M C Q   O F   E L E C T R I C I T Y

1.The rate of flow of an electric charge is known as :
(a) Electric potential (b)electric conductance (c)electric current (d)none of these
Ans : (c) electric current

2.The SI unit of electric current is :
(a)ohm (b)ampere (c)volt (d)faraday
Ans :(b)ampere

3.The instrument used for measuring electric current is :
(a)ammeter (b)galvanometer (c)voltmeter (d)potentiometer
Ans :(a)ammeter

4.The amount of work done in joules, when one unit electric charge moves from one point to another point in an electric circuit is called :
(a)electric current (b)electric resistance (c)electric conductance (d)potential difference
Ans :(d)potential difference

5.The unit of potential difference is :
(a)volt (b)ohm (c)ampere (d)faraday
Ans :(a)volt

6.The relation between potential difference (V) and current (I) is :
(a)V α I2 (b) V α 1/I (c) V2 α I (d) V α I
Ans :(d) V α I

7.The relation between potential difference (V) and current (I) was discovered by :
(a)Newton (b) Ampere (d) Volta
 Ans : (c) Ohm

8.The obstruction offered by material of conductor to the passage of electric current is known as :
(a)Resistance (b) Conductance (c) Inductance (d) None of these
 Ans : (a)Resistance

9.The SI unit of resistance is :
(a) Newton (b) Ohm (c) Watt (d) Joule
Ans : (b) Ohm

10. Which of the following statement is not true, regarding the electrical set-up for the verification of Ohm's law:
(a) The voltmeter is connected in parallel with the known resistance
(b) The ammeter is connected in series circuit
(c) The rheostat can only increase the resistance in electric circuit
(d) The single key is used to switch on/off the electric circuit
 Ans : (c) The rheostat can only increase the resistance in electric circuit

11. A voltmeter is used to find p.d. in any electrical circuit which of the statement given below is true :

(a) A voltmeter is a high resistance instrument and is connected in series circuit
(b) A voltmeter is a low resistance instrument and is connected in series circuit
(c) A voltmeter is a high resistance instrument and is connected in parallel circuit
(d) A voltmeter is a low resistance instrument and is connected in series circuit
Ans : (c) A voltmeter is a high resistance instrument and is connected in parallel circuit

12. A battery of 12V is connected in series with resisters of 0.2 ohm , 0.3 ohm,0.4 ohm,0.5 ohm and 12 ohm. How much current would flow through the 0.3 ohm resister
 (a) 0.895A (b) 1.11A (c) 0.5A (d)none of these
Ans : (a) 0.895A

13. Among which of the following resistance does not depend :
(a) length of conductor (b) area of cross-
section (c) temperature (d)density
Ans : (d)density

14. The resistance of a conductor is directly proportional to :
(a) its area of cross-section (b) density (c) melting point (d) length
Ans : (d) length

15. The resistance of a conductor is inversely proportional to its :
(a) area of cross-section (b) length (c) specific resistance (d) density
 Ans : (a) area of cross-section

16. A current of 2A flows trough a conductor whose ends are at a p.d of 4V. The resistance of the conductor is :
(a) 8 Ω (b) 0.5 Ω (c) 6 Ω (d) 2 Ω
Ans: (d) 2 Ω

17. The rheostat is used in the circuit to :
(a) increase the magnitude of current only
(b) decrease the magnitude of current only
(c) increase or decrease the magnitude of current
(d) none of these
Ans : (c) increase or decrease the magnitude of current

18. During the verification of Ohm's law :
(a) ammeter and voltmeter should be connected in series
(b) ammeter should be connected in series and voltmeter in parallel
(c) ammeter should be connected in parallel and voltmeter in series
(d) ammeter and voltmeter should be connected in parallel
Ans: (b) ammeter should be connected in series and voltmeter in parallel

19. Which of the following laboratory apparatus is not used during the verification of Ohm's law :
(a) Voltmeter (b) Ammeter (c) Galvanometer (d) Rheostat
Ans : (c) Galvanometer

