CHAPTER 12: ELECTRICITY

1. **Define the following terms with suitable mathematical relations.**
a. Electric Current b) Potential Difference c) Resistance d) Electric power e) Ampere f) Volt

a. Electric Current (I): The rate of flow of electric charges.

$$I = \frac{Q}{t}$$

b.Potential Difference : Amount of work done to move a unit positive charge from one point to another in the electric field.

$$V = \frac{W}{Q}$$

c. **Resistance R :** The opposition that a substance offers to the flow of current.

1. $R = \frac{V}{I}$

d. **Electric power P :** Electric power is the rate,per unit time, at which electric energy is transferred by an electric circuit. It can be represented as P=VI ii) $P = I^2R$ iii) $P = \frac{V^2}{R}$ iv) $P = \frac{w}{t}$

e. **1 Ampere :** Is defined as 1 coulomb of charge per second.
1A = 1 C/ 1s

f. **1 Volt :** One volt is defined as energy consumption of one joule per electric charge of one coulomb.

$1V=1\ JC^{-1}$

2. **Complete the following related to Physical Quantities and SI units : -**

Sl. No	Physical Quantities	----------	SI units
1	**Electric Current**	----------	A (Ampere)
2	**Potential Difference**	----------	V (Volt)
3	**Resistance**	----------	Ω (Ohm)
4	**Electric power**	----------	W (Watt)

3. **Name the various Electronic devices used in a circuit?**
Ammeter : Used to measure the flow of current.
Voltmeter : Used to measure potential difference (Voltage) between two points in a circuit.
Galvanometer : Used to detect electric current in a circuit.
Ohm meter: Used to measure the electrical resistance of a component.

4. **State Ohm's Law and express mathematically.**
Ohm's law states that the current through a conductor between two points is directly proportional to the potential difference across the two points, provided its temperature remains the same.

$\frac{V}{I}$ = constant $\frac{V}{I} = R$

5. **Draw a circuit diagram to verify Ohm's law.**

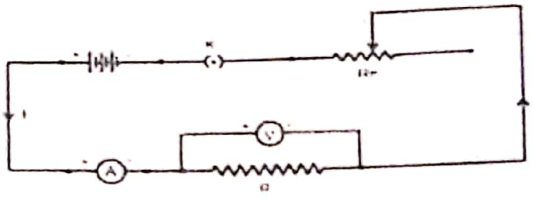
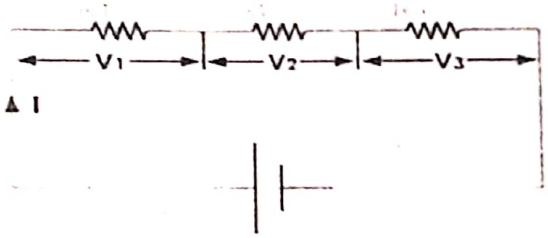
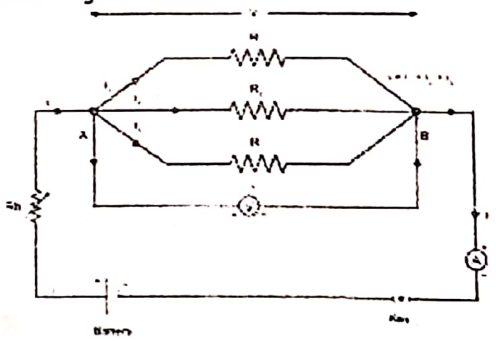


Fig. Circuit diagram for verification of Ohm's law

6. **Name the 4 factors on which the resistance of a conductor depends?**
   a. Length of a conductor
   b. Material of conductor
   c. Temperature
   d. Area of Cross section of conductor
7. **How does the resistance of a wire vary with its area of cross section?**
   Resistance is inversely proportional to area of cross section of the conductor.
8. **How is a voltmeter connected in the circuit to measure the potential difference between two points?**
   A voltmeter is connected in parallel with a device to measure its voltage.
9. **Draw a circuit diagram to show three resistors connected in series with a cell.**



10. **Write the equation to represent the equivalent resistance when set of resistors are connected in series.**
    $R_S = R_1 + R_2 + R_3$....
11. **Draw a circuit diagram to show three resistors connected in parallel with a cell and key.**



Parallel combination of resistors R_1, R_2 and R_3

12. **Write the equation to represent the equivalent resistance when set of resistors are connected in parallel.**
    $$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots\ldots$$
13. **Three resistors 12Ω, 8, 4Ω are connected in series. Calculate the total resistance of the circuit.**
    Solution : As resistors are connected in series, $R_s = R_1 + R_2 + R_3$
    $$\therefore R_s = 12 + 8 + 4 = 24\Omega$$

