11. ELECTRIC CURRENT

1 Mark Questions

1. Whatis Electric current ? (As–1)

Ans. Electric current is expressed as the amount of charge flowing through a particular cross section of area in unit time.

2. Why does a bulb glow immediatly when we swich on ? (As–2)

Ans. When we switch on any elecric circuit, irrespective of length of the connecting wire an elecricfield is set us throughout the conductor instantaneously due to the potential difference of the source connected to the circuit.

3. State the ohm's Law ? (As–1)

Ans. The potential difference between the ends of a conductor is directly proportional to the electric current passing through it at constant temperature.

4. What is resistance ? (As–1)

Ans. The resistance of a conductor is defined as the obstruction to the motion of the electrons in a conductor.

5. What is resistor ? (As–1)

Ans. The material which offeas resistance to the motion of electrons is called resistor.

6. What are the factors affecting the resistance of a material ? (As–1)

Ans. The factors affeating the resistance of a material are

1. Temperature
2. Nature of a material
3. Length of a conductor
4. Crossection area

7. What is resistivity ? What is its S.I unit ?

Ans. The resistivity of a maerial is the resistance per unit length of a unit cross section of the material the S.I unit of resistivity is ohm meter.

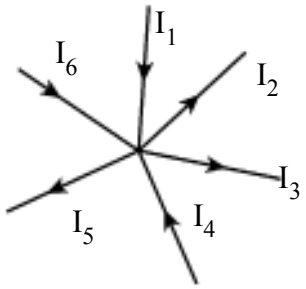
8. When kirchhoff's rules are applicable in Electric current ? (As–2)

Ans. The kirchhoff's rules are applicable to any DC circuit containing batteries and resistors connected in any way.

9. Name the two kirchhoff's laws ? (As–1)

Ans. 1. Junction Law 2. Loop Law

10. Apply the Kirchhoff's Junction Law to the following figure ?



Ans. $I_1 + I_4 + I_6 = I_2 + I_3 + I_5$

The sum of the currents into the junction is equal to the sum of the currents leaving the Junction.

11. What is electric power ? Write the S.I unit of electric power ? (As–1)

Ans. Electric power is the product of potential difference and the current.

The S.I unit of electric power is watt.

12. Which type of charge flows through an elecric wire when it is connected in an electric circuit ?

Ans. Negative

13. Is there any evidence for the motion of charge in daily life situations ? (As–6)

Ans. Yes, lighting is a live example.

14. What is a value of 1KWH in Joules ? (As–1)

Ans. 1KWH = $1000 \times 60 \times 60 = 36 \times 10^5$ Joules.

15. Find the resistance of a bulb, on which 60 W and 120 V is marked ?

Ans. Power P = 60 W, Potential (voltage) V = 120 V

Resistance R $\frac{V^2}{P} = \frac{120 \times 120}{60} = 240\ \Omega$

16. Silver is better conductor of electricits than copper why do we use copper wire for conduction electricits.

Ans. Silver is better conductor of electricits than copper. But the cost silver is very high when compare with copper. So we use copper wire for conduction of electricity.

17. Why do we consider tungsten as a suitable material for making the filament of a bulb ? (As–2)

Ans. Tungsten is consider as a suitable material for making the filament of a bulb because thin wire of tungsten has high resistance and high melting point. When current is passed through it, it becomes hot and emits light.

18. Name the instrument used to measure both electric current and potential difference ? (As–1)

Ans. Multimeter is the instrument used to measure both electric current and potential difference.

19. How should we connect the fuse in house wiring circuit ? In series parallel ? Why. (As–6)

Ans. The fuse wire in house wiring circuit is connected in series. When the current exceeds the safely limit, the fuse wire melts and breaks the circuit. The electric installations are thus saved from

getting damaged.

20. Three resistors of values 2Ω, 4Ω, 6Ω are connected in serias and paralle. Find the equivalent resistance of the combinations ?