Important Question Answers

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1. **Name a device that helps to maintain a potential difference across a conductor.**
   Answer. Cell or battery
2. **Define 1 volt. Express it in terms of SI unit of work and charge calculate the amount of energy consumed in carrying a charge of 1 coulomb through a battery of 3 V.**
   Answer. When 1 joule of work is done in carrying 1 coulomb of charge, from infinity to a point in the electric field, then potential at that point is called 1 volt. Potential difference between two points is

$$V = \frac{W}{Q}$$
or
$$W = Q \times V$$
$$= 1 \times 3 = 3 \text{ J}$$

3. **Write S.I. unit of resistivity.**
   Answer. Ohm-metre (Ωm).
4. **How is an ammeter connected in a circuit to measure current flowing through it?**
   Answer. In series
5. **What happens to resistance of a conductor when its area of cross-section is increased?**
   Answer.

Resistance decreases as $R \propto \dfrac{1}{A}$.

6. **Name the physical quantity which is (i) same (ii) different in all the bulbs when three bulbs of:**
   (a) same wattage are connected in series.
   (b) same wattage are connected in parallel.
   (c) different wattage are connected in series.
   (d) different wattage are connected in parallel.
   Answer. (a) For identical bulbs in series- same current, same potential difference.
   (b) For identical bulbs in parallel- same potential difference, different current.
   (c) For unidentical bulbs in series- same current, different potential difference.
   (d) For unidentical bulbs in parallel- different current, same potential difference.
7. **A given length of a wire is doubled on itself and this process is repeated once again. By what factor does the resistance of the wire change?**
   Answer. Am. Length becomes one-fourth of the original length and area of cross-section becomes four times that of original.

i.e.
$$l_2 = \frac{1}{4}l_1 \text{ and } A_2 = 4A_1$$
$$\therefore \quad \frac{R_2}{R_1} = \frac{l_2}{l_1} \times \frac{A_1}{A_2} = \frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$$
$$\Rightarrow \quad R_2 = \frac{1}{16}R_1$$

So, new resistance is (1/16)th of original resistance

8. **What is an electric circuit? Distinguish between an open and a closed circuit.**
   Answer. An arrangement for maintaining the continuous flow of electric current by the electrical energy source through the various electrical components connected with each other by conducting wires is termed as electric circuit.
   An open circuit does not carry any current, while a closed circuit carries current.

9. **(a) Define the term 'volt'.**
   (b) State the relation between work, charge and potential difference for an electric circuit. Calculate the potential difference between the two terminals of a battery if 100 J of work is required to transfer 20 C of charge from one terminal of the battery to the other.
   Answer.
   (a) When 1 joule of work is done in carrying 1 coulomb of charge, from infinity to a point in the electric field, then potential at that point is called 1 volt.
   (b) Potential difference, V = Work done on unit charge =W/q
   Work is 100 J,q=20C
   Potential difference,V=W/q=100/20=5V

10. **A 9Ω resistance is cut into three equal parts and connected in parallel. Find the equivalent resistance of the combination.**
    Answer.

    Resistance of each part $= \dfrac{R}{3} = \dfrac{9}{3} = 3\ \Omega$

    $\therefore\quad R_1 = R_2 = R_3 = 3\ \Omega$

    In parallel combination,

    $$\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}$$
    $$= \dfrac{1}{3} + \dfrac{1}{3} + \dfrac{1}{3} = \dfrac{3}{3} = 1$$

    $\therefore\qquad\qquad R_p = 1\ \Omega$

11. **(a) Define the term 'coulomb'.**
    (b) State the relationship between the electric current, the charge moving through a conductor and the time of flow.
    Calculate the charge passing through an electric bulb in 20 minutes if the value of current is 200 mA.
    Answer.

    $$I = \dfrac{q}{t}$$
    $$t = 20 \times 60 = 1200 \text{ seconds,}$$
    $$I = 200 \text{ mA} = 200 \times 10^{-3}\text{A}$$

    Charge passing $= q = It = 200 \times 10^{-3} \times 1200 = 240$ C

    (a) When 1 A current flows across the wire in 1 second, the charge transfer across its ends is said to be 1 coulomb.
    (b) The relationship between the electric current I, the charge q and time t is

12. **(a) How is the direction of electric current related to the direction of flow of electrons in a wire?**
    (b) Calculate the current in a circuit if 500 C of charge passes through it in 10 minutes.
    Answer.

