

Chapter 4

ELECTRIC CHARGE AND ELECTRIC CURRENT

Exercise

I.) Choose the correct answer.

1.) In current electricity, a positive charge refers to,

- a) Presence of electron
- b) Presence of proton
- c) Absence of electron
- d) Absence of proton

Ans: c) Absence of electron

Explanation: Because, when the electron is removed negative charge will be decreased and hence it becomes positive charge.

2.) Rubbing of comb with hair

- a) Creates electric charge
- b) Transfers electric charge
- c) Either (a) or (b)
- d) Neither (a) nor (b)

Ans: b) Transfers electric charge

Explanation: Because, when a comb is rubbed with hair, the charges are transferred from hair to comb.

3.) Electric field lines---- from positive charge and---- in negative charge.

- a) Start; start
- b) Start; end
- c) Start: end
- d) End; end

Ans: b) Start; end

c) Start: end

Explanation: Because, the electric field lines start from positive charge and end in negative charge.

And this is the direction of electric field given by electric lines of force.

4.) Potential near a charge is the measure of its--- to bring a positive charge at that point.

- a) Force
- b) Ability
- c) Tendency
- d) Work

Ans: **d) Work**

Explanation: Because, potential near a charge is the measure of its work to bring a positive charge at that point.

5.) Heating effect of current is called,

- a) Joule heating
- b) Coulomb heating
- c) Voltage heating
- d) Ampere heating

Ans: **a) Joule heating**

Explanation: Since, the heating effect of electric current is called as Joule's heating effect.

6.) In an electrolyte the current is due to the flow of

- a) Electrons
- b) Positive ions
- c) Both (a) and (b)
- d) Neither (a) nor (b)

Ans: **c) Both (a) and (b)**

Explanation: Because, in the electrolyte the current is due to the ionization of ions which produces positive and negative ions.

7.) Electroplating is an example for

- a) Heating effect
- b) Chemical effect
- c) Flowing effect
- d) Magnetic effect

Ans: **b) Chemical effect**

Explanation: Because, electroplating is an example of chemical effect, in which charges are deposited on the electrodes.

8.) Resistance of a wire depends on,

- a) Temperature
- b) Geometry
- c) Nature of material
- d) All the above

Ans: **d) All the above**

Explanation: Because, the resistance of the material depends on the temperature, geometry, nature of material also.

II. Match the following.

Ans:

- 1) Electric charge: coulomb
- 2) Potential difference: volt
- 3) Electric field: newton per coulomb
- 4) Resistance: ohm
- 5) Electric current: ampere

III. State whether true or false. If false, correct the statement.

- (1) Electrically neutral means it is either zero or equal positive and negative charges.

Ans: True

(2) Ammeter is connected in parallel in any electric circuit.

Ans: False

Supporting Statement: Because, ammeter is always connected in series in an electric circuit.

(3) The anode in electrolyte is negative.

Ans: False

Supporting Statement: Because, the anode in an electrolyte is positive electrode.

(4) Current can produce magnetic field.

Ans: True

Supporting Statement: Because, the changing current can produce magnetic field and vice versa which is called as electromagnetic induction.

IV. Fill in the blanks.

(1) Electrons move from ----potential to ----potential.

Ans: Electrons move from **lower** potential to **higher** potential

(2) The direction opposite to the movement of electron is called ----current.

Ans: The direction opposite to the movement of electron is called **conventional** current.

(3) The e.m.f of a cell is analogous to ----of a pipe line.

Ans: The emf of a cell is analogous to **water pump** of a pipe line.

(4) The domestic electricity in India is an a.c with a frequency of ---Hz.

Ans: The domestic electricity in India is an a.c with a frequency of **50 Hz.**

V. Conceptual questions.

1.) A bird sitting on a high power electric line is still safe. How?

Ans:

The bird sitting on high electric line is still safe, because the electricity always try to reach the ground anyway. But here, the both legs of bird are on the electric line and not touching to the ground, due which current cannot pass through the body of bird.

Also, the both the legs of the bird are at same potential, so there is no movement of electrons and hence no current flows through the body of bird. Therefore the bird sitting on the high electric line still safe.

2) Does a solar cell always maintain the potential across its terminals constant? Discuss.

