

Definitions and Concepts for CAIE Physics GCSE

Topic 4: Electricity and Magnetism

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

4.1 Simple Phenomena of Magnetism

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

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

Demagnetisation: Process of removing magnetic qualities in a material.

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

Electromagnet: A solenoid with an iron core. The magnetism of an electromagnet can be switched on and off, and the strength changed, through varying the current in the solenoid.

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.

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

Magnetisation: Process of inducing magnetic qualities in a material.

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: 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.

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4.2 Electrical Quantities

4.2.1 Electric Charge

Charging by induction: Is a method used to charge an object without actually touching the object to any other charged object.

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

Coulomb: The unit of charge.

Electric charge: Is 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. All charged objects have an electric field around them, and this field is stronger the closer you are to the charge.

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: When two charges of the same polarity meet, they will repel.

Point charge: The electric field around a point charge becomes weaker the further away you are. The field lines for a positive charge point radially outwards, whereas the field lines for a negative charge point radially inwards.

Unlike charges: When two charges of opposite polarities meet, they will attract.

4.2.2 Current

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: Is defined as moving in the same direction as the positive charge flow.

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



Electric Current: The rate of flow of electrical charge. Its value is the same at any position in a single closed loop. In metals, the charges that flow are electrons.

4.2.3 Electromotive Force

Electromotive force: The energy supplied by a source in driving charge round a complete circuit. Measured in Volts.

Volt: The unit of potential difference (voltage). One volt is equal to one joule per coulomb.

4.2.4 Potential Difference

Potential difference: The energy that is transferred per unit charge between two points in a circuit. It is often also called a voltage and measured in volts.

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

4.2.5 Resistance

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

Current–voltage characteristic: Is a relationship, typically represented as a chart or graph, between the electric current through a circuit and the corresponding voltage, or potential difference across it.

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

Ohmic resistor: A resistor that functions according to Ohm's law.

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:

4.2.6 Electrical Working

Battery: Is a device that stores chemical energy and converts it to electrical energy.

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.



4.3 Electric Circuits

4.3.1 Circuit Diagrams

Circuit diagram: Is 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.

Electric heater: Is an electrical device that converts an electric current into heat.

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

Fixed resistors: Are the 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.

Galvanometer: Is an electromechanical instrument used for detecting and indicating an electric current.

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

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.

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

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: Is a resistor of which the electric resistance value can be adjusted.

4.3.2 Series and Parallel Circuits

Parallel: Components connected in parallel have the same potential difference across each component. The current from the source is larger than the current in each branch and **the total current is equal to the sum of the currents flowing through each component.**



Resistors in parallel: The total resistance is less than the lowest individual resistance.

Resistors in series: The total resistance is equal to the sum of the resistances of the individual resistors.

Series: Components connected in series have the same current passing through each component but share the total potential difference (voltage) of the power supply. **The sum of the potential difference across the components in a series circuit is equal to the total potential difference across the supply.**

4.3.3 Action and use of Circuit Components

Input transducers: Is a device that takes a form of physical energy and converts it into a signal which can be read.

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

Rectifier: Is an electrical device that converts alternating current (AC) to direct current (DC).

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.

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

Variable potential divider: Is a simple circuit that uses resistors(or thermistors / LDRs) to supply a variable potential difference.

4.4 Digital Electronics

Analogue: They are electronic systems with a continuously variable signal.

AND gate: Is a logic gate that implements logical conjunction.

Digital: A waveform that switches representing the two states of low and high.

NAND gate: Is a logical gate which is the opposite of an AND logic gate.

NOR gate: Is a logical gate which is the opposite of an OR logic gate.

NOT gate: Is a logic gate which implements logical negation.



OR gate: Is a logic gate that implements logical disjunction.

Truth table: Is a mathematical table used in logic which sets out the functional values of logical expressions on each of their functional arguments.

4.5 Dangers of Electricity

Circuit breaker: A safety device that cuts off the power supply if a surge of current passes through it. Circuit breakers can be reset and are quicker acting than fuses.

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

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.

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

4.6 Electromagnetic Effects

4.6.1 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: Is the production of an electromotive force across an electrical conductor in a changing magnetic field. **The direction of an induced e.m.f. opposes the change causing it**

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.

4.6.2 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.

Rotating-coil generator: A device consisting of a coil, which when spun in a magnetic field, induces a current in the coil.

Slip ring: Is an electromechanical device that allows the transmission of power and electrical signals from a stationary to a rotating structure.

4.6.3 Transformer

High-voltage transmission: Electricity is transported along them at very high voltages to reduce the energy loss and make the transportation more efficient.

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. This is equal to the voltage ratio for a 100% efficient transformer.

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

4.6.4 The 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. **The direction of a magnetic field line at a point is the direction of the force on the N pole of a magnet at that point.**

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

Solenoid: A wire wrapped into the shape of a coil, that has a strong and uniform magnetic field inside of it. The solenoid's magnetic field strength can be increased by adding an iron core.

4.6.5 Force on a Current-Carrying Conductor

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



Charged particle: Is a particle with an 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.

4.6.6 d.c. Motor

Electric motor: A current-carrying coil of wire in a magnetic field. The two sides of the coil that are perpendicular to the magnetic field experience forces in opposite directions, causing rotation. The effect is increased by increasing the number of turns on the coil, increasing the current, or increasing the strength of the magnetic field

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.

