Electricity

1.Define the following:

A) i. Electric Charge: The physical property of matter that causes force of attraction or repulsion by sub atomic particles electron and proton present in the atom.

ii. Electric conductor: A matter that allows the flow of current through it is called electric conductor.

Ex. Metals like silver, copper, aluminium etc

iii. Bad conductor of electricity: A matter doesn't allow the flow of current through it at ordinary conditions is called bad conductor of electricity.

Ex. Distilled water, air etc

iv. Insulator: Matter strictly prohibited the flow of current through it is called insulator.

Ex. Wood, glass, porcelain, ceramic etc

v. Cell: A device convert chemical energy into electrical energy is called cell.

vi. Conventional flow of current: The direction of flow of current from positive terminal to the negative terminal is called conventional flow of current. It is opposite to the direction of movement of electrons.

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2. Write a short note on electric current?

A) i. The rate of flow of charges (electrons) at a point in a conductor is called electric current.

ii. That is number of charges (electrons) passed at a point in unit time in a conductor is called electric current.

iii. Current=charge/time (I=Q/t)

iv. The S.I unit of current is ampere

v. One ampere=1coulomb/ 1 sec

vi. Ammeter is using to measure strength of current in conductor or in circuit.

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3. Define one ampere. (or) Define the unit of current.

A. There is a coulomb of charge passed through a point in one second, then the current strength is one ampere.

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4. How many numbers of electrons are present in 1 coulomb of charge.

A) Charge of 1 electron = 1.6×10^{-19} coulomb

1 coulomb = $1 / 1.6 \times 10^{-19}$ electrons

= $10^{19} / 1.6$ electrons

= $10^{20} / 16$ electrons

= $100 \times 10^{18} / 16$ electrons

= 6.25×10^{18} electrons.

1 coulomb = 6.25×10^{18} electrons.

Note: 1 mA (milli Ampere) = 10^{-3} A

1 µA (micro Ampere) = 10^{-6} A

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5. Calculate the current supplied by a cell if the charge supplied by the cell is 360 coulomb in 3 minutes?

A) Given:

Q=360 C

t = 6 minutes = 3 × 60sec =180sec

I=?

We know that

I= Q / t

= 360 / 180

= 2 A.

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6. What will be the time taken of current drawn of 2 ampere by the net charge 4 coulomb ?

A. Given: I=2A

Q=4C

t=?

We know that, I = Q / t

t = Q / I

= 4 / 2

= 2 sec.

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7. 4A of current is passed through a circuit in 8 seconds of time. Then calculate the charge flow in the circuit?

A) Given: I=4A

t=8 seconds

Q=?

We know that, I=Q/t

Q = I × t

= 4 × 8

= 32 C

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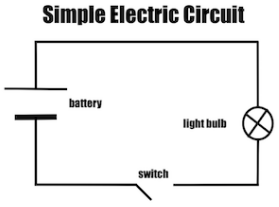
8. What does an electric circuit mean? And draw a diagram of simple electric circuit.

A) Closed path of flow of current between two points through various electrical components is called electric circuit.



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9. Define potential?

A) The amount of work required to move a unit positive charge from infinity to a specific point. The SI unit of electric potential is the volt

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10. Write a short note on potential difference?

A) i. The amount of work is done to move unit positive charge between two points is called potential difference.

ii. Potential difference= work done/time (V=W/Q)

iii. The S.I unit of P.D is volt(V)

iv. One volt=one joule/ one coulomb (1V=1J/1C)

v. Volt meter a device using to measure potential difference.

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11. Define one volt. (Or) What is meant by saying that the potential difference between two points is 1 volt?

A) If a joule of work is said to be done to move unit charge between two points. Then the P.D at the ends of the conductor is one volt.

12.What potential difference is required to do 100 J of work to carry a charge of 10 C between two points?

A) Given,

work done (W) = 100J

Charge (Q) = 10C

Potential difference (V) =?