(a) Conventional direction of electric current is opposite to the direction of flow of electrons in a wire.

(b) q = 500 C, t = 10 X 60 = 600 s I =

500/600 = 5/6A

13. **An electric iron has a rating of 750 W, 220 V. Calculate the (i) current flowing through it, and (ii) its resistance when in use.**
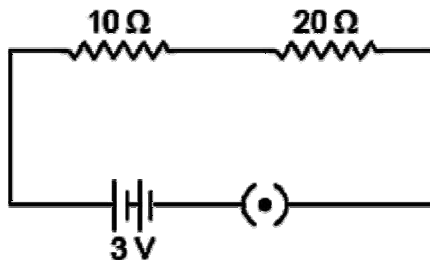
(i) **Answer.** Given: P = 750 W, V = 220 V   (i) P=VI

$$750 = 220 \times I \quad \Rightarrow \quad I = \frac{750}{220} = 3.40 \text{ A}$$

$$(ii) \qquad P = \frac{V^2}{R} \quad \Rightarrow \quad R = \frac{V^2}{P} = \frac{220^2}{750} \Rightarrow R = 64.53 \ \Omega$$

14. **Study the following electric circuit and find (i) the current flowing in the circuit and (ii) the potential difference across 10 Ω resistor.**

Answer.

10 Ω and 20 Ω are connected in series, their equivalent resistance is

$$R_s = R_1 + R_2$$
$$= 10 + 20 = 30 \ \Omega$$

(i) Current flowing in the circuit

$$I = \frac{V}{R_s} = \frac{3}{30}$$
$$= \frac{1}{10} = 0.1 \text{ A}$$

(ii) Potential difference across 10 Ω resistor

$$V = IR$$
$$= \frac{1}{10} \times 10 = 1 \text{ volt.}$$

15. **What is meant by electric current? Name and define its SI unit. In a conductor electrons are flowing from B to A. What is the direction of conventional current? Give justification for your answer. A steady current of 1 ampere flows through a conductor. Calculate the number of electrons that flows through any section of the conductor in 1 second. (Charge on electron 1.6 X 10^{-19} coulomb).**

Answer.

Electric Current: The amount of charge 'Q' flowing through a particular area of cross section in unit time 't' is called electric current, i.e.

Electric current, I = Q/t

SI unit of electric current is ampere.

One ampere of current is that current which flow when one coulomb of electric charge flowing through a particular area of cross-section of the conductor in one second, i.e. $1A = 1 \text{ Cs}^{-1}$.

The direction of conventional current is A to B, i.e. opposite to the direction of flow of electrons. In a metal, flow of electrons carrying negative charge constitutes the current.

Direction of flow of electrons gives the direction of electronic current by convention, the

direction of flow of positive charge is taken as the direction of conventional current. Charge = q = ne

$$\text{For } q = 1 \text{ coulomb, } n = \frac{1C}{1.6 \times 10^{-19}C} = \frac{10^{19}}{1.6} = 6.25 \times 10^{18} \text{ electrons}$$

16. **What is meant by electrical resistivity of a material? Derive its S.I. unit.**

    Answer. Mathematically, resistivity of the conducting material is given by = R x A/J

    If l = 1 m, A = 1 m^2, then = R

    Hence, the resistivity of the material is defined as the resistance offered by a metallic wire having a unit length and a unit area of cross-section. Since unit length and unit area of cross-section forms a cube, the specific resistance or resistivity can also be defined as the resistance offered by a cube of a material of side 1 m when current flows perpendicularly through the opposite faces. In SI system, its units is

    $$\text{Unit of } \rho = \frac{\text{Unit of R} \times \text{Unit of area of cross - section}}{\text{Unit of length of conductor}}$$

    $$= \frac{\Omega \times m^2}{m} = \Omega m$$

17. **(a) Write two points of difference between electric energy and electric power. (6) Out of 60 W and 40 W lamps, which one has higher electrical resistance when in use.**

    (c) What is the commercial unit of electric energy? Convert it into joules.