Ans. $R_1 = 2\ \Omega$, $R_2 = 4\Omega$, $R_3 = 6\Omega$

Inseries

equivalent resistance $R = R_1 + R_2 + R_3$

$= 2 + 4 + 6 = 12\ \Omega$

In prallel

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

$= \frac{1}{2} + \frac{1}{4} + \frac{1}{6}$

$= \frac{6+3+2}{12} = \frac{11}{12}$

$R = \frac{12}{11}\ \Omega$

2 Mark Questions

21. Write the differences between potential difference and e.m.f ? (As–1)

Ans. Potential difference : Work done by the electric force on unit charge is called potential difference.

The work has done by the cell to moveunit positive

Electromotive force : Charge from negative terminal to positive termenal of the battery.

Potential difference = $\frac{\text{Workdone}}{\text{Ch arg e}}$

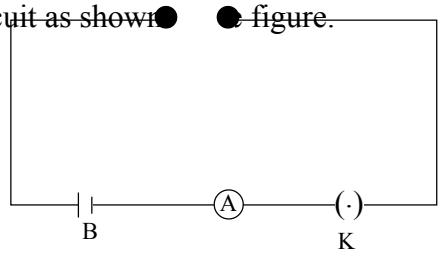
22. How can you veerify that the resistance of a conductor is temperature depends ? (As–1)

Ans. 1. When a conductor is connected to a batters, the free elecrons start moving with a drift speed in a special direction.

2. During the motion, the electrons collide with positive ions of the lattice and come to halt.
3. This means that they loss mechanical energy in the form of heat.
4. Thisproves that the resistance of a conducter is temperature dependent.

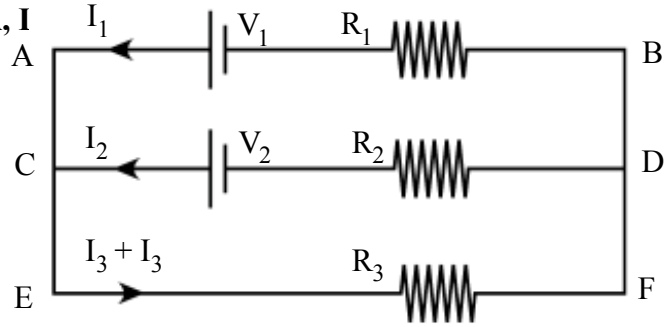
23. How do you verify that resistance of a conductor is proportional to the length of the conductor for constant cross section area and temperature ? (As–1)

Ans. 1. Make a circuit as shown figure.



2. Connect one of the iron spoke say 10 cm length between A and B.
3. Measure the value of correct using the current not down in your note book.
4. Repeate this for other lengths of the iron spokes.
5. We note that the current decreases with increasing the length of the spoke. So the resistance of a conductor is proportional to its length.

24. By using the following circuit, apply the Kirchhott's second Law or the Loop Law to the Loop ACDBA, I **(As–5)**



Ans. By using Kirchhoff's Loop Law or second Law.

For the Loop ACDBA

$V_1 - I_1R_1 + I_2 R_2 - V_2 = 0$

For the Loop EFDCE

$I_2 R_2 + (I + I_2) R_3 - V_2 = 0$

For the Loop EFBAE

$I_1 R_1 + (I_1 + I_2) R_3 - V_1 = 0$

25. Explain overloading of house hold current ? **(As–1)**

Ans. 1. The lien wires that are etering into the meter have a potential difference about 240V and limit of current from the mains is 5-20 A.

2. If we consume above 20 A, then circuit resistor in overheating that mars cause a firce. Twisis called overloading.
3. To preventthe damagedue to overloading we connec electric fuse to the household circuit.

26. Two bulbs have rating 100 W, 220 V and 60 W, 220 V. which one has the gratest resistance?

Ans. Power $P = \frac{V^2}{R}$

For the first bulb $P = \frac{V^2}{R} = \frac{220 \times 220}{100} = 484\ \Omega$

For the second bulb $R_2 = \frac{V^2}{P} = \frac{220 \times 220}{60} = 806.6\ \Omega$

So the second bulb having 60W, 220V has greater resistance.

