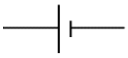
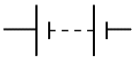
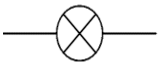
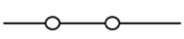
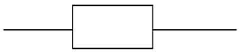
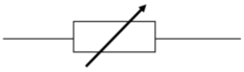
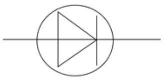
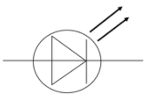
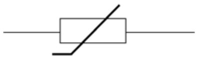
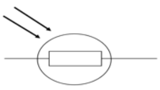
Electric Circuits

1. Circuit diagrams use standard symbols for components:

Circuit Symbol	Component Name	Function
	Cell	Push charges around the circuit. Supplies energy
	Battery	
	Bulb/Lamp	Lights up
	Ammeter	Measures current
	Voltmeter	Measures potential difference
	Open switch	Breaks the circuit
	Closed switch	Completes the circuit
	Fixed Resistor	Adds resistance to a circuit
	Variable Resistor	Can be used to vary current
	Diode	Allows current to flow in one direction only
	Light-emitting diode (LED)	Gives out light when current flows through in one direction
	Thermistor	Resistance decreases with higher temperature
	Light-dependent resistor (LDR)	Resistance decreases with higher light intensity

2. For electrical charge to flow through a **closed** circuit the circuit must include a source of **potential difference**.
3. Electric **current** is a **flow** of electrical **charge**.
4. The size of the electric current is the **rate** of flow of electrical charge.
5. 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

6. A current has the same value at any point in a single closed loop.
7. Electrical components can be connected in series or in parallel.
8. When components are connected in **series**, the **current** is the **same** through each component.
9. When components are connected in series, the **potential difference** of the power supply is **shared** between components.
10. When components are connected in **parallel**, the **potential difference** across each branch is the **same**.
11. When components are connected in parallel, the total **current** through the whole circuit is the **sum** of the currents through the separate branches.
12. The **current** through a component depends on the **resistance** of the component and the **potential difference** across the component.
13. The **greater** the **resistance** of the component the **smaller** the **current** for a given potential difference across the component.
14. 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.

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

$$Rtotal = R1 + R2$$

17. When components are connected in **parallel**, the **total resistance** of two resistors is **less than** the resistance of the **smallest individual resistor**.
18. 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

19. For some resistors (fixed resistors), the value of **R remains constant** but that in others it can change as the current changes.
20. 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.
21. The resistance of components such as lamps, diodes, thermistors and LDRs is **not constant**; it changes with the current through the component.
22. The **resistance** of a **filament lamp increases** as the **temperature** of the filament increases.
23. The **current** through a **diode** flows in **one direction** only. The diode has a very high resistance in the reverse direction.
24. The **resistance** of a **thermistor decreases** as the **temperature increases**.
25. There are a number of applications of thermistors in circuits e.g. a thermostat
26. The **resistance** of an **LDR decreases** as **light intensity increases**.

Electrical Power

27. Power is the **rate** at which **energy** is **transferred** or **work** is **done**.
28. When **charge flows** through a **circuit**, **work** is **done**.
29. 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.

$$P = I^2R$$

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

Mains Electricity and the National Grid

30. **Direct current** (d.c.) travels in **one direction** only.
31. **Cells** and **batteries** supply **direct** current.
32. **Alternating current** (a.c.) continually **reverses direction**.
33. **Mains** electricity supplies **alternating current**.
34. Mains A.C. has a potential difference of **230 V** and a frequency of **50 Hz.**
35. The **National Grid** is a system of **cables**, **pylons** and **transformers** linking power stations to consumers.
36. Electrical power is transferred from power stations to consumers using the National Grid.
37. **Step-up transformers** are used to **increase** the **potential difference** from the power station to the transmission cables to increase the **efficiency** of transfer
38. **Step-down transformers** are used to **decrease**, to a much lower value, the **potential difference** for domestic use, so it is safe for consumers
39. **Power** is **conserved** in transformers.
40. **(HT)** $V_1I_1 = V_2I_2$