CHAPTER - 12

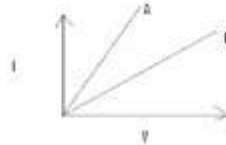**ELECTRICITY**

HOTS Questions for Practice

1. Name a substance whose resistance almost remains unchanged by increase of temperature.

2. Name two special characteristics of heater coil.

3. A wire of resistance 4 ohms is bent to form a circle. What is the resistance between two diametrically opposite ends?

4.   How does the resistance of a conductor change if its temperature is increased?

5. A current of 4A flows in a wire of resistance 60 ohms. Calculate electrical energy consumed in 2 minutes.

6. V-I graph for two resistors is given. Which of the two has minimum resistance?

7. Alloys are used in electrical heating devices rather than pure metals. Give one reason.

8. An electric geyser has the ratings 2000W, 220V marked on it. What should be the minimum rating, in whole number of a fuse wire that may be required for safe use with this geyser?

9. The electrical resistivity of few materials is given below in ohm-meter. Which of these materials can be used for making element of a heating device?

A.   6.84 x 10-8   B.   1.60 x 10-8   C. 1.00 x 10-4 D. 2.50 x 1012   E. 4.40 x 10-5   F. 2.30 x 1017

10. Where do we connect a fuse: with live wire or with neutral wire?

11. What is the resistance of an air gap?

12. Name two safety measures commonly used in electric circuits and appliances.

13. Two metallic wires A and B are connected in parallel. Wire A has length *l* and radius r, wire B has a length 2*l* and radius 2r. Compute the ratio of the total resistance of parallel combination and the resistance of wire A.

14. What is the meaning of the term 'frequency' of an alternating current? What is its value in India? Why is an alternating current considered to be advantageous over direct current for long-range transmission of electric energy?

16. An electric wire is stretched to increase its length by 25%.By what % will the resistance be increased and what will be increase in its resistivity?

17. An electric iron of resistance 20Ω takes a current of 5 A. Calculate the heat developed in 30 sec.

.18. A 60 W electric lamp gives off energy in the form of light at the rate of 7.5 J/s. What percentage of energy does the lamp transform into light?

19. The voltage-current variation of two metallic wires A and B at constant temperature are

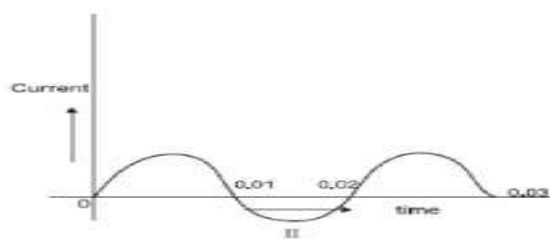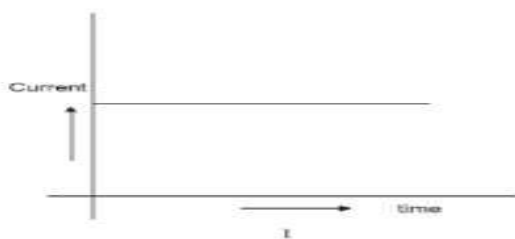Shown in fig. Assuming that the wires have the same length and same diameter,

Explain which of the two wires will have larger resistivity.
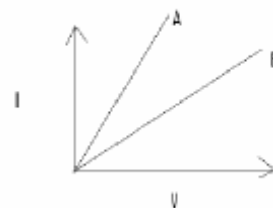
20. You are given following current-time graphs from two different sources:

(i) Name the type of current in two cases. (ii) Identify any one source for each type of these currents.

(iii) What is the frequency of current in case II in India ?

Q.21 The electric power consumed by a device may be calculated by using either of the two expressions P = I^2R or P = V^2/R . The first expression indicates that it is directly proportional to R where as the second expression indicates inverse proportionality. How can the seemingly different dependence of P on R in these expressions be explained?