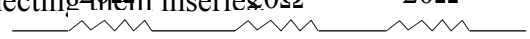
27. We use parallel arrangement of electrical appiances like Fan, bulb and T.V. why ?**

Ans. In a series combination, if any electrical appliance is switched off, all the electrical appliamces in house will be off. Therefore we use parallel arrangement of electrical appliances like Fan,

bulb and T.V indmestic circuits.

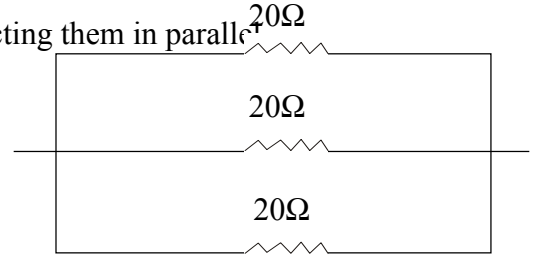
28. Suppose that you have three resistores each of value 20Ω. How many resitors can you obtain by various combinations of these three resistors ? Draw diagramsin support to your predictions ? (As–1)

Ans. 1. Connecting them inseries 20Ω 20Ω 20Ω



= 20 + 20 + 20 = 60Ω

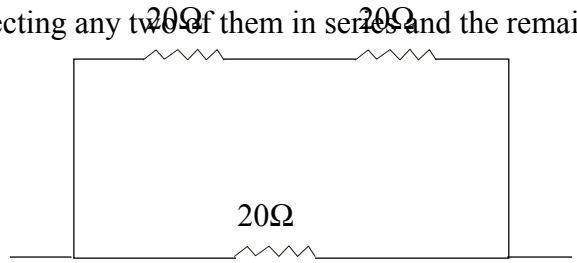
2. Connecting them in parallel



$$\frac{1}{R} = \frac{1}{20} + \frac{1}{20} + \frac{1}{20} = \frac{1+1+1}{20} = \frac{3}{20}$$

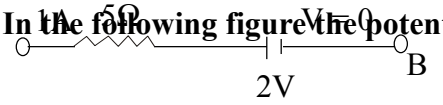
$$R = \frac{20}{3} = 6.67\ \Omega$$

3. Connecting any two of them in series and the remaining third one in parallel



29. In the following figure the potential at 'A' is ..... when the potential at B is zero ? (As–6)

Ans.



The potential at A is V = iR = 1 × 5

= 5 Volt.

The potential V = $V_1 + V_2$ = 5 + 2 = 7V.

30. A uniform wire of resistance 100 Ω is melted and recasts into wire of length double that of the original. What would be resistance of the new wire formed ? (As–1)

Ans. $R_1 = 100\ \Omega$ $l_1 = t$

$R_2 = ?$ $l_2 = 2\ l$

$$\frac{R_1}{R_2} = \frac{W}{t^2} = \frac{11}{2l_2} = \frac{100}{R_2} = \frac{1}{2 \times 2l} \text{ or } \frac{100}{R_2} = \frac{1}{4}$$

$R_2 = 400\Omega$

4 Mark Questions

31. Explain how electron flow causes electric current with lorentz – Drude theory of electrons.

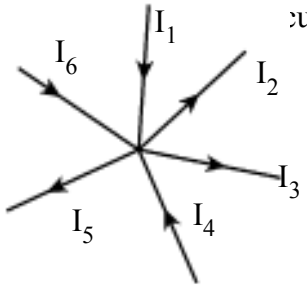
Ans. 1. Drude and Lorentz are proposed that conductors like metals contain large number of free electrons as while the positive ions are fixed in their locations. The arrangement of the positive ions is called lattice.