    Answer. (a) Difference between electric energy and electric power:

| Electrical energy	Electric power
(i) The work done or energy supplied by the source in maintaining the flow of electric current is called electrical energy. It appears in the form of heat given by $H \ VIt \ \dfrac{V^2 t}{R} I^2 RT$	(i) The time rate at which electric energy is consumed or dissipated by an electrical device is called electric power and is given by $P \ VI \ \dfrac{V^2}{R} I^2 R$
(ii) It is equal to the product of power and time i.e. E = P × t	(ii) It is equal to the rate of doing work by an energy source i.e. $P \ \dfrac{W}{t}$
(iii) Its SI unit is joule (J) 1 J = 1 W × 1s	(iii) Its SI unit is watt (W) 1 W = 1 J s^{-1}

    i.e. less the power of electrical device, higher is its electrical resistance.

    (c) Kilowatt hour – Commercial unit of electrical energy 1 kWh
    = 1000 Wh = 1000 J/S x 3600 sec
    = 3600000 J = 3.6 x10^{6}J

18. **Draw a labelled circuit diagram showing three resistors R$_1$, R$_2$ and R$_3$ connected in series with a battery (E), a rheostat (Rh), a plug key (K) and an ammeter (A) using standard circuit symbol. Use this circuit to show that the same current flows through every part of the circuit. List two precautions you would observe while performing the experiment. Answer.**
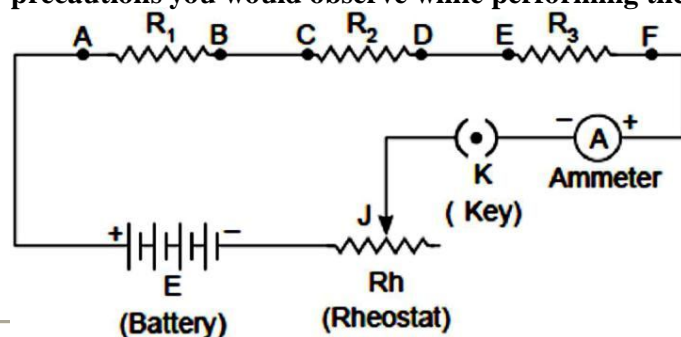
Aim: Same current flows through every part of the above circuit.

Procedure:

Connect ammeters, 'A'$_1$ between B and C, and 'A$_2$' between D and E.

Adjust the sliding contact of the rheostat initially for a small current.

Note all the ammeter readings. These reading give us current flowing through the resistors **R$_1$, R$_2$ and R$_3$**

The current in the circuit is now increased by changing the position of sliding contact J' of the rheostat.

Note all the ammeter readings each time.

Conclusion: Same reading of all the ammeter in each observation concluded that same current flows through every part of the circuit.

Precautions:

All the connection should be tight and properly connected as per circuit diagram.

The positive terminal of the ammeter and voltmeter must be connected to the positive terminal of the battery or battery eliminator.

19. **State Ohm's law. Write the necessary conditions for its validity. How is this law verified experimentally? What will be the nature of graph between potential difference and current for a conductor? Name the physical quantity that can be obtained from this graph. Answer.** Ohm's law : When the physical conditions such as temperature etc. remain same, the current flowing through the conductor is directly proportional to the potential difference applied across the ends of the conductor, i.e.,