Q.22. Draw a schematic diagram of a circuit containing the following electrical components:(a) a resistance (b) a voltmeter (c) an electric bulb (d) a cell (e) an ammeter and (f) plug key

3 Marks Questions & Answers of Electricity

1. Two students perform the experiments on series and parallel combinations of two given resistors R1and R2 and plot the following V-I graphs.
Which of two diagrams correctly represent the labels 'series and parallel' on the plotted curves? Justify your answer.
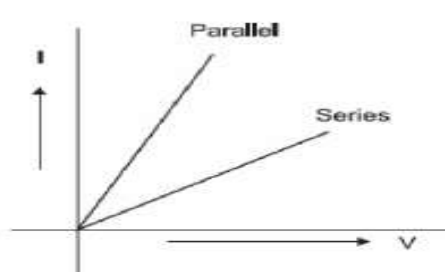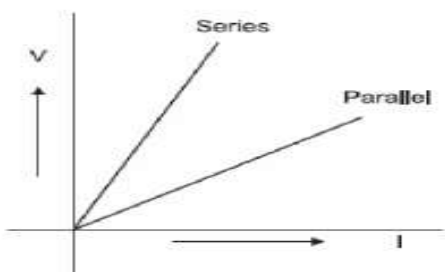
Ans. Both are correct because dV/dI= resistance(R) and dI/dV=1/R Series means high resistance and parallel means low resistance

2. A student performs an experiment to study the magnetic effect of current around a current carrying straight conductor. He reports that

(i) for a given battery, the degree of deflection of a N – pole decreases when the compass is kept at a point farther away from the conductor.

(ii) the direction of deflection of the north pole of a compass needle kept at a given point near the conductor remains unaffected even when the terminals of the same battery sending current in the wire are inter changed. Which of the above observations of the student appears to be wrong and why?

Ans. Observation (ii) is wrong. When the direction of flow of current is changed, the direction of the magnetic field and hence the direction of force also changes.

3. A household uses the following electric appliances:

(i) Refrigerator of rating 400 W for ten hours each day.

(ii) Two electric fans of rating 80 W each for twelve hours each day.

(iii) Six electric tubes of rating 18 W each for 6 hours each day.

Calculate the electricity bill of the household for the month of June if the cost per unit of electric energy is Rs. 3.00.

Ans: Electric Energy consumed per day

= 400 x 10 + 2 x 80 x 12 + 6 x 18 x 6

= 6568 w h

Total Energy per month = $\frac{6568 \times 30}{100}$ =197.040 kWh

Total Cost=197.040 x 3= Rs 591 (Approx.)

5 marks Questions with Answers of Electricity

1.. In a household electric circuit different appliances are connected in parallel to one another. Give two reasons.

An electrician puts a fuse of rating 15A in that part of domestic electrical circuit in which an electrical heater of rating 1.5kW, 220V is operating. What is likely to happen in this case and why? What change, if any, needs to be made?

Ans   (i) The appliances can be operated independently.   ½

      (ii) They get the same applied voltage   ½

      The fuse will not blow off even if the current in these devices were to exceed their safe current value.

      This could damage these devices and even cause fire.   3

      Any fuse of lower amperage needs to put in the circuit.   1

2 (a) The electric power consumed by a device may be calculated by using either of the two expressions

$$P = I^2R \text{ or } P = V^2/R .$$

The first expression indicates that it is directly proportional to R whereas the second expression indicates inverse proportionality. How can the seemingly different dependence of P on R in these expressions be explained?

(b) (i) A 100 W electric bulb is connected to 220 V mains power supply. Calculate the strength of the electric current passing through the bulb. (ii) If the same bulb is taken to U.S.A where the main power supply is 110 V, how much electric current will pass through the bulb when connected to mains?

Ans (a) Both the expressions are correct. In the first case, I remains constant whereas the second expression is true when V remains constant

$$i) \ P=VI$$
$$I = P / V = 100 / 220 = 10 / 22 \text{ A}$$
$$R = V / I = 220 \times 22 / 10 = 484 \ \Omega$$
$$ii) \ I = V / R = 110V / 484\Omega = (110 / 484) \text{ A}$$

3) State and explain Ohm's law

Ans) Ohms law is a relationship between the potential difference across a conductor and the current flowing through it.
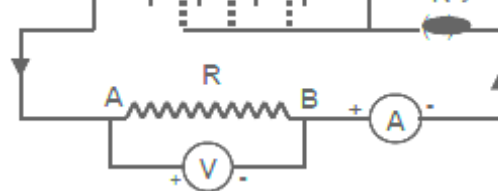
Ohm's law states that :-

'The current flowing through a conductor is directly proportional to the potential difference between its ends provided its temperature remains constant.'

$$V \propto I \ \text{ or } \ \frac{V}{I} = R$$

Where R is a constant called resistance for a given metallic wire at a given temperature.