Ans:

The solar cell always maintain the potential across its terminal constant because the electrochemical process inside the battery supplies the electrons at its negative terminal and thereby remove or draws the current from positive terminal.

Thus, in this way by supplying the energy to the electrons cell is maintaining the potential difference across its two terminals.

3) Can electroplating be possible with alternating current?

Ans:

Electroplating is possible only with DC current, because there will be ionization of electrolyte used.

Due to DC used the positive ions flows in the direction of electric field and the negative ions flows opposite to the electric field direction. Hence, resulting in the ionization which is needed for electroplating.

If we used alternating current for electroplating then the polarity of electrodes will be changing continuously and because of this the ions get attracted towards any one of the electrode, and there is no ionization of ion takes place which does not leads to electroplating.

And hence alternating current is not used in electroplating.

VI. Answer the following.

(1) On what factors does the electrostatic force between two charges depend?

Ans:

The electrostatic force is the force of attraction or repulsion between the two static charges.

The like charges repels each other and the unlike charges attracts each other.

The electrostatic force of attraction between two charges is directly proportional to the product of the charges and inversely proportional to square of the distance between them.

Thus, the electrostatic force between two charges depends on magnitude of the charges and distance between the two charges also.

(2) What are electric lines of force?

Ans:

The electric field lines are the lines representing electric field. Electric lines of force are the straight or curved path along which a unit positive charge moves in the electric field.

These are the imaginary lines.

The closeness of electric field lines gives the strength of the electric field.

If the lines are crowded then the strength of electric field is more and if they are more separated then, Strength of electric field will be less.

For an isolated positive charge, the electric field lines are radially outward.

Whereas for the negative charge the electric field lines are radially inward.

(3) Define electric field.

Ans:

The region in which the charge experiences an electric force is the electric field around the charge.

Electric lines of force represents the direction of electric field.

Electric field at a point is the measure of electric force acting on the unit positive charge placed at that point.

The direction of electric field is from positive to negative.

The positive charge experiences a force in the direction of electric field.

The negative charge experiences a force in the opposite direction to that of electric field.

(4) Define electric current and give its unit.

Ans:

Electric current is the rate of flow of electric charge to pass through it.

When we apply a potential difference to any conductor, the free electrons inside it get drifted from lower potential to higher potential region. This flow of electrons gives rise to electric current through the circuit.

The direction of flow of electrons is from negative to positive terminal of battery. And the direction of electric current is opposite to it that means from positive to negative terminal of battery.

If q is the charge flowing through the circuit in time t then,

$$I = q/t$$

The SI unit of electric current is ampere and in its symbol is A.

1A current is the current when 1coulomb of charge flows through a unit area of cross section in a 1 second.

The resistance of the conductor opposes the flow of current.

(5) State Ohm's law.

Ans:

According to Ohm's law, the current flowing through the circuit is directly proportional to the potential difference applied across its two ends and inversely proportional to the resistance of the circuit.

If I is the current flowing and V is the applied potential difference for a resistance R then, by Ohm's law we write

$$I = V/R \quad \text{and hence, } V = IR$$

Thus, if the resistance of the material is less it would be a good conductor.

And if the resistance of the material is more it would be bad conductor.

On the basis of resistivity materials are classified as conductors, semiconductors and insulators.

The conductors having zero resistance that means infinite current are called as superconductors.

(6) Name any two appliances which work under the principle of heating effect of current.

Ans:

The heat is produced when the flow of electrons is opposed by the resistance of the material. Because, to overcome this resistance while moving the electrons work has to be done and which is then converted into heat energy.

The effect of converting electrical energy into heat energy is called as the Joule's heating effect.

The iron box and water heater are the two home appliances which are working on the principle of Joule's heating.

Due to the resistance in the material, there is opposition to the flow of electrons. And work is to be done which is converted into heat and iron box become warm. And same in case of water heater also.

(7) How are the home appliances connected in general, in series or parallel? Give reasons.

Ans:

The home appliances are connected in parallel combination only.

In parallel combination, the voltage dropped across each component which are connected in parallel remains same and which is equal to voltage applied.

The total effective resistance of resistors connected in parallel combination becomes low or less than the resistances connected.

The current through each component in parallel combination is also different.

In parallel combination, if any one of the component get damaged then the whole circuit not get damaged. In parallel combination we can make one component ON and other OFF at a time.