$$I \propto V \quad \text{or} \quad V \propto I$$

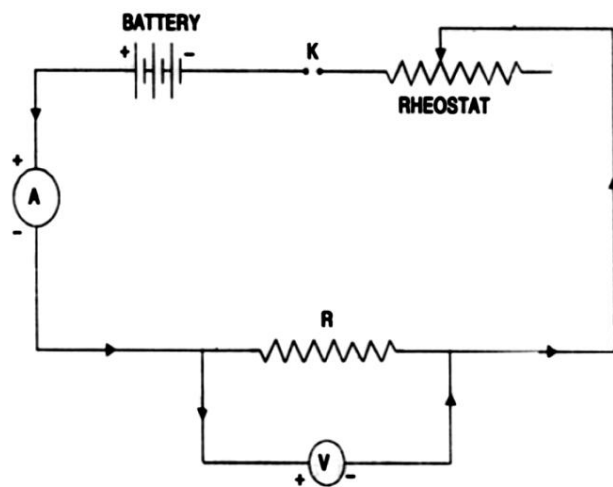$$\Rightarrow \quad \frac{V}{I} = \text{constant}$$

$$\Rightarrow \quad V = IR$$

where R is constant of proportionality and is called resistance of the wire.

Necessary condition for validity of Ohm's law is that physical condition such as temperature of the conductor remains same.

Procedure:

Experiment to verify ohm's law

**Procedure** : 1. Connect the various components as.

2. Close the sky, so that current begins to flow in the circuit.

3. Note down the potential difference (V) across the conductor PQ of resistance R shown by the voltmeter and the corresponding current (I) shown by the ammeter.

4. Now move the knob of rheostat so that the current in the circuit increases.

5. Again note down the potential difference (V) across the conductor R in the voltmeter and current in the circuit shown by ammeter.

6. Repeat the experiment five times by increasing the current in the circuit by moving the knob of the rheostat in steps.

S. No.	Potential Difference (V)	Current (I)	V/ I
1			
2			
3			
4			

The value of V/I = R (constant)

Plot a graph between V and I by taking V along X- axis along. We get a straight line passing through origin.
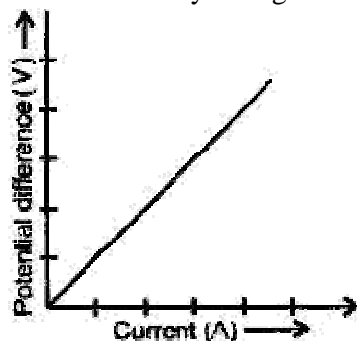
Conclusion : From the graph between V and I, we conclude that I = V, which is Ohm's law.

Hence Ohm's law is verified experimentally.

Ohm's law does not hold under all conditions. Ohm's law does not hold for non-ohmic material such as electrotyte

20. **(a) Define electric power. Express it in terms of potential difference V and resistance R.**

(b) An electrical fuse is rated at 2 A. What is meant by this statement?

(c) An electric iron of 1 kW is operated at 220 V. Find which of the following fuses that respectively rated at 1 A,3 A and 5 A can be used in it.

Answer.

(a) Electric power: It is the rate of doing work by an energy source or the rate at which the electrical energy is dissipated or consumed per unit time in the electric circuit is called electric power.

So, $$\text{Power } P = \frac{\text{Work done } (w)}{\text{Time } (t)}$$

$$= \frac{\text{Electrical energy dissipated}}{\text{Time } (t)}$$

$$= VI = \frac{V^2}{R}$$

(b) It means, the maximum current will flow through it is only 2 A. Fuse wire will melt if the current exceeds 2 A value through it.

(c) Given: $P = 1$ kW $= 1000$ W, $V = 220$ V

Current drawn, $I = \dfrac{P}{V} = \dfrac{1000}{220} = \dfrac{50}{11} = 4.54$ A

To run electric iron of 1 kW, rated fuse of 5 A should be used.

21. Write relation between heat energy produced in a conductor when a potential difference V is applied across its terminals and a current I flows through for 't'

Answer. Heat produced, H = VIt

22. State difference between the wire used in the element of an electric heater and in a fuse wire.

Answer. The wire used in the element of electric heater has a high resistivity and have a high melting point, i.e. even at a high temperature element do not burn while fuse wire have a low melting point and high resistivity.