2. When the conductor is in an open circuit. The elctrons move randomly in latice space.
3. If we imagine any cross section, the number of electrons, crossing the cross section from left to right in one second is equal to that of electrons passing the cross section from right to left in one second. Hence the net charge moving along a conductor through any cross section is zero.
4. When the ends of the conduct are connected to the battery through a bulb, the bulb flows because energy flow takes place from battery to the bulb. This is because the orderly motion of electrons.
5. When the electrons are in ordered motion, there will be a net charge crossing through any cross section of tl s is called electric current.

Random motion of electrons
(in open circuit)

32. Explain Kirchhol's Laws with examples.

Ans. 1. Junction Law : At any Junction point in a circuit where the current can divide the sum of the currents into junction mus currents leaving the Junction.

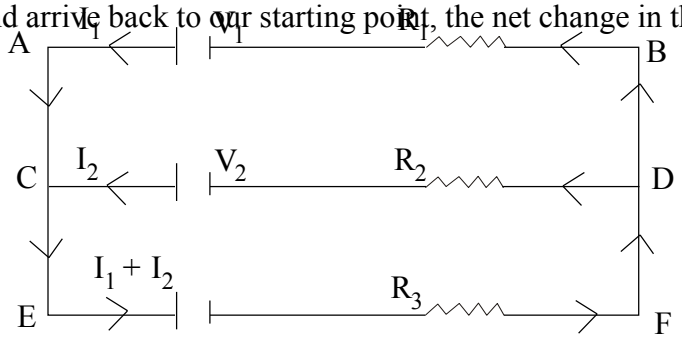


$I_1 + I_4 + I_6 = I_2 + I_3 + I_5$

2. Loop Law : The algetoric sum of the increases and decreases in potential difference across various components of the circuit in aclosed circuit loop must be zero. This Law is based on the conservation of energy.

Ex : Let us imagine a circuit loop the poential difference between the two points at the beginning of the loop has a certain value. As we move around the circuit looop and measure the

potential difference across each component in the loop, the potential difference may decrease on increase depending upon the nature of the element. But when we have completely traversed he circuit loop and arrive back to our starting point, the net change in the poential difference must be zero.



Apply loop law to the circuit

For the LooP ACDBA $- V_2 + I_2 R_2 - I_1 R_1 + V_1 = 0$

For the LooP EFDCE $- (I_1 + I_2) R_3 - I_2 R_2 + V_2 = 0$

For the LooP EFBAE $- (I_1 + I_2) R_3 - I_1 R_1 + V_1 = 0$

33. State Ohm's Law. Suggest an experiment to verify it and explain the procedure ? (As–1)

Ans. Ohm's Law : Ohm's Law states that the potential difference between the ends of a conductor is directly proportional to the electrical current passing through it.

Verification of Ohm's Law

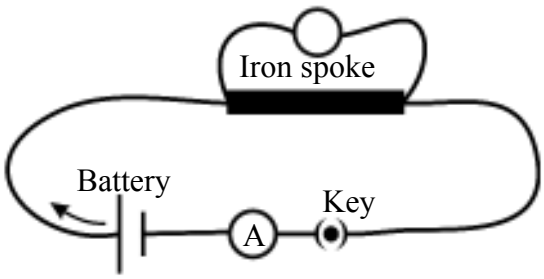
Aim : To verify Ohm's Law

Material required : Batters, rheostat,

Resistance, Ammeter, Voltmeter and wire.