Now, if the parallel combination is used in home appliances, then voltage dropped across each electrical device will be same which is equal to the voltage applied.

Due to parallel combination, the effective resistance will be low and hence maximum current will be obtained. So that each device can draw a current requiring to it. Hence, the current flowing through each branch will be different due to parallel combination.

Because of the all above advantages, the parallel combination is used in home appliances.

(8) List the safety features while handling electricity.

Ans:

The following are the safety features we have to follow while using electricity:

Water is a good conductor of electricity, because of this we have to water far from electric appliances always.

We have to not touch any electrical wiring with wet hand or bare feet, that time we have to wear sleepers or we have to stand on a wooden table or chair.

Keep the electrical device far away from the children's always.

Avoid the use of damaged wires or broken plugs, repair it at right time and then safe for use.

While working on electrical appliances we have to switch the main circuit firstly.

VII. Exercises.

1.) Rubbing a comb on hair makes the comb get $-0.4C$.

(a) Find which material has lost electron and which one gained it.

(b) Find how many electrons are transferred in this process.

Ans:

a) Here, the comb is rubbed with dry hairs and comb is getting $-0.4C$.

It means that, dry hair loosed the electrons, and the no. of electrons loosed by hair will be gained by the comb.

b) The comb get $-0.4C$ charge.

In $1C$ the no. of electrons present are given by,

$$1C = \text{no. of electrons} * \text{charge on one electron} \\ = n * 1.602 * 10^{-19}$$

$$n = 1 / 1.602 * 10^{-19}$$

$$n = 0.624 * 10^{19}$$

Hence, in $1C$ the no. of electrons present are $6.24 * 10^{18}$ electrons.

Here, $0.4C \Rightarrow$ no. of electrons = $0.4 * 6.24 * 10^{18}$ electrons

No. of electrons = $2.496 * 10^{18}$

Thus, $2.496 * 10^{18}$ no. of electrons are loosed by hair and it will be gained by comb at the same time.

2.) Calculate the amount of charge that would flow in 2 hours through an element of an electric bulb drawing a current of 2.5 A.

Ans:

Given that, $I = 2.5A$ and $t = 2 \text{ hours} = 2 * 60 * 60 = 7200$ seconds

Hence, the current flowing is given by,

$$I = Q/t$$

$$Q = I * t = 2.5 * 7200$$

$Q = 1800C$

Thus, the amount of charge that would flow in 2hrs will be $1800C$.

(3) The values of current (I) flowing through a resistor for various potential differences V across the resistor are given below. What is the value of resistor? [Hint: plot V-I a graph and take slope]

Ans:

From graph, the slope of the graph gives the resistance value.

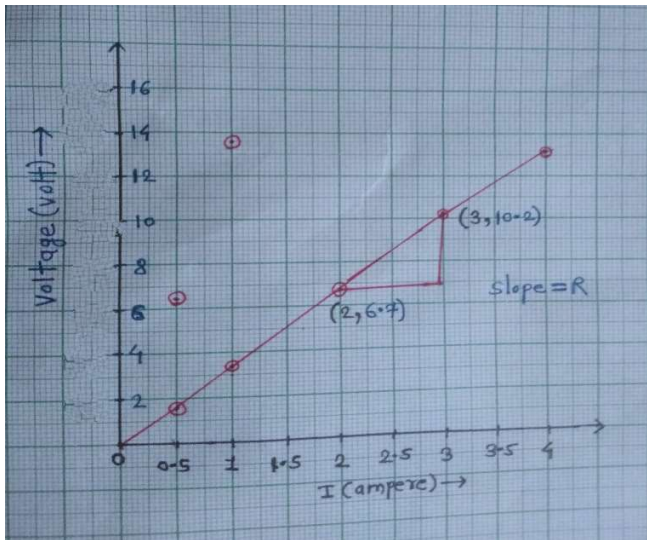


Fig. V-I graph

$$\begin{aligned}\text{Resistance of the circuit} &= V_2 - V_1 / (I_2 - I_1) \\ &= 10.2 - 6.7 / (3 - 2) \\ &= 3.5\text{ohm}\end{aligned}$$

Hence, the resistance of the resistor used is **3.5ohm.**