CLASS-X SUBJECT - PHYSICS

CHAPTER-8 TEACHER - charanjeet kaur

Good Morning Students!

This lesson is of class-X, for the subject of 'Physics', Topic - 'Electrical Energy and Power', which is covered in chapter - 8 'Current Electricity' and this particular topic is on Page Number - 203 of your textbook, Titled - 'Concise Physics by Selina Publications'

ELECTRICAL ENERGY AND ITS MEASUREMENT

According to the law of conservation of energy, energy can be transformed from one form to the other, but it can neither be created nor destroyed.

There are many devices where electrical energy is used to form other forms of energy like sound energy, heat energy, light energy, mechanical energy, chemical energy and magnetic energy.

The formula for electrical energy supplied by the source (i.e. battery or mains) in providing the current (I) for t seconds in conductor under a potential difference (V) is given by:

$$\text{ELECTRICAL ENERGY} = VIt \quad - (1)$$

Using Ohm's Law: $V = IR$,

the expression for electrical energy can be written as:

$$E = I^2Rt \quad \text{or,} \quad E = \frac{V^2t}{R} \quad - (2)$$

Also, S.I. unit of Electrical Energy is - **JOULE (J).**

ELECTRICAL POWER (P) – It is defined as the rate at which the electrical energy is supplied by the source.

$$\text{Power} = \frac{\text{Electrical Energy}}{\text{Time taken}} \quad \frac{VIt}{t} = VI$$

Also, using Ohm's law: $V = IR$

$$P = (IR) \times I = I^2R.$$

S.I. unit – Watt or joule/second (J/s).

So, 1 Watt = 1 Volt × 1 Ampere.

1 Watt is the electrical power consumed when a current of 1 Ampere flows through a circuit having a potential difference of 1 Volt.

Bigger Units of Electric Power are: Kilowatt, megawatt and gigawatt

$1\ KW = 10^3\ W$, $1\ MW = 10^6\ W$, $1\ GW = 10^9\ W$

COMMERCIAL UNIT OF ELECTRICAL ENERGY

In practice, electrical energy is measured in bigger units i.e. Wh and KWh.

- WATT HOUR – 1 Wh is the electrical energy consumed by an electrical appliance of power 1 Watt when it is used for 1 hour.

So, 1 Watt hour = 1 Watt × 1 hour = 1 Watt × 3600 s = 3600 Ws

1 Wh = 3600 J

- KILOWATT-HOUR – 1 KWh is the electrical energy consumed by an electrical appliance of power 1 kilowatt when it it is used for 1 hour.

$1\ KWh = 1\ kW \times 1\ h = 1000\ W \times 3600\ s$

$1\ kWh = 3.6 \times 10^5\ J$

Students, The electrical energy consumed by various appliances in our houses is measured in the KWh and its cost is paid as electric bill.

POWER RATING OF COMMON ELECTRICAL APPLIANCES:

Students, generally an electrical appliance such as electric bulb, geyser, heater etc. is rated with its power and voltage. For instance,-
An electric bulb is rated as 100 W - 220 V.
This statement means that, if bulb is lighted on a 220 V supply, the electric power consumed by it is 100 W.
By knowing the power rating of an electrical appliance, we can calculate:

i) the resistance of its filament (or element) when it is in use, and
ii) the safe limit of current which can flow through the appliance while in use.

So, know for a Power rating of '220V - 100 W' of an electric bulb,

i) Resistance of the element, $R = \frac{V^2}{P} = \frac{220 \times 220}{100} = 484\ \Omega$

ii) Safe Current, $I = \frac{P}{V}$ (Using $P = VI$)

$$I = \frac{100}{220} = 0.454\ A$$

If current exceeds 0.454 A, it may cause the bulb to fuse as it can withstand only current upto its safe limit.
(Students remember that, in our country, a.c. is supplied at a voltage of 220 V and has a frequency of 50 Hz)

CLASS - X

PHYSICS

CHAPTER - 8

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HEATING EFFECT OF CURRENT: (Joule's law Of Heating)

Students, whenever electric current flows through a wire, a certain amount of heat is produced, which depends on three factors. These factors are:

i) **The amount of current passing through the wire:** Heat produced in wire is directly proportional to the square of current passing through the wire i.e.

$$H \propto I^2$$

ii) **The resistance of wire:** Heat produced in the wire is directly proportional to the resistance of the wire i.e. $H \propto R$

iii) **The time for which current is passed in the wire:** Heat produced in wire is directly proportional to the time (t) for which current is passed in the wire. i.e. $H \propto t$

So, combining all the three factors:

$$H \propto I^2 R t$$

or, $H = I^2 R t$ (in joules)

(Students, here constant of proportionality is 1)

As already learnt in class - IX, heat energy is also measured in calorie and

$$1 \text{ cal} = 4.186 \text{ J} \simeq 4.2 \text{ J}$$

Now Students before going further, I want you all to go through all the concept and formulae learnt today as further we will be starting the numericals. So, kindly pause this audio / video and take a break for 20 - 25 minutes and go through the notes.

I hope you all have gone through the notes. Students now open Page Number - 212 of your Physics Textbook and also your Physics notebook.