

Definitions and Concepts for CAIE Physics IGCSE

Topic 4: Electricity and Magnetism

*Definitions in **bold** are for extended students only*

4.1 Simple Phenomena of Magnetism

Bar magnet: A rectangular piece of an object that shows permanent magnetic properties.

Direct current: Current flow consisting of charges flowing in a single direction only. Batteries and cells provide direct current.

Electromagnet: A temporary induced magnet with a soft iron core coiled in wire with a direct current running through it, to create a magnetic field. The magnetism of an electromagnet can be switched on and off, and the strength changed, through varying the current.

Induced magnetism: Process of inducing magnetic qualities in a material.

Magnet: A magnet is a material or object that produces a magnetic field.

Magnetic field: The region around a magnet in which another magnet or magnetic material will experience a force.

Magnetic field lines: Lines that show the strength and direction of a magnetic field. The lines point from North to South and their concentration represents the magnitude of the field

Magnetic materials: Materials which are attracted by a magnet. (Iron, steel, cobalt and nickel)

Non-magnetic materials: Materials which are not attracted by a magnet.

Permanent magnet: A magnet that produces its own magnetic field.

Temporary (induced) magnet: A material that becomes a magnet when it is placed in an existing magnetic field, but loses its magnetism quickly once it is removed. Induced magnetism always produces attractive forces.

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4.2 Electrical Quantities

4.2.1 Electric Charge

Conductor: A material that allows electrical charge to flow easily. Metals are particularly good conductors due to the free electrons in their structures.

Conducting plate: A flat plate of conductive material.

Conducting sphere: A spherical shell with an electric charge distributed on its surface uniformly.

Coulomb: The unit of charge.

Electric charge: The physical property of matter that causes it to experience a force when placed in an electromagnetic field. There are two types of electric charges: positive and negative.

Electric field: A region in which a charge will experience a non-contact, electric force.

Electrostatic charge: The electric charge at rest on the surface of an insulated body.

Insulator: A material that doesn't allow electrical charge to flow.

Like charges: Two charges of the same polarity (which repel).

Point charge: A charge concentrated at a single point in space.

Unlike charges: Two charges of opposite polarities (which attract).

4.2.2 Electric current

Alternating current: A current in which electrons flow in one direction, from the negative terminal to the positive terminal.

Ammeter: A device connected in series with a component to measure the current that flows through it.

Analogue device: A measuring device that requires the user to read from a scale to obtain the measurement.

Conventional current: Defined as moving in the same direction as the positive charge flow (from positive to negative).

Digital device: A measuring device that displays the measurement on a display, rather than requiring the user to read from a scale.



Direct current: A current in which electrons change direction of flow regularly.

Electric current: The charge passing a point in the circuit per unit time.

4.2.3 Electromotive force and potential difference

Circuit component: Any device in an electric circuit that transfers electrical energy into another form.

Electromotive force: The electrical work done by a power source in moving a unit charge around a complete circuit. Measured in Volts.

Potential difference: The work done by a unit charge passing through a component.

Volt: The unit of both potential difference and electromotive force (voltage).

Voltmeter: A device that is connected in parallel with a component to measure the potential difference (voltage) across it.

Work done: Work done is equal to the energy transferred in an event or process.

4.2.4 Resistance

Cross-sectional area: The area of a 2D cross-section of a 3D shape.

Diode: a circuit component that only allows current to flow in one direction so is used to make logic gates.

Filament lamp: A light emitting component consisting of an enclosed metal filament. Its resistance increases as the filament's temperature increases.

Resistance: A measure of the opposition to current flow. Calculated as ratio of the p.d. applied to the electric current which flows through it.

Resistor: A circuit component which restricts or limits the flow of electrical current.

4.2.5 Electrical energy and electrical power

Electrical power: The rate at which an appliance transfers energy. For a circuit component, it is equal to the product of the current passing through it and the potential difference across it.

Kilowatt-hour: The electrical energy converted by a 1 kW appliance used for 1 hour.



4.3 Electric Circuits

4.3.1 Circuit Diagrams and circuit components

Battery: A collection of cells that provide a steady source of electrical energy to a circuit.

Cell: A single power source that converts chemical energy into electrical energy.

Circuit diagram: A graphical representation of an electrical circuit.

Diode: A component that only allows current to flow through in the forward direction. They have very large resistances in the reverse direction.

Filament lamp: A light-emitting component consisting of an enclosed metal filament. Its resistance increases as the filament's temperature increases.

Fixed resistors: Resistors whose resistance does not change with the change in voltage or temperature.

Fuse: A safety device consisting of a thin metal filament that melts and cuts off the power supply if there is a surge in current. Fuses are connected to the live wire.

