

The City School

North Nazimabad Boys Campus

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**Class: 11TH**

**Subject: Physics**

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**Important Notes:**

**Electricity:current, I**

 defined as the rate of flow of electric charge

 There is electric current only when there are moving electric charges

 I = Q / t

 where Q is the amount of charge flows (in C), and t is the time taken (in s) SI unit is ampere, A

The ammeter, milli-ammeter, and micro-ammeter are current-measuring instruments and must be connected in series in the circuit



**Potential difference V and electromotive force, emf**

 The **potential difference or voltage**, V between 2 points is defined as the work done, W in taking 1 C of positive charge from the lower potential to the point of higher potential.

 In a circuit, it is the energy sources that supply energy, not the electric charges.

 The energy that drives the free electrons around the circuit is known as emf

 More than 1 cell can be connected in a circuit (series/parallel)

**Cells in series**

 the combined emf used to drive the electric charges is the sum of all the individual cell's emf

 with more cells, the circuit will have more power to drive the electric charge

**Cell** the combined emf used to drive the electric charges is the emf of one individual cell (each cell contributes an equal amount of emf)

 with more cells, the circuit will have longer time to drive the electric charges

**Potential difference = work done / charge transferred**

 **V = E / Q**

 where V is potential difference, E is energy, Q is charges flow

**Example**

**To transfer 2 C of charge from points X to Y in an electrical circuit 50 J of energy is needed. What is the potential difference between X and Y?**

**Solution**

Potential difference between X and Y = 50 / 2 = 25 V

 1 volt is defined as the potential difference between two points such that one joule of work is done in transferring 1 C of charge from one point to the other.

 The voltmeter and millivoltmeter are voltage-measuring instruments and must be connected in

parallel to the component across which the potential difference is being measured.

 The emf of an electrical source like a battery is equal to the electrical energy provided by the source for every coulomb of charge which flows round the circuit.

 The emf of an electrical source can also be defined as the potential difference across the

terminals of the source in an open circuit

**Voltmeter connected in parallel**

**Ammeter connected in series**

Ohm's Law and Resistance

 Ohm's Law states that the current I, passing through a conductor is directly proportional to the potential difference, V between its ends provided that the physical conditions and temperature of the conductor remain constant.

 a resistor is a conductor with known value of resistance. It can be used to control (reduce) the

size of current flowing in a circuit.

 Resistance, is therefore a measure of how difficult it is for the current to pass through the circuit.

 **V / I = constant**

 The resistance is also given by the gradient of the graph V vs.I

* Conductors or resistors which obey Ohm's Law are called **ohmic**.  Eg. pure metal, copper sulphate solution with copper electrodes, metal alloy

 Those which do not obey Ohm's Law are called **non-ohmic**.

* The resistance, R of an electrical component is defined as the ratio of the potential difference, V

 across the component to the current, I flowing through it.



**Example**

**The voltage across a lamp is found to be 1.4V when the current in the lamp is 0.2A. Calculate the resistance of the lamp.**

**Solution**

Resistance of lamp, R = V / I = 1.4 / 0.2 = 7 ohm



Rheostat

 

 a variable resistor used to vary the control of electric current

 A rheostat can be used to find the resistance of an unknown resistor.



 The voltmeter is connected in parallel

 Use the rheostat to adjust the size of the current to a convenient value. Hence, record the readings shown on the ammeter and voltmeter

 adjust the rheostat to take 5 sets of readings of I and V

 Calculate the resistance from the equation **R = V / I**

**Factors affecting resistance of a wire**

**1. Length**

 for a wire of uniform cross-sectional area, the resistance is directly proportional to the length of the wire

 hence, the longer the wire, the higher the resistance

**2. Cross-sectional area**

 for a wire of fixed length, its resistance is inversely proportional to the cross-sectional area

 **so, the thinner the wire, the higher the resistance**

**3. Material**

 resistance depends on the kind of substance

 copper is a good conductor and is used for connected wires

 nichrome has more resistance and is used in the heating elements of electric heater

**4. Temperature**

 **for metallic wires, as temperature increases, the resistance increases**

 **but for some materials like silicon and germanium as temperature increases, the resistance decreases**

**Electric Circuits**

An electric circuit is a complete or closed path through which electric charges flow from one terminal of an electrical source to the other, passing through one or more circuit components.

***Series circuit***

 It has only one path for the current to flow.

 the sum of voltages across individual components in the circuit is equal to the voltage across the terminals of the electrical source or the whole circuit.

 **Application: voltage divider**



***Parallel circuit***

 It has more than 1 path for the current to flow

 The sum of the currents flowing in the separate branches of a parallel circuit is equal to the current from the source.

 **Application: electrical household connections**



**Short circuit**

 A short circuit occurs when a large current flows due to the very little or negligible resistance of the circuit

 A short circuit leads to

 overheating of wires which may cause electric fires

 damage of the electrical source (egbattry) and other circuit components

To prevent short circuits, use fuse

- fuses break the circuit if the current flowing through them exceed their respective ratings.

**Combined resistance of resistors in series or parallel**

**In Series: Effective resistance = R1 + R2 + R3**

**Total voltage = V1 + V2 + V3 + ...**

 **Application: voltage divider**



**In Parallel: Effective resistance**

**1/RTOTAL = 1/R1 + 1/R2 + 1/R3**

**Total current = I1 + I2 + I3 + ...**

 **Application: current divider**