3. Current Electricity

Extra Questions

Q.1 Which method should be used to connect the bulbs?
Ans. Parallel combination

b) What are the characteristics of this way of connecting the bulbs depending on the answer of A above ?
Ans.- a) The potential difference across each resistors is same.
b) The total current is equal to sum of currents through individual resistors.
c) The effective resistance of combination is less than any of the individual resistances.
d) The reciprocal of effective resistance of combinations equal to the sum of reciprocal of individual resistances.
e) The current through each resistor is inversely proportional to the resistance of the resistor.
f) This combination is used to decrease the resistance in circuit.

Q. 2 The following table shows current in Amperes and potential difference.
a)

V (volts)	I (Amp)
4	9
5	11.25
6	13.25

1) $R_l = \frac{4V}{9A}$ = about 0.44 Ω

$R_2 = \frac{5V}{11.25A} = 0.44\ \Omega$

$R_3 = \frac{6V}{13.5A} = 0.44\ \Omega$

Q.3 What will be the nature of the graph between the current and potential difference?

Ans- A straight line will be passing through the original (0,0)

Q.4 Match the pairs

1. Free electrons -	Increases the resistance in the circuit
2. Current -	V/R
3. Resistivity -	Weakly attached
4. Resistance in series	VA/LI

Ans.-

1. Free electrons -	VA/LI
2. Current -	Increases the resistance in the circuit
3. Resistivity -	Weakly attached
4. Resistance in series	V/R

Q. 5 The resistance of a conductor of length x is r. If its area of cross section is what is its resistivity? what is its unit ?

Ans- The notation for $R = \rho \frac{L}{A}$ ∴ Resistivity $\rho = \frac{RA}{L}$

∴ $\rho \frac{ra}{x}$ unit : Ω m

Q.6 Resistances R1, R2, R3, and R4.

Ans R_4 is provided by an electric current by s2. Thus, the resistance of this combination will be zero.

R1 and R2 in parallel

$$\therefore \frac{1}{R_p} = \frac{1}{R1} + \frac{1}{R2}$$

$$\therefore \quad Rp = \frac{R_1 R_2}{R_1 + R_2}$$

R_3 and Rp in series-

$$\therefore R_S = R_3 + Ra_p$$

$$\therefore I_3 = \frac{V}{R_3 + R_s}$$

$$V_1 = V - I_3 R_3$$

$$= V - \frac{R_3 V}{R_3 + Rp} = V\left(1 - \frac{R_3}{R_3 + R_p}\right)$$

$$= V\left(\frac{Rp}{R_3 + R_p}\right)$$

$$\therefore \quad I_1 = \frac{V_1}{R_1} = \frac{V}{R_1}\left(\frac{Rp}{R_3 + R_p}\right)$$

In the same way,

$$I_2 = \frac{V}{R_2}\left(\frac{Rp}{R_3 + R_p}\right)$$

Consider the following figure

$$Rs = R_1 + R_3 + R_4$$

$$I = \frac{V}{R1+R3+R4}$$

Consider the following figure

$$Rp = \frac{R1R2}{R1+R2}$$

$$Rs = R3 + R4 + \frac{R1R2}{R1+R2}$$

$$I = \frac{V}{Rs} = I_3 = I_4$$

Also, $I = I_1 + I_2$ and $R_1I_1 = R_2I_2$

$$\therefore I = I_1 + \frac{I1R1}{R2} \quad \therefore \quad I_1 \left(1 + \frac{R1}{R2}\right) = I_1 \left(\frac{R1+R2}{R2}\right)$$

$$\therefore I_1 = \frac{R2I}{R1+R2}, \; I_2 = \frac{I1R1}{R2} = \frac{R1}{R2}\left(\frac{R2I}{R1+R2}\right)$$

$$= \frac{R1I}{R1+R2}$$

Q. 7 Three resistances x1, x2 and x3.

A. Current I flows through x1, x2, and x3

Ans- Series combination, as resistances x1, x2 and x3 are in series and same current flows throughout them. This current is I.

b. x is large than x1, x2 and x3

Ans- The following resistances are connected in series the total x resistance. Is greater than each individual resistances.

c. The resistances are connected in parallel, the resistance x is less than each individual. Resistance, which is in a parallel combination.

d. Parallel combination

e. $x = x1 + x2 + x3$

series combination

f. $x = \frac{1}{\frac{1}{x1} + \frac{1}{x2} + \frac{1}{x3}}$

Ans.- Parallel combination

Q.8 Solve the following problems

A. The resistance of 1m long

Ans.- R1 = 6Ω, R2 = ?, L1=1m = 100cm, L2 = 70cm

$R \alpha L$ Hence we get that $R1 \alpha L1$ and $R2 \alpha L2$

We know that, $R = \rho \frac{L}{A}$

$\therefore$ $Rl = \rho \frac{LI}{A}$ and $R2 = \rho \frac{L2}{A}$

Now, we get that $\frac{R2}{R1} = \frac{L2}{L1} = 0.7$

$\therefore$ $R2 = 0.7 \times R1$ let us put the value of $R1 = 0.7 \times 6\Omega$

$= 4.2\ \Omega$

The resistance will be 4.2 Ω.