23. Find the current flowing through the following electric circuit.
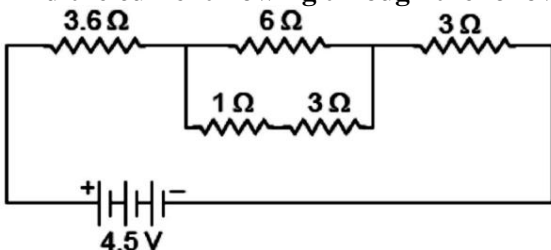
Answer.

Series combination of 1 Ω and 3 Ω resistance is in parallel combination with 6 Ω. Their equivalent resistance is

$$\frac{1}{R_P} = \frac{1}{6} + \frac{1}{3+1} = \frac{1}{6} + \frac{1}{4} = \frac{2+3}{12}$$

$$\therefore \qquad R_P = \frac{12}{5} = 2.4\ \Omega$$

Now, 3.6 Ω, 2.4 Ω and 3 Ω are in series, their equivalent resistance be

$$R_S = R_1 + R_2 + R_3$$
$$= 3.6 + 2.4 + 3 = 9\ \Omega$$

Hence, the current flowing through the circuit is

$$I = \frac{V}{R} = \frac{4.5}{9} = \frac{45}{90} = \frac{1}{2} = 0.5\ A.$$

24. An electric bulb of resistance 200Ω draws a current of 1 Ampere. Calculate the power of the bulb the potential difference at its ends and the energy in kWh consumed burning it for 5h. Answer.

Power of the bulb,

Power of the bulb,

$$P = I^2R = (1)^2 \times 200$$
$$\Rightarrow \qquad P = 200\ W$$

Energy consumed by bulb in 5h in burning = Power × Time
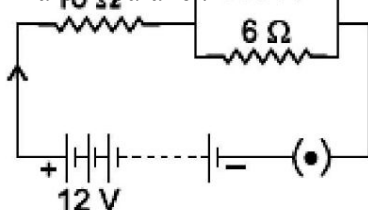$$= 200 \times 5$$
$$= 1000\ Wh = 1\ kWh$$

25.
Consider the circuit shown in the diagram. Find the current in 3Ω resistor.

Answer. 3 Ω and 6 Ω are in parallel.

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{3} + \frac{1}{6} = \frac{1}{2}$$

$\therefore \quad R_P = 2 \ \Omega$

R_P and $10 \ \Omega$ are connected in series. So,

$$R_S = R_P + R_3 = 2 + 10 = 12 \ \Omega$$

Total current in the circuit,

$$I = \frac{V}{R_S} = \frac{12}{12} = 1 \ A$$

Potential difference across, $R_P = IR_P = 1 \times 2 = 2 \ V$

So, Potential difference across, $3 \ \Omega = 2 \ V$

Current through $3 \ \Omega$, $I_1 = \frac{V}{R_1} = \frac{2}{3} = 0.67 \ A$

26. Series arrangements are not used for domestic circuits. List any three reasons.
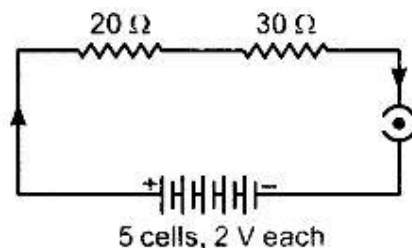
Answer. Series arrangements are not used for domestic circuit because

The electrical appliances need current of widely different values to operate properly. In series arrangement, when one component fails, the circuit is broken and none of the components works.

All electrical appliances work at a constant voltage. But in series circuit, the current is constant throughout the electric circuit and potential is different across the different components. So, series arrangement is not suitable for domestic circuits.

27. Draw a schematic diagram of an electric circuit consisting of a battery of five 2 V cells, a 20 Ω resistor, a 30 Ω resistor, a plug key, all connected in series. Calculate the value of current flowing through the 20 Ω resistor and the power consumed by the 30 Ω resistor.

Answer. Req = 20 + 30 = 50 Ω

5 cells, 2 V each

Here, V = 5 x 2 V = 10V, Total Resitance, R = 20Ω + 30Ω = 50Ω

Current through both 20 Ω and 30 Ω = I = V/R = 10/50 A = 0.2 A Power

consumed by 30 Ω = I^2R = $(0.2)^2$ x 30 = 1.2W

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