

P9: Electricity Knowledge Organiser

Lesson sequence

1. Electrical circuits
2. Current and potential difference
3. Current, charge and energy
4. Current, resistance and potential difference
5. Resistors
6. Controlling resistance
7. Core practical – investigating resistance (CP15)
8. Energy transfers
9. Electrical power
10. Using electricity
11. Electrical safety

1. Electrical circuits

**Delocalised electrons	Electrons that are free to move between many different atoms.
**Conventional current	The flow of positive charge from the positive terminal towards the negative terminal (goes in the opposite direction to electrons).
**Electron flow	Electrons flow from the negative terminal towards the positive terminal.
*Series circuit	A circuit in which there is only one path for the current to flow.
*Parallel circuit	A circuit with multiple paths for the current to flow.

2. Current and potential difference

*Amperes, A	The unit of measurement for current. Amps for short.
*Ammeter	Used for measuring current. Connected in series.
*Potential difference	Aka voltage. This is what pushes electrons around a circuit.
*Volts, V	The unit of measurement for potential difference.
*Voltmeter	Used for measuring potential difference. Connected in parallel.

**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	The same across each branch as it is across the battery.

3. Current, charge and energy

*Charge	The amount electricity that has flowed through a circuit.
*Coulombs, C	The unit of measurement for charge.
*Current	The number of coulombs of charge that flows past a point each second.
*Calculating charge	Charge = current x time $Q = I \times t$ Charge = coulombs Current = amps Time = seconds
8*The meaning of volts	The amount of energy transferred by each coulomb of charge. One volt = 1 joule per coulomb.
*Calculating energy	Energy = charge x potential difference $E = Q \times V$ Energy = joules Charge = coulombs Potential difference = volts

4. Current, resistance and potential difference

*Resistance	The difficulty with which current passes through materials.
*Ohms, Ω	The unit of measurement for resistance.
**High/low resistance	Higher resistance \rightarrow better insulator Lower resistance \rightarrow better conductor

*Calculating current	Current = potential diff / resistance $I = V / R$ Current = amps, A Potential diff = volts, V Resistance = ohms, Ω Note: This equation is normally written as $V = IR$.
**Changing current	Higher voltage \rightarrow higher current Higher resistance \rightarrow lower current

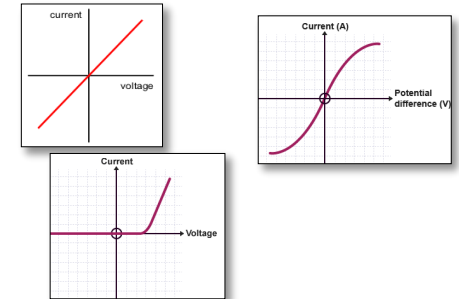
5. Resistors

**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 each of the resistors.
**Voltage and resistors in series	Voltage is shared in proportion to the resistance. The resistor with more resistances 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.
**Variable resistors	Resistors where you can change the resistance to adjust the current.

6. Controlling 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.
**Resistor graph	Current increases in direct proportion to voltage (straight line going through (0,0)).
**Filament lamp graph	Current increases as voltage increases, but levels out eventually.

**Diode graph	Graph slopes up with a positive voltage but stays at 0 with a negative voltage.
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7. Core practical – investigating resistance (CP15)

*CP15 - Aim	To explore how resistance changes in different circuits.
*CP15 - Investigating resistance	Set up a circuit with an ammeter, resistor and voltmeter across the resistor. Vary the voltage and record voltage and current.
*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 power supply. Vary voltage, record all readings.
*CP15 - Results	Resistor – doubling voltage doubles current Series circuit – voltage at bulbs half of that at power supply Parallel circuit – voltage at bulbs equal to power supply, current half that at power supply



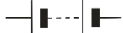







8. Energy transfer	
**Calculating energy transfer	Energy = current x potential difference x time $E = I \times V \times t$ Energy = joules Current = amps Potential difference = volts Time = seconds
**Resistance and energy transfer	Electrons flowing through wires collide with atoms and lose energy. This energy is transferred to heat.
**Electrical energy dissipation	When electrical energy is transferred to wasted heat energy by resistance.
**Reducing resistance	Use thicker wires, use shorter wires, use lower-resistance metals, reduce the temperature.


9. Electrical power	
Power	The rate of energy transfer.
*Watts, W	The unit of power: 1 W = 1 joule per second
*Power and work done	$P = \frac{E}{t}$ Where 'P' is power in W, 'E' is work done in J, 't' is time in s.
*Power, current and voltage	$P = I \times V$ Where 'P' is the power in W, 'I' is the current in A, V is the potential difference in V.
**Power, current and resistance	$P = I^2 \times R$ Where 'P' is the power in W, 'I' is the current in A, 'R' is the resistance in Ω .

10. Using electricity	
*Mains electricity	The electricity supplied from wall sockets.
*National grid	The systems of power lines and sub-stations that distributes electricity from power stations to homes and businesses.
*Heaters	Transfer energy from electrical to thermal.

*Motors	Transfer energy from electrical to kinetic.
**Direct current	Current that flows in one direction.
**Alternating current	Current that switches direction many times each second.
**Frequency of mains current	Mains current alternates (switches direction) 50 times each second. The frequency is 50 Hz.

11. Electrical safety	
*Live wire	Brown, 230 V, connects the appliance to the power station.
*Neutral wire	Blue, 0 V, completes the circuit.
*Earth wire	Green and yellow, 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 rather than replacing.

Circuit symbols	
*Switch	
*Cell	
**Battery	
*Lamp	
*Ammeter	
*Voltmeter	
*Resistor	
**Variable resistor	
**Diode	
**LDR	

**Thermistor	
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