Q.9 When two resistance are connected in series,

Ans- Let us consider two resistances as R1 and R2

Now Rs= 80 Ω, as resistors are in series

Rap = 20Ω, as resistors are in parallel

Rs = R1 + R2

∴ R1 + R2 = 80, we get R2 = 80 – R1

Now, $\frac{1}{Rp} = \frac{1}{R1} + \frac{1}{R2}$ ∴ $\frac{1}{20} = \left(\frac{R1+R2}{R1 .R2}\right)$

∴ R1.R2 = 20 (R1 + R2)

∴ $R_1 (80 – R_1) = 20 (R_1 + 80 – R_1)$

∴ $80R_1 – R_1^2 = 1600$

∴ $R_1^2 – 80R_1 + 1600 = 0$

∴ $R_1^2 – 40R_1 – 40R_1 + 1600 = 0$

∴ $R_1 (R_1 - 40) – 40 (R_1 – 40) = 0$

∴ $(R_1 - 40) (R_1 – 40) = 0$

∴ $R_1 – 40 = 0$ ∴ $R_1 = 40\ \Omega$

∴ $R_2 = 80 - R_1$

Let us put the values of R1 in given statement

∴ $R_2 = 80 – 40$

We get $R_2 = 40\ \Omega$

∴ The two resistances are 40Ω and 40Ω.

Q. 10 If a charge of 420c flows through a conducting wire in 5 minutes, what is the value of current ?

Ans- Let us consider the given data,

Q = 420c and time t = 5 mins,

Let us convert time in seconds

t = 5 × 60 = 300s

We know that I = $\frac{Q}{t}$

= $\frac{420}{300}$

∴ I = 1.4A

The value of the current is 1.4A.

Q. 11 What is an insulator?

Ans- The substances that have extremely high resistance are insulators.

Q. 12 To decrease the effective resistance in circuit, the resistance is connected in ____.

Ans- Parallel

Q. 13 Describe the magnitude of charge an one electron ?

Ans- The magnitude of charge on one electron is 1.6×10^{-19}C.

Q. 14 Describe the law proved in the experiment of electric current, potential difference and electric resistance. Explain it.

Ans- Ohm's law is proved in the experiment of electric current, potential difference and electric resistance.

If the physical state of a conductor remains constant, current (I) flowing through it is directly proportional to the potential different (v) between its two ends.

i.e I ∝v.

∴ I = kv

$\therefore I \times \frac{1}{k} = v$

Where, $\frac{1}{k}$ = R = Resistance of conductor.

I × R = V

V = IR.

The physical state of a conductor includes length, are a of cross section, temperature &material

Q. 15 Describe the effect of change in length and thickness of electrical wire in experiment of electric current, potential difference and electrical resistance?

Ans.- a) In an experiment of electrical current, potential different and electrical resistance, the resistance (R) of a electrical wire is directly proportional to its length (L) and inversely proportional to its area(A) of cross-section, when temperature is maintained at same level.

b) Let R, be resistance of electrical wire

R& L, $R \alpha \frac{I}{A}$

$\therefore R \alpha \frac{L}{A}$

$\therefore R \alpha p\frac{L}{A}$

P= constant, that is resistivity of a material.

c) If there is a change in electrical wire's length and thickness then it changes the resistance of wire, which changes the current, when potential difference is kept constant.

Q. 16 Explain the expression for the resistors connected in parallel combination

Ans.- a) Let R_1, R_2, R_3 are the resistors connected in parallel between points C and D, as in the diagram.

b) I_1, I_2 I_3 are the currents passing through resistors R_1, R_2 and R_3.

c) Let 'v' is the potential difference between C and D.

Total current is –

$$I = I_1 + I_2 + I_3 \text{ ---------- 1)}$$

d) Using ohm's law ----

$$I_1 = \frac{V}{R_1}, \quad I_2 = \frac{V}{R_2}, \quad I_3 = \frac{V}{R_3} \text{ --------2)}$$

And $I = \frac{V}{Rp}$

Where Rp = equivalent resistance.