Generator: An electrical energy source creating electrical energy from mechanical.

Heater: An electrical device that converts an electric current into heat.

Lamp: A circuit component which converts the electric current into light using a filament, which is heated by the current.

Light dependent resistor (LDR): A light sensitive component whose resistance decreases as its temperature increases.

Magnetising coil: A coil of wire used to generate a nearly uniform magnetic field.

Motor: Convert electrical energy from the circuit to mechanical energy.

NTC Thermistor: A temperature dependent component, whose resistance increases as its temperature decreases.

Potential divider: A simple circuit that uses resistors (or thermistors / LDRs) to divide the source voltage into smaller parts to vary the voltage.

Relay: Is a special type of switch turned on and off by an electromagnet.



Switch: Is a device used for making and breaking electric current through the circuit.

Transformer: An iron core with a primary and secondary coil of wire wound around opposite ends. Transformers can change the magnitude of an alternating voltage.

Variable resistor: A resistor with an adjustable resistance.

4.3.2 Series and Parallel Circuits

Junction: Intersection of three or more pathways in a circuit.

Parallel: The placing of components in a circuit, in parallel branches, so that the current can flow through each branch independently.

Series: The placing of components in a circuit, one after the other in a continuous loop.

4.4 Electrical Safety

Earthed casing: The removal of excess charge by providing a low resistance path for electrons to flow through.

Earth wire: The wire that protects from sudden voltage fluctuations by creating the low resistance path.

Live wire: The wire which carries current to the device.

Neutral wire: The wire which carries current back to the power source.

Non-conducting casing: A layer of insulation around the wires which is non-metallic.

Trip switch: A safety device which cuts off the power supply if there is a surge in current by **automatically flicking off** when the current is too high.

4.5 Electromagnetic Effects

4.5.1 Electromagnetic Induction

Conductor: A material that allows electrical charge to flow easily. Metals are particularly good conductors due to the free electrons in their structures.



Electromagnetic induction: The production of an electromotive force across an electrical conductor in a changing magnetic field, or a moving electrical conductor in a stable magnetic field.

Fleming's right-hand rule: induced current, magnetic field, and wire movement directions are at right angles to one another, along each axis.

Induced current: The current induced in a conducting loop that is exposed to a changing magnetic field.

Magnetic field: The region around a magnet in which another magnet or magnetic material will experience a non-contact force.

4.5.2 The a.c. Generator

Alternating current: Current flow consisting of charges that continually change direction. These oscillations usually occur at a set frequency.

Direct current: Current flow consisting of charges flowing in a single direction only. Batteries and cells provide direct current.

Generator effect: When there is relative motion between an electrical conductor and a magnetic field, a potential difference will be induced across the ends of the conductor. A current will flow if this conductor is part of a complete circuit.

Slip ring commutator: Is an electromechanical device that allows the transmission of power and electrical signals from a stationary to a rotating structure, resulting in an a.c. current.

Carbon brush: connects the commutator to the circuit, to transmit the current.

4.5.3 Magnetic Effect of a Current

Magnetic field: The region around a magnet in which another magnet or magnetic material will experience a non-contact force.

Oscillate: Move back and forth in a regular rhythm.

Relay: A type of switch turned on and off by an electromagnet in another circuit.

Solenoid: A wire wrapped into the shape of a coil, that has a strong and uniform magnetic field inside of it.



4.5.4 Force on a Current-Carrying Conductor

Beam of charged particles: A spatially localized group of electrically charged particles that have approximately the same position, kinetic energy, and direction.

Deflection: A reversal of direction. Such as that seen when moving charged particles encounter a magnetic field and the force they experience alters their motion to become circular until they exit the magnetic field again.

4.5.5 The d.c. Motor

Electric motor: A current-carrying coil of wire in a magnetic field which rotates due to opposing forces experienced on either side of the coil.

Split-ring commutator: Device used to reverse the direction of the current in the coil each half turn. This allows the motor coil to rotate continuously in one direction.

4.5.6 The transformer

High-voltage transmission: Electricity is transported along power lines at very high voltages.

Step-Down transformer: A transformer that has a smaller potential difference in the secondary coil than in the primary coil. This is a result of the secondary coil having fewer turns.

Step-Up transformer: A transformer that has a larger potential difference in the secondary coil than in the primary coil. This is a result of the secondary coil having more turns.

Transformer: An iron core with a primary and secondary coil of wire wound around opposite ends. Transformers can change the magnitude of an alternating voltage.

Turns ratio: The number of turns in the primary coil of a transformer over the number of turns in the secondary coil.

Voltage ratio: The voltage across the primary coil of a transformer over the voltage across the secondary coil.

