Topic 19 Current of electricity

Summary

- Electric current is the rate of flow of charge: $I = Q/t$
- Conventional current is a flow of positive charge from positive to negative. In metals, current is carried by electrons, which travel from negative to positive.
- Charge on charge carriers is quantised.
- The coulomb in the unit of charge and is an ampere second.
- Charge can be calculated using $Q = It$
- For a current-carrying conductor $I = nAvq$
- Potential difference (or voltage) measures the electrical energy transferred by each coulomb of charge: $V = W/Q$
- Resistance R of a resistor is defined as: $R = V/I$
- Electrical power $P = VI = I^2R = V^2/R$
- Ohm's law: for a conductor at constant temperature, the current in the conductor is proportional to the potential difference across it.
- The resistance of a metallic conductor increases with increasing temperature; the resistance of a semiconductor decreases with increasing temperature.
- A diode has a low resistance when connected in forward bias, and a very high resistance in reverse bias.
- Resistivity ρ of a material is the resistance between opposite faces of a unit cube of the material: $R = \rho l/A$.

Definitions and formulae

- Charge = current × time
- The coulomb is the charge passing a point in a circuit when there is a current of one ampere for one second.
- Coulomb = ampere × second
- $I = Anvq$ where n is the number density of the charge carriers (number per unit volume).
- Potential difference = energy transformed from electrical to other forms (e.g. heat) per unit charge.
- $V = W/Q$
- One volt is the potential difference between points when one joule of energy is transferred by one coulomb passing from one point to the other.
- Volt = joule/coulomb
- Power $P = VI$ and $P = I^2R$
- Resistance = potential difference/current
- Ohm = volt/amp
- $V = IR$
- Ohm's law states that for certain conductors the current flowing through the conductor is proportional to the potential difference across the conductor provided the temperature remains constant.
- $R = \rho l/A$