4) Explain How Ohm's law is verified in the laboratory?

Set up the circuit as shown in the circuit diagram. First use one cell and note the current (I) in the ammeter and the potential difference (V) in the voltmeter across the nichrome wire AB. Repeat by using two cells, three cells and four cells and note the readings in the ammeter and voltmeter. Then plot a graph between the current (I) and potential difference (V). The graph will be a straight line. This shows that the current flowing through a conductor is directly proportional to the potential difference across its ends.

$$V \propto I \ \text{ or } \ \frac{V}{I} = R$$
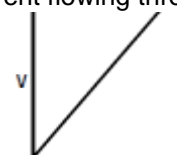
where R is a constant called resistance of the conductor .   current (I)

5. Define Resistance and its S.I.Unit? How the current will change when the resistance is doubled :-

Resistance is the property of a conductor to resist the flow of current through it.

Answer : According to Ohm's law R = V/I

The SI unit of resistance is ohm (Ω).

If the potential difference across the ends of a wire is 1 V and the current flowing through it is 1 A then the resistance R of the conductor is 1 ohm (1 Ω).

Since I = V/R

The current flowing through a resistor is inversely proportional to the resistance.

If the resistance is doubled, then the current gets halved.

6)On what factors resistance of a conductor depends? Give the order of resistivity of conductors and insulators.

Ans: Resistance of a conductor depends upon its:-

i) Length

ii) Area of cross section

iii) Material of the conductor.

Resistance is directly proportional to the length of the conductor and inversely proportional to the area of cross section of the conductor.

R α l

R α l /A

or R α l/A

or R = ρ l/A

Where ρ (rho) is a constant of proportionality called Resistivity of the material of the conductor.

The SI unit of resistivity is ohm meter (Ωm).

Conductors like metals and alloys have low resistivity 10^{-8} Ωm to 10^{-6} Ωm.

Insulators like rubber, glass etc. have high resistivity 10^{12} Ωm to 10^{17} Ωm.

7. Derive the equation for resultant resistance of Resistors in series parallel ?

When three resistors R_1, R_2 and R_3 are connected in series across AB
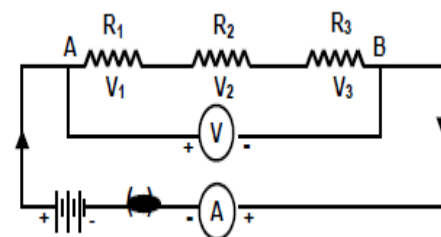
i) The current in all the resistors is the same.

ii) The total voltage (PD) across the resistors is equal to the sum of the voltage a

$(V) = V_1 + V_2 + V_3$
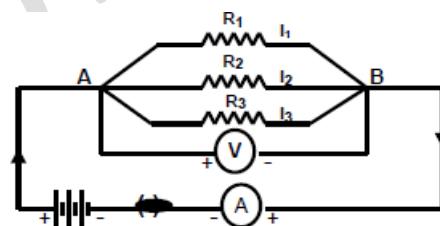
$IR_S = I(R_1 + R_2 + R_3)$

iii) The equivalent resistance is the sum of the resistances of each resistor.

$R_S = R1 + R_2 + R_3$

8. Derive the equation for resultant resistance of Resistors in parallel?

When three resistors R1, R2 and R3 are connected in parallel across AB,

i) The voltage (PD) in all the resistors is the same.

ii) The total current in all the resistors is the sum of the current in each

resistor. $I = I_1 + I_2 + I_3$

iii) The reciprocal of the equivalent resistance is the sum of the reciprocals of each resistance.

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$