Procedure :

1. Connectio n.
2. By changi flow of current in the circuit.

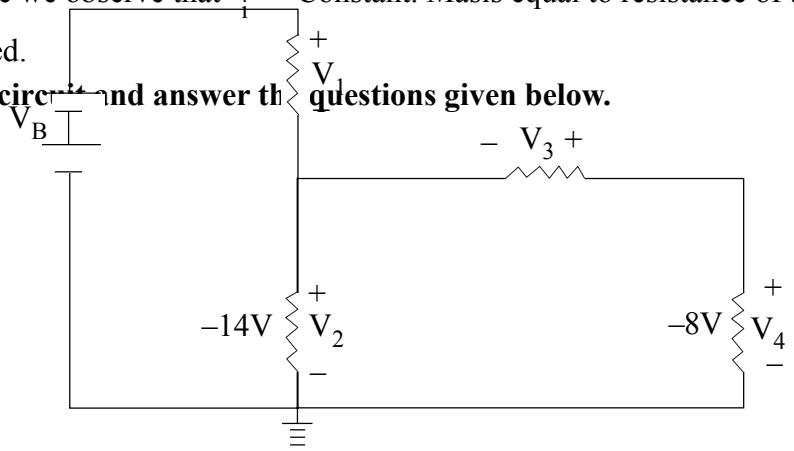


3. Note the reading in the voltmeter and ammeter and tabulated below

S.No	Voltmeter reading (V)	Ammeter Reading (I)	R = t

4. From the table we observe that $\frac{V}{i}$ = Constant. Masis equal to resistance of the wire. So Ohm's Law is verified.

34. Observe the circuit and answer the questions given below.



1. Are resistors 3 and 4 in series ?

Ans. No, they are not in series. They are in parallel.

2. Are resistors 1 and 2 in series ?

Ans. Yes, they are in series.

3. Is the battars in series with any resistors ?

Ans. No

4. What is the total emf in the circuit if the potential drop across the resistor 1 is 6 V ?

Ans. The total emf in the circuit.

$V_1 + V_2 + V_3 + V_4 = 6$ 14 + 8 + 8 = 36 V.

35. A house has 3 tube lights, two fans and Television. Each tube light draws 40 W. The fan draws 80 W and the television draw 60 W on he average, it alll the tube lights are kept on fortive hours. Two fans for 12 hours and the television for five hours every day. Find the cost of electric energy used in 30 days at the rate of Rs. 3.00 per KWH. (As–1)

Ans. Total consumption of current in 30 days

$$= \frac{(3\times 40\times 5)+(2\times 80\times 12)+(5\times 60\times 30)\times 100}{1000}$$

$$= \frac{(600+1920+300)30}{1000}$$

$$= \frac{(600+1920+300)30}{1000}$$

$$= \frac{2820\times 30}{1000} = \frac{282\times 3}{10} = 84.6 \text{ Walts}$$

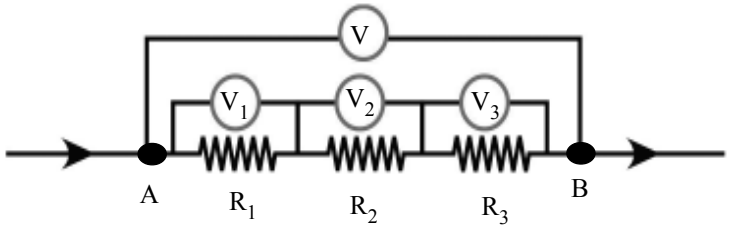
Cost of 1 unit charge = Rs. 3.00

Cost of 84.6 Watts + 846 × 3 = Rs. 253.80 Ps.

36. Deduce the expression for the equivalent resistance of the three resistors connected in series. (As–1)

Ans. Let R_1, R_2 and R_3 are the three resistances and V_1, V_2, V_3 are the potential difference across the

resistances R_1, s. Let I be the current flowing throug nce in the circuit.