14. **Three resistors 12Ω, 6Ω, 3Ω are connected in parallel. Calculate the total resistance of the circuit.**

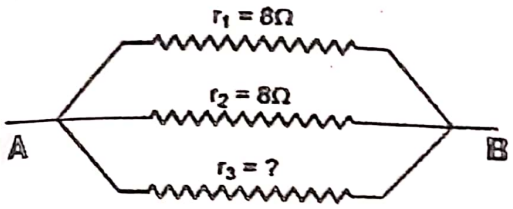
Solution : As resistors are connected in parallel, $\frac{1}{R_p}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$

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

$$\therefore \frac{1}{R_p}=\frac{1}{12}+\frac{1}{6}+\frac{1}{3}=\frac{1+2+4}{12}=\frac{7}{12}$$

$$\therefore R_p=\frac{12}{7}=1.71\Omega$$

15.



If the total resistance between the points A and B is 2 Ω then calculate r_3.

Solution : As resistors are connected in parallel,

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

$$\therefore \frac{1}{2}=\frac{1}{8}+\frac{1}{8}+\frac{1}{r}$$

$$\frac{1}{r}=\frac{1}{2}-\frac{1}{8}-\frac{1}{8}$$

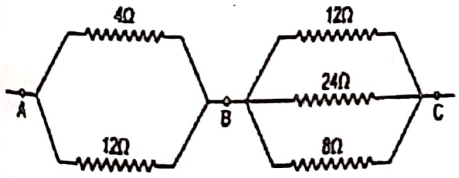
$$=\frac{4-1-1}{8}=\frac{2}{8}=\frac{1}{4}$$

$$\therefore r=4\Omega$$

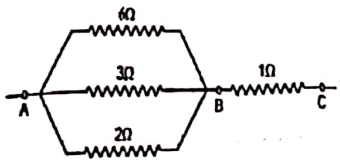
16. **Tungsten is used in electric bulbs. Why?**

The melting point of tungsten is 3380°C and has high resistance. So that the electric energy can easily change into heat energy and then light energy.

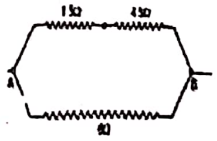
17. **Calculate the total resistance in the following circuits.**



(a)



(b)



(c)

What are the characteristics of a fuse wire?

a) It should has high resistivity b) Low melting point

19. **What connection is used in domestic appliances and why?**

Parallel connection is used in domestic appliances. Because parallel connection

a. In domestic wiring provides equal amount of energy to all appliances.
b. This reduces the equivalent resistance and results in consumption of energy,
c. All the appliances can be operate separately.

20. **The specific resistance of copper is $1.62 \times 10^{-8}\ \Omega m$. What do you mean by the statement?**

The resistance offered by copper wire of length 1m, area of cross section $1m^2$ is $1.62 \times 10^{-8}\Omega$

21. **What is heating effect of electric current?**

When current flows through a conductor, heat energy is generated in the conductor. This phenomenon is called heating effect of electric current.

22. **What are the factors does the heating effect of electric current depends.**

a. The resistance of the conductor.
b. The time t for which the current flows.
c. The amount of current.

23. **State Joule's law of electrical heating.**

Joule's law of electrical heating states that, the heat produced in a resistor is

a. Directly proportional to the square of electric current flowing through it.
b. Directly proportional to the resistance of the conductor
c. Directly proportional to the time for which electric current flows through it.

24. **Write the Joule's equation of electrical heating.**

$H = I^2Rt$

25. **Write the equations to find the heat generated in a conductor when current flows through it.**

$H = I^2Rt$ $H=VIt$

26. **What determines the rate at which energy is delivered by a current?**

The rate at which energy is delivered by a current is determined by

a. Magnitude of current
b. Resistance of the device

27. **An electric iron of 30 Ω takes a current of 5 A. Calculate the heat developed in 30 seconds.**

Given : $R = 30\ \Omega$, $I = 5A$, $t=30s$

$H = I^2Rt = 5^2 \times 30 \times 30 = 25 \times 900 = 22500J = 2.25 \times 10^4$ J or 22.5kJ

28. **Calculate the monthly bill for a heater of resistance 40Ω, which is used on 220V mains, such that its daily use is for 5 hours. The cost of electric energy is Rs 5.00 per kWh. Solution:**

Resistance of heater = $40\ \Omega$, Potential Difference = 220V , time = 5 hrs

Power $= \frac{v^2}{r} = \frac{220 \times 220}{40} = 1210W$

Energy consumed in 5 hrs = p X t = 1210 x 5 = 6050 Wh

Energy consumed in a month = 6050 x 30 = 181500Wh $= \frac{181500}{1000}$ kWh = 181.5 kWh