Putting the values of 2 and 3

$$\frac{V}{KP} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$\therefore V\left[\frac{1}{R_p}\right] = v\left[\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right]$$

$$\therefore \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \text{ --------4)}$$

The above equation 4 is the equivalent resistance in parallel combination.

Let us consider, 'n' resistors in parallel,

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + ----+ \frac{1}{R_n}$$

Q. 17 Why does our body conduct electricity ?

Ans- Flow of charges and i on s contain electric current. The body contain different type of i on s as sodium, potassium, chloride etc, that have the property to conduct electricity.

Q. 18 Distinguish in Potential difference and Electric current.

Ans.-

Potential difference	Electric current
1) The difference in potential between positive and negative terminals of a cell.	1) The charge that is passing through a conductor in unit time.
2) Potential difference. (v) = $\frac{work\ done\ (w)}{Charge\ (Q)}$	2) Electric current (I) = $\frac{charge\ (Q)}{Time\ (t)}$
3) S. I unit is volt.	3) S.I unit is ampere.
4) Potential difference is measured by a voltmeter.	4) Electric current is measured by an ammeter.

Q. 19 A current of 0.34 A flows through a conductor, when a potential difference of 34V,is applied between its two ends, what is its resistance ?

Solution :- Potential difference (v) = 34v,

Current (I) = 0.34A, Resistance (R)

$\therefore R = \frac{V}{I}$, $R = \frac{34}{0.34} = 100\Omega$.

$\therefore$ Resistance of the conductor = 100Ω.

Q. 20 Two identical wires made of two different materials are connected in series. If resistivities of the wires are in ration1: 5 and resistance of first wire is 20Ω. Find the effective resistance of the combination?

Solution- $\frac{P_1}{P_2} = \frac{1}{5}$, $R_1 = 20\Omega$

$R = P\frac{1}{A}$, $R_s = R_1 + R_2$.

The wires are identical, l and A are the same for both the wires.

From the formula.

$R \alpha P$

$\therefore \frac{R_1}{R_2} = \frac{P_1}{P_2} = \frac{1}{5}$

$\therefore R_2 = SR_1 = 5 \times 20 = 100\Omega$

$\therefore R_s = 20 + 100 = 120\Omega$

$\therefore$ We get, effective resistance of the combination is 120Ω.

Q. 21 Which substance does not allow current to flow through it?

Ans- An Insulator

Q. 22 What is the ratio of potential difference and current ?
Ans- Resistance

Q. 23 1 m A = ___ A.
Ans- 10^{-3}

Q. 24 1microvolt = ____ volt.
Ans- 10^{-6}

Q. 25 What is the relation between ohm, volt and ampere ?
Ans- 1ohm = $\frac{1 \text{ volt}}{1 \text{ ampere}}$

Q. 26 What is the relation between joule, coulomb and volt ?
Ans- 1 volt = $\frac{1 \text{ joule}}{1 \text{ joule}}$

Q. 27 Define electric current.
Ans- Electric current is a flow of electrons in a conductor or amount of charge flowing through a particular cross sectional area in unit time.

Q. 28 What is an electric circuit?
Ans- A continuous path consisting of conducting wires, a switch or a plug key and other resistances, between the terminals of a battery or a cell along which an electric current flows is an electric circuit.

Q. 29 Describe a semi-conductor ?
Ans- A substance that works as an insulator under normal conditions, and behaves as a conductor under certain conditions is called semi-conductor.
E.g – Germanium

Q. 30 State the large units used for resistance.

Ans- 1 kilo ohm = 10^3 ohms, 1KΩ = 10^3Ω.

1 mega ohm = 10^6 ohms, 1MΩ = 10^6Ω.

Q. 31 Why is electricity meter used?

Ans- The electricity meter measures the electric energy consumed. It is usually expressed in 'units', 1 unit = 1kilowatt- hour.

Q. 32 What safety measures will you take while using electricity.

Ans- 1) Every circuit should have electric fuse in proper working condition.

2) Periodically insulation of wires should be checked.

3) Electric appliances should have proper earthing.

4) Many electric appliances having high power should not be connected in same circuit.

5) With wet hands, electric appliances should never be handled.

Q. 33 Differentiate between Conductors and Insulators.

Ans.-

Conductors	Insulators
1) Conductors are the substances that have low resistances. Current flows with an ease in them.	1) Insulators are the substances that have extremely high resistance, and hence current does not easily flow through them.
2) Mostly they are metals.	2) They are mostly non-metals.
3) They contain large number of free electrons.	3) They do not contain any free electrons.

