**Electric Circuits**

1. Circuit diagrams use standard symbols for components:

|  |  |  |
| --- | --- | --- |
| **Circuit Symbol** | **Component Name** | **Function** |
| cell symbol | Cell | Push charges around the circuit. Supplies energy |
| battery symbol | Battery |
| lamp (indicator) symbol | Bulb/Lamp | Lights up |
| Diagram  Description automatically generated | Ammeter | Measures current |
| **Diagram  Description automatically generated** | Voltmeter | Measures potential difference |
| **SPST on-off switch symbol** | Open switch | Breaks the circuit |
| **Diagram  Description automatically generated** | Closed switch | Completes the circuit |
| **Shape, rectangle  Description automatically generated** | Fixed Resistor | Adds resistance to a circuit |
| **A picture containing clock  Description automatically generated** | Variable Resistor | Can be used to vary current |
| **Shape  Description automatically generated** | Diode | Allows current to flow in one direction only |
|  | Light-emitting diode (LED) | Gives out light when current flows through in one direction |
| **Chart  Description automatically generated with low confidence** | Thermistor | Resistance decreases with higher temperature |
| **Diagram  Description automatically generated** | Light-dependent resistor (LDR) | Resistance decreases with higher light intensity |

1. For electrical charge to flow through a **closed** circuit the circuit must include a source of **potential difference**.
2. Electric **current** is a **flow** of electrical **charge**.
3. The size of the electric current is the **rate** of flow of electrical charge.
4. Charge flow, current and time are linked by the equation:

$$Q= It$$

Charge flow, Q, in Coulombs, C; current, I, in amperes, A; time, t, in seconds, s.

**Series and Parallel Circuits**

1. A current has the same value at any point in a single closed loop.
2. Electrical components can be connected in series or in parallel.
3. When components are connected in **series**, the **current** is the **same** through each component.
4. When components are connected in series, the **potential difference** of the power supply is **shared** between components.
5. When components are connected in **parallel**, the **potential difference** across each branch is the **same**.
6. When components are connected in parallel, the total **current** through the whole circuit is the **sum** of the currents through the separate branches.
7. The **current** through a component depends on the **resistance** of the component and the **potential difference** across the component.
8. The **greater** the **resistance** of the component the **smaller** the **current** for a given potential difference across the component.
9. Current, potential difference or resistance can be calculated using the equation:

$$V = IR$$

Potential difference, V, in Volts, V; current, I, in amperes, A; resistance, R, in Ohms, Ω.

1. **Voltmeters** must be connected in **parallel** and **ammeters** must be connected in **series**.
2. When components are connected in **series**, the **total resistance** of two components is the **sum** of the resistance of each component:

$$Rtotal = R1 + R2$$

1. When components are connected in **parallel**, the **total resistance** of two resistors is **less than** the resistance of the **smallest individual resistor**.
2. Adding resistors in series increases the total resistance because the current decreases but adding resistors in parallel decreases the total resistance because the current increases as there is another branch.

**Resistance of Components**

1. For some resistors (fixed resistors), the value of **R remains** **constant** but that in others it can change as the current changes.
2. 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.
3. The resistance of components such as lamps, diodes, thermistors and LDRs is **not** **constant**; it changes with the current through the component.
4. The **resistance** of a **filament lamp** **increases** as the **temperature** of the filament increases.
5. The **current** through a **diode** flows in **one** **direction** only. The diode has a very high resistance in the reverse direction.
6. The **resistance** of a **thermistor** **decreases** as the **temperature increases**.
7. There are a number of applications of thermistors in circuits e.g. a thermostat
8. The **resistance** of an **LDR decreases** as **light intensity increases**.

**Electrical Power**

1. Power is the **rate** at which **energy** is **transferred** or **work** is **done**.
2. When **charge flows** through a **circuit**, **work** is **done**.
3. The **power transfer** in any circuit device is related to the **potential difference** across it and the **current** through it, and to the energy changes over time.

$$P = VI$$

Power, P, in watts, W; potential difference, V, in volts, V; current, I, in amperes, A.

$$P = I^{2}R$$

Power, P, in watts, W; current, I, in amperes, A; resistance, R, in ohms, Ω

**Mains Electricity and the National Grid**

1. **Direct current** (d.c.) travels in **one** **direction** only.​
2. **Cells** and **batteries** supply **direct** current.
3. **Alternating** **current** (a.c.) continually **reverses direction**.
4. **Mains** electricity supplies **alternating** **current**.
5. Mains A.C. has a potential difference of **230 V** and a frequency of **50 Hz.**
6. The **National Grid** is a system of **cables**, **pylons** and **transformers** linking power stations to consumers.
7. Electrical power is transferred from power stations to consumers using the National Grid.
8. **Step-up transformers** are used to **increase** the **potential difference** from the power station to the transmission cables to increase the **efficiency** of transfer
9. **Step-down transformers** are used to **decrease**, to a much lower value, the **potential difference** for domestic use, so it is safe for consumers
10. **Power** is **conserved** in transformers.
11. **(HT)** $V\_{1}I\_{1}= V\_{2}I\_{2}$