Monthly bill = 181.5 x 5.00 = Rs-907.50

29. **Define specific resistance.**

It is the amount of resistance offered by a conductor of unit length and unit area of cross section

SI unit is Ωm. It is mathematically expressed as $\rho = R\frac{a}{l}$

30. **How many 9Ω resistors(in parallel) are required to carry 4A on 12V battery ?**

Solution:

Current (I) = 4A, Potential Difference (V) = 12 V,

Total resistance of the circuit (when resistors are in parallel) $(R_p) = \frac{V}{I} = \frac{12}{4} =$ 3Ω

$$\frac{1}{R_p} = \frac{1}{r_1} + \frac{1}{r_2} + \ldots\ldots\ldots\ldots n$$

$$\frac{1}{3} = \frac{1}{9} + \frac{1}{9} + \ldots\ldots\ldots\ldots n$$

$$\frac{1}{3} = \frac{n}{9} \qquad \therefore n = 3$$

31. **A piece of wire having a resistance R is cut into five equal parts**

i.How will be the resistance of each part of the wire compare with the original resistance?

ii. If the five parts of the wire are placed in parallel, how will the resistance of the combination compare with the resistance of the original wire? What will be the ratio of resistance in series with that of parallel?

Sol :

i. Let the resistance of original wire be R. We know that the resistance of wire is proportional to its length. Here the wire is cut into five equal parts, hence the resistance of each part will be $\frac{R}{5}$

ii. If the five parts of the wire are placed in parallel, then the equivalent resistance is

$$\frac{1}{R'} = \frac{5}{R} + \frac{5}{R} + \frac{5}{R} + \frac{5}{R} + \frac{5}{R}$$

$$= \frac{25}{R}$$

$$R^1 = \frac{25}{R}$$

The ratio of resistance in series with that of parallel is

$$\frac{R}{R'} = R \times \frac{25}{R}$$

$$\frac{R}{R'} = 25$$

$R:R^1 = 25:1$

32. **Give scientific reasons :-**

1. Why copper wire cannot be used as a fuse wire.

Because it has low resistance and high melting point..

2. Why parallel circuit arrangement best for domestic wiring?

a. Parallel arrangement in domestic wiring provides equal amount of energy to all appliances.

i. This reduces the equivalent resistance and results in consumption of energy,

ii. All the appliances can be operate separately.

3. Why is the series arrangement not used for domestic circuit?

In series circuit

- All electrical switches will have common switch due to which they cannot be turn on or off Separately.
- Overall resistance of circuit will increase due to which the current from power supply will be less

33. **Why the voltmeter needs to be connected in parallel with resistor.**

Voltmeter is s device which measures the voltage across a resistor. If it is connected in series then it will change the value of potential difference which will minimise the current in the circuit as it has very large resistance and you will get faulty readings.

34. Why an ammeter is always connected in series in a circuit.

Ammeter measures the current flowing in the circuit. It has low resistance. If it is connected in parallel across any load then all current in circuit will choose lower resistive path (i.e ammeter) to cause its circuit to damaged. Hence it is used in series.

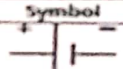
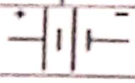
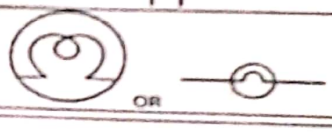
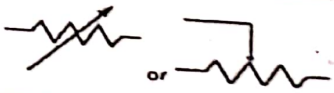
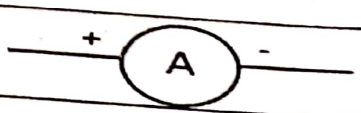
35. Why does the cord of an electric heater not glow while the heating element does?

The cord of the electric heater is a good conductor so it does not get heated up and also does not glow. But the heating element of the heater is made up alloy which has very high resistance, so when current flows through it gets heated up and glows.

36. Why are coils of electric toasters and electric irons made of an alloy rather than a pure metal.

The resistivity of an alloy is higher than the pure metal and also at high temperatures the alloys
Do not melt easily.

37. List out various symbols of electrical circuits.

S.No.	Electric Component	Symbol
1	Electric Cell	
2	Electric Battery	
3	Bulb	
4	Plug key or open Switch (off)	
5	Plug key or closed Switch (on)	
6	Wire Joint	
7	Wire crossing without joint	
8	Resistor	
9	Variable Resistor or Rheostat	
10	Ammeter	
11	Voltmeter