IB ELECTRIC CURRENTS DEFINITIONS AND CONCEPTS

ELECTRIC CHARGE (Q): The cause of electric fields and currents. Either positive or negative. Q=It

THE COULOMB (1C): The charge which passes a point when 1 A flows for 1s. 1C = 6.25 x 10^{18} electronic charges. e = 1.60 x 10^{-19}C

ELECTRIC POTENTIAL ENERGY (W): The energy gained when work is done moving a charge in an electric field.

ELECTRIC POTENTIAL DIFFERENCE (V): The work done per unit charge moving a positive test charge between two points in a circuit. V=W/Q measured in volts.

A PD acts **across** a component.

VOLT (1V): Unit of PD. One joule of electric potential energy is transferred to other forms when one coulomb flows between two points.

ELECTRONVOLT: Unit of energy. The energy required to move one electron through a PD of one volt. W (eV) = q (electron charges) x V (volts). The formula below calculates the kinetic energy gained by an electron accelerated through a PD.

$$Ve = \tfrac{1}{2}mv^2$$

ELECTRIC CURRENT (I): The rate of flow of charge. Unit is the ampere. Conventional current flows from + to –.

A current flows **through** a component.

$$I = \frac{\Delta q}{\Delta t}$$

RESISTANCE (R): The ratio of PD across a conductor to current through the conductor. R=V/I. Unit is the ohm (Ω): 1Ω = 1V/A

$$R = \frac{V}{I}$$

RESISTORS IN PARALLEL: Connected like a ladder. They all experience the same PD across them.

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$$

RESISTORS IN SERIES: Connected like a chain. They all have the same current flowing through them.

$$R = R_1 + R_2 + \cdots$$

RESISTIVITY (ρ): An electrical property of a material. $R = \frac{\rho L}{A}$

OHM'S LAW: The current through a metallic conductor is directly proportional to the voltage across its ends if the temperature and other conditions are constant.

NON-OHMIC CONDUCTOR: A conductor which does not obey Ohm's Law ie V is not proportional to I.

POWER (P): The rate of converting energy. Unit is watt (W) = 1J/S

$$P = VI = I^2R = \frac{V^2}{R}$$

EMF (E): The total electrical energy given by the battery to each coulomb of charge OR the terminal PD of the source when no current flows.

INTERNAL RESISTANCE: The resistance of the battery. Some of the energy provided by the source is converted to heat here and is not available in the external circuit components.

$$\mathcal{E} = I(R + r)$$

TERMINAL PD: The PD measured across the terminals of the source which is less than the EMF due to the internal resistance of the source.

AMMETER: Instrument which measures current in a circuit. It must be connected in series with the current it measures and has a very low resistance.

VOLTMETER: Instrument which measures PD in a circuit. It must be connected in parallel with the PD it measures and has a very high resistance.

IDEAL METERS: These do not affect the readings they make. Ideal ammeters and voltmeters have zero and infinite resistances respectively.

ELECTRICAL SENSORS: A component whose electrical properties (usually resistance) changes with its physical conditions.

THERMISTOR: A resistor whose resistance falls when its temperature rises.

LIGHT DEPENDENT RESISTOR: A resistor whose resistance falls as the intensity of light falling on it increases.

STRAIN GAUGE: A long thin wire whose resistance increases when it is stretched.

POTENTIAL DIVIDER: The PD of a source is divided over two resistors in series in proportion to their resistances.

SENSOR CIRCUITS: One of the resistors in a potential divider is replaced by a sensor so that the PD across the resistors in the potential divider changes as a physical condition changes (eg temperature, light intensity or strain)