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Electrical energy and power

CLASS-XII

SUBJECT : PHYSICS
CHAPTER NUMBER: 03
CHAPTER NAME : CURRENT ELECTRICITY

LEARNING OUTCOME

After this lesson, students will be able:

- Explain from where electricity comes and how we use it.
- Define electrical energy in terms of charge, voltage, current and resistance.
- Identify the types of engineering careers that work primarily with electrical energy.

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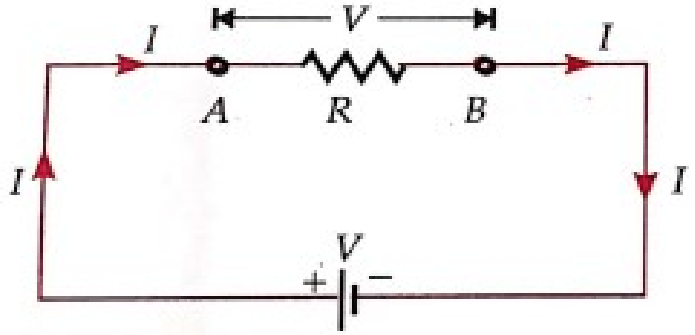
Slide 2

3	@Format for content and slide heading is missing? Just like you have mentioned in DOC., We need to specify, for each slide's heading and text content, what will be the font style +amanrouniyar@odmegroup.org _Assigned to you_ -Swoyan Satyendu , 6/17/2020

REVIEW

1. Define conductance.
2. What is the expression of mobility in terms of relaxation time. Give its SI unit.
3. What is the expression of Ohm’s law in vector form?.
4. State ohm’s law .
5. State relationship between mobility and relaxation time.

Electrical energy and power



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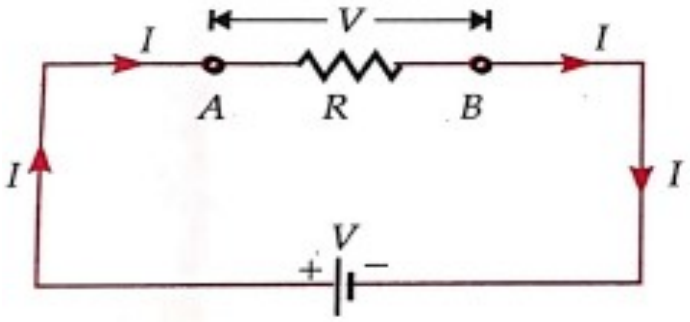
For steady current I = constant

So $H = I^2Rt$



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The expression for electrical energy and electrical power :

$\therefore$ For small-time dt the electrical energy consumed is $dW = (V_A - V_B)dq = VIdt$

The total electrical energy consumed in any time t is $W = \int_0^t VIdt$

For steady current I and V are constants then the electrical energy consumed in time t is;

$$W = VIt$$

Numerical

Question: State Joule's law of heating .

Solution: Heat dissipated from a current-carrying conductor is directly proportional to the square of the current, resistance of the conductor, and time of flow of current.

i.e. H α I^2 , H α Rand H α t

⇒ H α $I^2 Rt$

Numerical

Question: An electric current of 2.0 A passes through a wire of resistance 25Ω. How much heat will be developed in 1 minute?

Solution : $\mathrm{H} = \mathrm{I}^2\mathrm{Rt} = (2\mathrm{A})^2 \times 25\Omega \times 60\mathrm{s} = 6000\mathrm{W} = 6\mathrm{kW}$

Electric power and electrical energy

Some practical units of power are

(i) 1 kW = 1000 W (ii) 1 MW = 106 W (iii) 1 GW = 109 W (iv) 1 hp = 746 W

SI unit of electrical energy is joule (i) . $1J = 1CV$

A practical unit of electrical energy is 1 B.O.T. unit = 1 kWh = (1000 W)(3600 s) = 3.6 x 10^6 J

Rated power of a device

Rated power of a device is the power consumed by it when connected across the rated voltage i.e. the household voltage (220 V).

If the rated voltage of a device is V_0 and rated power is P_0 then, its resistance is;

$$R = \frac{V_0^2}{P_0}$$

p1

If the device is used across voltage V then power consumed is

$$P = \frac{V^2}{R} = \frac{V^2}{\frac{V_0^2}{P_0}} = \frac{V^2}{V_0^2} P_0$$

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Slide 10

p1 pinky.23815@gmail.com, 12/23/2021

Numerical

Question: An electric bulb is rated as 100W - 220 V . Calculate

(i) its resistance

(ii) power consumed by it when connected across 220 V .

(iii) power consumed by it when connected across 120 V.

Zero watts bulb

Rated power of zero watt bulb is 0 .

Its resistance $R = \frac{V_0^2}{P_0} = \frac{V_0^2}{0} = \infty$.

Practically it consumes a very small power, so its resistance is very high.

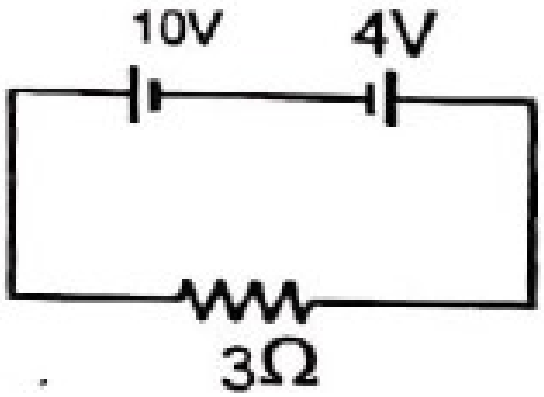
Numerical

Question: In the circuit shown in the figure find out

(i) Power supplied by 10 V battery

(ii) Power consumed by 4V battery

(iii) The power dissipated by 3 Ω resistor



HOME ASSIGNMENT

1. Two bulbs are rated $(P_1, V)\ and (P_2, V)$. If they are connected (i) in series and (ii) in parallel across a supply V, find the power dissipated in the two combinations in terms of P_1 and P_2 .
2. Two electric bulbs P and Q have their resistances in the ratio of 1:2. They are connected in series across a battery. Find the ratio of the power dissipation in these bulbs.

3. A 25 W and a 100W bulb are joined in (i) series (ii) parallel and connected to the main. Which bulb glows brighter?

THANKING YOU

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