From Ohm's Law

at $V_1 = IR_1$, $V_2 = IR_2$ and $V_3 - IR_3$

Since the resistors are connected in services

$V = V_1 + V_2 + V_3$ ..... (1)

Substituting the values of V_1, V_2 and V_3 in (1)

$V = IR_1 + IR_2 + IR_3$ ..... (2)

But $V = IR$ ..... (3)

From (2) and (3)

$IR = IR_1, + IR_2 + IR_3$

$IR = I (R_1, + R_2 + R_3)$

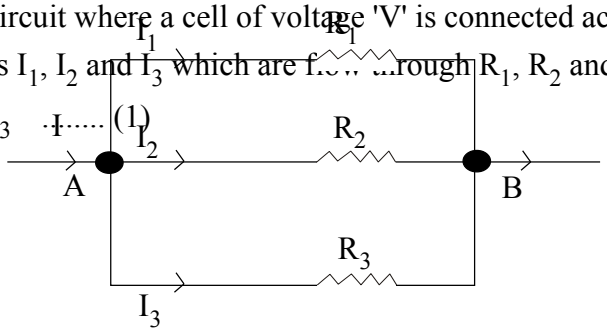
$\therefore R = R_1 + R_2 + R_3$

Result : When two or more resistores are connected in series combination then the equivalent resistance is equal to the sum of the individual resistors.

37. Deduce the expression for the equivalent resistance of the three resistors connected in Parallel. (As–1)

Ans. Consider R_1, R_2 and R_3 are three resistors connected in parallel. Suppose a current. I flows through the circuit where a cell of voltage 'V' is connected across the combination. The current I is divided as I_1, I_2 and I_3 which are f... ...rough R_1, R_2 and R_3 respectively.

$I = I_1 + I_2 + I_3$ ..... (1)



Ohm's Law as $I_1 = \frac{V}{R_1}, I_2 = \frac{V}{R_2}$ and $I_3 = \frac{V}{R3}$

Substituting the values of curents in (1)

$$I_1 = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R3}$$

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

From (2) and (3)

$$\frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R3}$$

$$V\left(\frac{1}{R}\right) = V\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)$$

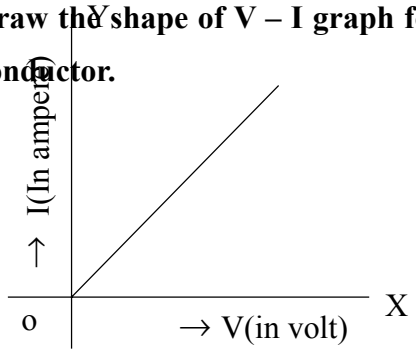
$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R3}$$

Result : The resiprocal of equivalent resistance is equal to the sum of the resiprocal of the individual resistance

5 Mark Questions

38. Draw the shape of V – I graph for a conductor and the shape of V – I graph for a semi conductor.

Ans.



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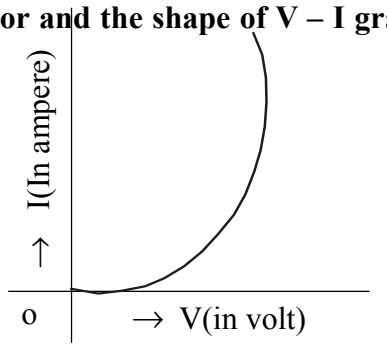


For Semi conductor

39. Explain over loading of house hold circuit with diagram.

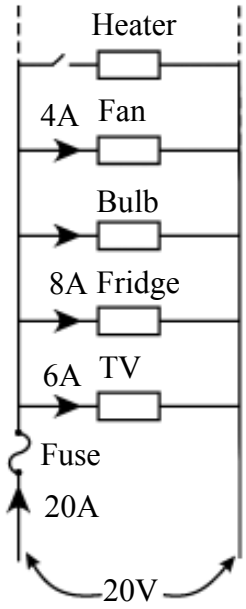
Ans. 1) Electricity enters our house through two wires called lines these lines are low resistance and the potential difference between the wires as usually about 240 V.

2) All electrical devies are connected in parallel in our home. The P.D drop across each devide is 240 V.

