charge to flow through a closed circuit the circuit must include a source of potential difference.
4.2.1.2	Electric currents are the flow of charge.	Electric current is a flow of electrical charge. The size of the electric current is the rate of flow of electrical charge. Charge flow, current and time are linked by the equation: $$charge\ flow = current\ x\ time$$ $$[\ Q\ =\ I\ t\ ]$$ charge flow, *Q*, in coulombs, C current, *I*, in ampere, A time, *t*, in seconds, s
4.2.1.2	The current around a series circuit.	The current at any point in a single closed loop of a circuit has the same value as the current at any other point in the same closed loop.
4.2.1.3	How the resistance of a component affects the current flowing through it.	The current through a component depends on both the resistance of the component and the potential difference across the component. The greater the resistance of the component the smaller the current for a given potential difference (p.d.) across the component.
4.2.1.3	How potential difference, current and resistance are linked.	Current, potential difference or resistance can be calculated using the equation: $$potential\ difference = current\ x\ resistance$$ $$[\ V\ =\ I\ R\ ]$$ potential difference, V, in volts, V

		current, I, in amperes, A resistance, R, in ohms, Ω
4.2.1.4	Ohm's law and the conditions needed for it to apply.	The current through an ohmic conductor (at a constant temperature) is directly proportional to the potential difference across the resistor. This means that the resistance remains constant as the current changes.
4.2.1.4	How the resistance of electrical components change with external conditions. Current-voltage graphs for electrical components.	The resistance of components such as lamps, diodes, thermistors and LDRs is not constant; it changes with the current through the component. The resistance of a filament lamp increases as the temperature of the filament increases. The current through a diode flows in one direction only. The diode has a very high resistance in the reverse direction. The resistance of a thermistor decreases as the temperature increases. The resistance of an LDR decreases as light intensity increases.
4.2.1.4	How to find the resistance of electrical components by experiment.	Explain the design and use of a circuit to measure the resistance of a component by measuring the current through, and potential difference across, the component. Students should set up and use a circuit to investigate a factor/ the factors that affect the resistance of an electrical component(s).
4.2.2	Series and parallel circuits.	There are two ways of joining electrical components, in series and in parallel. Some circuits include both series and parallel parts.
4.2.2	Properties of series circuits and adding resistors in series.	For components connected in series: • there is the same current through each component • the total potential difference of the power supply is shared between the components. • the total resistance of two components is the sum of the resistance of each component.

		$R_{total} = R_1 + R_2$ resistance, R, in ohms, Ω
4.2.2	Properties of parallel circuits including giving the upper limit of resistance when resistors are added in parallel.	For components connected in parallel: • the potential difference across each component is the same • the total current through the whole circuit is the sum of the currents through the separate components • the total resistance of two resistors is less than the resistance of the smallest individual resistor.
4.2.2	Resistance in series and in parallel circuits.	Students should be able to explain qualitatively why adding resistors in series increases the total resistance, while adding resistors in parallel decreases the total resistance.
4.2.3.1	Alternating and direct current.	Cells and batteries supply current that always passes in the same direction. This is called direct current (d.c.). An alternating current (a.c.) is one that changes direction. Mains electricity is an a.c. supply. In the UK it has a frequency of 50 Hz and is about 230 V.
4.2.3.2	The name, colour and function of each wire in a three core electrical cable.	Most electrical appliances are connected to the mains using three-core cable. The insulation covering each wire is colour coded for easy identification: live wire – brown neutral wire – blue earth wire – green and yellow stripes. The live wire carries the alternating potential difference from the supply. The neutral wire completes the circuit. The earth wire is a safety wire to stop the appliance becoming live. The potential difference between the live wire and earth (0 V) is about 230 V.The neutral wire is at or close to earth potential (0 V). The earth wire is at 0 V, it only carries a current if there is a fault.
4.2.3.2	Why an electric shock happens when we touch live wires.	Our bodies are at earth potential (0 V). Touching the live wire produces a large potential difference across our body. This causes a current to flow through our body, resulting in an electric shock. So the live wire may be dangerous even when a switch in the main circuit is open.
4.2.4.1	Electrical power and how it is calculated.	The power of a device is related to the potential difference across it and the current through it by the equation: $power =$

		$$potential\ difference\ x\ current$$ $$[P = V I]$$ $$power =$$ $$current\ squared\ x\ resistance$$ $$[P = I_2 R]$$ power, P, in watts, W potential difference, V, in volts, V current, I, in amperes, A resistance, R, in ohms, Ω
4.2.4.2	Changes of energy stores in electrical appliances.	Everyday electrical appliances are designed to bring about energy transfers. Describe how different domestic appliances transfer energy from batteries or a.c. mains to the kinetic energy of electric motors or the energy of heating devices. The amount of energy an appliance transfers depends on how long the appliance is switched on for and the power of the appliance.
4.2.4.2	Work done on a charge. Calculating the amount of electrical energy transferred.	Work is done when charge flows in a circuit. The amount of energy transferred by electrical work can be calculated using the equation: $$energy\ transferred =$$ $$power\ x\ time$$ $$[E = P t]$$ $$energy\ transferred =$$ $$charge\ flow\ x$$ $$potential\ difference$$ $$[E = Q V]$$ energy transferred, E, in joules, J power, P, in watts, W time, t, in seconds, s

		charge flow, Q, in coulombs, C potential difference, V, in volts, V
4.2.4.3	The National Grid.	The National Grid is a system of cables and transformers linking power stations to consumers. Electrical power is transferred from power stations to consumers using the National Grid. Step-up transformers are used to increase the potential difference from the power station to the transmission cables then step-down transformers are used to decrease, to a much lower value, the potential difference for domestic use. This is done because, for a given power, increasing the potential difference reduces the current, and hence reduces the energy losses due to heating in the transmission cables.