ELECTRICITY

CHAPTER NO.12

SUB: PHYSICS

LEARNING OUTCOMES

- **Students will be able to** :

- Demonstrate heating effect of joules law.

- Define Joules law of heating

POINTS TO BE COVERED

Practical applications of Heating
effect of electric current
Electric bulb
Electric fuse.

HEATING EFFECT OF ELECTRIC CURRENT

Q. Explain how does the electric bulb glow?

When electricity passes through the tungsten wire of a bulb, then the temperature of the wire increases and it glows.

Joules law of heating: It states that, heat produced in a resistor is

1.   Directly proportional to the square of current for a given resistance.

2.   Directly proportional to the resistance for a given current.

3.   Directly proportional to the time for which the current flows through the resistor.

   mathematically   **H = I2Rt.**

How is Heat Formula Derived?

We know that

Energy = Power × Time

Thus,

Heat energy due to current = Electric Power × Time

$$H = P \times t$$

$$H = VI \times t$$

$$\mathbf{H = VIt}$$

Also, putting V = IR by Ohm's Law

$$H = VIt$$

$$H = (IR) \times It$$

$$\mathbf{H = I^2Rt}$$

Also, putting $I = \frac{V}{R}$ by Ohm's Law

$$H = VIt$$

$$H = V \times \frac{V}{R} \times It$$

$$\mathbf{H = \frac{V^2}{R}t}$$

Note-

Tungsten Metal is used to make filament because

It offers higher resistance ,and produces more heat

it has very high melting point (3380 Degree Celsius) .It does not melt while producing heat

What is an Electrical Fuse?

Fuse is an electrical safety device

If excess current flows through an appliance,it breaks off the circuit

Thus it prevents overheating of appliance and electrical fires

How does Fuse work?

It contains wire made of metal like aluminium,copper,lead etc

these metals have low melting point

When excess current flows through circuit,the metal wire melts. Thus, breaking the circuit

Thus it prevents overheating of electrical appliance and electrical fires.

Note-

Argon or nitrogen Gas is used instead of Oxygen in Glass Bulb because

they do not react with tungsten like oxygen

This makes the bulb last longer

Q1. What does an electric circuit mean ?

A continuous closed path made of electric components through which an electric current flows is known as an electric circuit. A simple circuit consists of the following components: (a) Conductors (b) Cell (c) Switch (d) Load

Q2. Define the unit of current.

The unit of current is ampere. Ampere is defined by the flow of one coulomb of charge per second.

Q3. Calculate the number of electrons constituting one coulomb of charge.

The value of the charge of an electron is 1.6×10^{-19} C. According to charge quantization, Q = nq, where n is the number of electrons and q is the charge of an electron. Substituting the values in the above equation, the number of electrons in a coulomb of charge can be calculated as follows:

$1C= n.e= n*1.6 \times 10^{-19} C$ $n=1/1.6 \times 10^{-19} C =25 \times 10^{18}$

Therefore, the number of electrons constituting one coulomb of charge is 25×10^{18}.

1. Name a device that helps to maintain a potential difference across a conductor.

Solution: Battery consisting of one or more electric cells is one of the devices that help to maintain a potential difference across a conductor.

2. **What is meant by saying that the potential difference between two points is 1 V?**

Solution: When 1 J of work is done to move a charge of 1 C from one point to another, it is said that the potential difference between two points is 1 V.

3. **How much energy is given to each coulomb of charge passing through a 6 V battery?**

Solution: We know that the potential difference between two points is given by the equation, $V = W/Q$, where, W is the work done in moving the charge from one point to another Q is the charge From the above equation,

we can find the energy given to each coulomb as follows:

$W = V \times Q$ Substituting the values in the equation,

we get $W = 6V \times 1C = 6$ J Hence, 6 J of energy is given to each coulomb of charge passing through a 6 V of battery.

Q1. On what factors does the resistance of a conductor depend?

Solution: The resistance of the conductor depends on the following factors: a. Temperature of the conductor b. Cross-sectional area of the conductor c. Length of the conductor d. Nature of the material of the conductor

Q2. Will current flow more easily through a thick wire or a thin wire of the same material, when connected to the same source? Why?

Solution: Resistance is given by the equation, $R = \rho\, l/A$ where, ρ is the resistivity of the material of the wire, l is the length of the wire A is the area of the cross-section of the wire.

From the equation, it is evident that the area of the cross-section of wire is inversely proportional to the resistance. Therefore, thinner the wire, more the resistance and vice versa. Hence, current flows more easily through a thick wire than a thin wire.

Q3. Why are coils of electric toasters and electric irons made of an alloy rather than a pure metal? Solution: The melting point of an alloy is much higher than a pure metal because of its high resistivity. At high temperatures, alloys do not melt readily. Therefore, alloys are used in heating appliances such as electric toasters and electric irons

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