3) Based on the resistance of each electric device. It draws some current from the supply. Total current drawn from the mains is equal to the sum of the currents passing through each de-

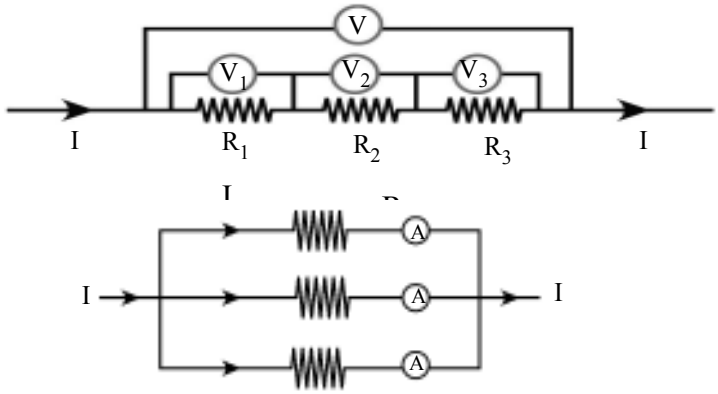
vice.

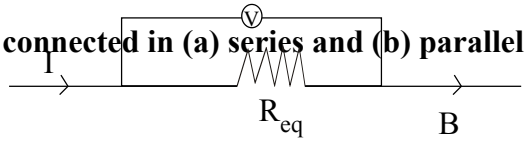
4) If we add more devices to the ... current from the mains also increases.

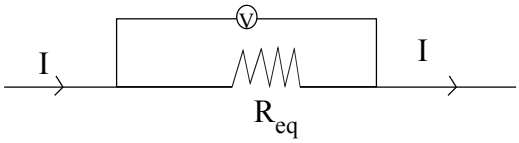


5) This leads to overheating and may cause a fire. This is called overloading.

4 ... connected in (a) series and (b) parallel







PART – B

I. Fill in the blanks.

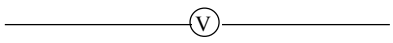
1. ..... is an electric discharge between two clouds or between cloud and earth.
2. ..... conduct electricity.
3. The ordered motion of electron is called .....
4. The S.I unit of electric current is .....
5. The obstraction of the flow of current is called .....
6. The metals which obey Ohm's Law are called ..... conductors.
7. The melting point of tungsten is .....

8. The filament of an electric bulb is made of .....
9. The S.I unit of power is .....
10. The Kilowatt hour is the unit of .....
11. Three resistors of 2Ω, 3Ω, 5Ω are connected to serives. The equivalent resistance of combination of resistors is .....
12. A thick wire has a ..... resistance than a thin wire.
13. An unknown circuit draws a current of 2A from a 12 V battery its equivalent resistance is .....
14. If two or more resistors are connected to series, these ..... flows through them is same.
15. 1KW = ... Watt.
16. Electricity enters our homes through two wires called .....

II. Matching.

I.	**A**		**B**
1.	Electric energy	( )	A. Volt
2.	Potential difference	( )	B. Ampere
3.	Current	( )	C. Ohm
4.	Resistance	( )	D. Watt
5.	Electric power	( )	E. KWH

II.	**A**		**B**
1.	Ohm's Law	( )	A. $R = R_1 + R_2$
2.	Series connection	( )	B. $V = iR$
3.	Parallel connection of resistors	( )	C. $P = \frac{W}{t}$
4.	Power	( )	D. $V = \frac{W}{q}$
5.	Potential difference (pd)	( )	E. $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

III.	**A**		**B**
1.		( )	A. Volmeter
2.		( )	B. Battery
3.		( )	C. Ammeter
4.		( )	D. Rheostat
5.		( )	E. Resistance

Answer

I. 1) Lightning 2) Conductor 3) Electric current 4) Ampere
5) Resistance 6) ohms 7) 3422°c 8) Jungsten
9) Watt 10) electrical energy 11) 10Ω 12) Less
13) 6Ω 14) current 15) 1000 16) lines

I. 1) E 2) A 3) B 4) C 5) D

II. 1) B 2) A 3) E 4) C 5) D

III. 1) B 2) C 3) A 4) E 5) D

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