Q. 33 Differentiate between Resistance in series and Resistance in parallel.

Ans.-

Resistance in series	Resistance in Parallel
1) The effective resistance of resistors is equal to the sum of their individual resistances. $R_s = R_1 + R_2 + R_3$.	1)The inverse of effective resistance is equal to the sum of the inverses of the individual resistances. $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_2}$
2) Same current flows through each resistor.	2)The current flowing through each resistor is inversely proportional to its resistance. The total current in circuit, is the sum of the currents, flowing through each resistance.
3) The effective resistance is larger than each of the individual resistances.	3) The effective resistance is smaller than each of the individual resistances.
4) This arrangement is used to increase the resistance in circuit.	4) This arrangement is used to reduce. The resistance in the circuit.

Q. 34 Is the following statement true ?

A voltmeter is always connected in series in circuit.

Ans.- False

Q. 35 The direction of conventional current is from the positive end to the negative end of a cell state True or False.

Ans.- True.

Q. 36 A current of 0.5 a flows through conductor for 5 minutes. How much charge would have passed through conductor?

Ans.- Given I = 0.5A, t = 5 minutes = 300s.

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

$Q = I \times t$

$= 0.5 \times 300$

$= 150c.$

A charge of 150c passes through the conductor.

Q. 37 A current of 0.33A flows through a conductor, when a potential difference. Of 33v is applied between its two ends. What is its resistance?

Ans.- solution – v = 33v , I = 0.33 A

$R = \frac{V}{I} = \frac{33}{0.33}$

$R = 100\Omega.$

The resistance of the conductor is 100Ω.

Q. 38 If a charge of 450c, flows through a conducting wire in 5 minutes, what is the value of the current?

Ans- solution- Q = 450c, t = 5 × 60 = 300s.

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

$= \frac{450}{300}$

$= 1.5A$

∴ I = 1.5A

Q. 39 The filament of an electric bulb has resistance of 600Ω. If a potential difference of 240v, is applied across, calculate the current flowing through it.

Ans- solution – R =600Ω, V= 240v.

By ohm's law, $I = \frac{V}{R}$

$= \frac{240}{600} = 0.4$ A.

Q. 40 Prove that – The unit of resistivity is Ωm.

Ans.- The resistivity of a material is given by the expression. $P = \frac{RA}{L}$.

Unit of cross section (A) is sq.m or (m×m)

Unit of length (L) is m.

Unit of resistance R is Ω.

∴ Putting the values in the formula, $P = \frac{RA}{L}$

Q. 41 Define- one Ampere.

Ans- In a conductor, if one coulomb charge flows through it every second, the current is one Ampere.

Q. 42 Define – one ohm.

Ans- If one ampere current flows through a metallic conductor. When one volt potential difference is applied between its ends, then the resistance of the conductor is one ohm.

Q. 43 State ohm's law.

Ans- If the physical state of a conductor remains constant the current I flowing through it is directly proportional to the potential difference (v) between its two ends.

Q. 44 Why is a fuse always connected in series?

Ans- 1) Fuse stops the flow of excess of current, which prevents the damage to circuits and appliances. 2) The fuse is connected in series, so when current is passing through appliances, it passes through fuse.

Q. 45 Differentiate Voltmeter and Ammeter.

Ans.-

Voltmeter	Ammeter
1) This device measures the potential difference between two terminals of a cell. 2) It is connected in parallel with a cell. 3) It has very high resistance.	1) This device measures the electric current flowing through a circuit. 2) It is connected in series with the cell. 3) It has very low resistance.

Q. 46 Differentiate Resistance and Resistivity.

Ans.-

Resistance	Resistivity
1) The hindrance to the flow of electrons is called as Resistance. 2) The S.I unit of resistance is ohm Ω. 3) It depends upon temperature, length of conductor, area of cross section, material of conductor.	1) Resistivity is the specific property of material of a conductor. 2)The S.I unit of the resistivity is ohm- metre. 3) It depends on material of the conductor.

Q. 47 If three resistors 20 Ω, 10 Ω and 5 Ω each are connected in series, what is the effective resistance in circuit?

Solution - R_1= 20 Ω, R_2 =10 Ω, R_3 = 5 Ω

Effective resistance in series = R_s =?

$R_s = R_1 + R_2 + R_3$

$= 20 + 10 + 5$

$= 35\Omega$

Q. 48 Define – 1 volt.

Ans.- The potential difference between two points is said to be 1 volt if 1joule of work is done in moving 1coulumb of electric charge from one point to another.

$1\ v = \frac{1J}{1C}$

Q. 49 The potential difference between any two points in a circuit is 60v. If a charge of 25c is transferred between these two points, find the work done in joules.

Ans.- 1500 joule.

Q. 50 Describe about Earth wire?

Ans.- Earth wire is yellow or green color it is connected to a metal plate that is buried underground, near house for safety.