$V = W/Q$

$V = 100 /10$

$= 10V$

---

13. How much work is done in moving a charge of 1.5C across two points having a potential difference of 10V?

A) Given:

Charge (Q) = 1.5C

Potential difference (V) = 10V

To find: Work done (W) =?

$V = W / Q$

$W = V \times Q$

$\therefore W = 10 \times 1.5 = 15J$

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14. Name the device that helps to maintain a potential difference across a conductor?

A) cell or battery help to provide potential difference across the conductor

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15. How much energy is given to each coulomb of charge passing through a 6V battery?

A) Given:

Charge: Q = 1 C

Potential difference: V = 6 volts

We know that V=W/Q----->W=V×Q

Work done is also considered as energy I, e W=E

Energy: E = 1 × 6 = 6 J

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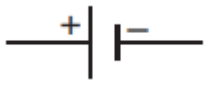
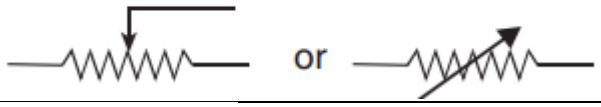
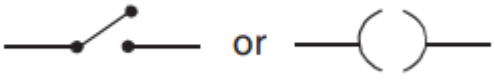
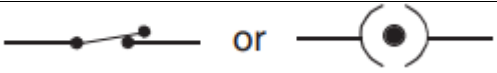
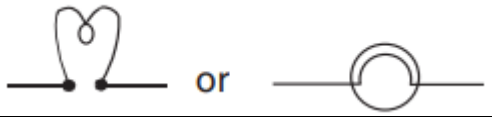
16. Symbols of some commonly used components in circuit diagrams.

A)

Sl. No	Name	Symbol
1.	Cell	
2.	Battery of two cells	
3.	Connecting Wire	
4.	A wire joint	
5.	Wires crossing without contact	
6.	Fixed Resistance (or Resistor)	
7.	Variable Resistance (or Rheostat)	
8.	Ammeter	
9.	Voltmeter	
10.	An open switch (An open plug key)	
11.	A closed switch (A closed plug key)	
12.	Electric Bulb (Electric Lamp)	

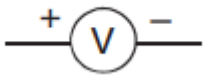
17. What are the differences between potential difference and electro motive force (emf)

A)

Potential Difference	Electro Motive Force (emf)
i. Work done by the electric force to move unit positive charge between two points	i. Work done by chemical force to move negative charge from positive terminal to negative terminal
ii. Potential Difference (V) = W / Q	ii. EMF (ε) = W / Q
iii. S.I unit is Volt	iii. S.I unit is Volt
iv. Volt meter is used to measure the P. D	iv. Volt meter is used to measure the emf

18. What are the differences between 'Volt meter' and 'Ammeter'?

A)

Volt Meter	Ammeter
i. A device using to measure potential difference and emf is called 'Volt-Meter'	i. A device using to measure current strength in a conductor is called 'Ammeter'.
ii. It is always connected in parallel across the points between which measure potential difference	ii. It is always connected in series in the circuit.
iii. It has high resistance	iii. It has low resistance
iv. Its symbol is 	iv. its symbol is 

19. State Ohm's law?

A) i. John Simon ohm a scientist given the relation between the current and potential difference called Ohm's law

ii. According to Ohm's law," At constant temperature the flow of current through a conductor is directly proportional to the potential difference across its ends."

iii. I is the current flowing through a conductor and V is the potential difference at its ends.

$V \propto I$

V= IR---->here R is the proportionality constant called as resistance.

20.Write a short note on resistance of a conductor?

A) i. The property of a conductor due to which it opposes the flow of current through it, is called resistance.

ii. The resistance of a conductor is numerically equal to the ratio of potential difference across its ends to the current flowing through it.

Resistance = Potential difference/Current, (R = V/I)

UNIT OF RESISTANCE

The S.I. unit of resistance is Ohm (Ω)

1 Ohm (Ω) = 1 volt(1V)/ Ampere (1 A)

Note: With respect to resistance, flow of current is always inverse proportion to resistance of the conductor.

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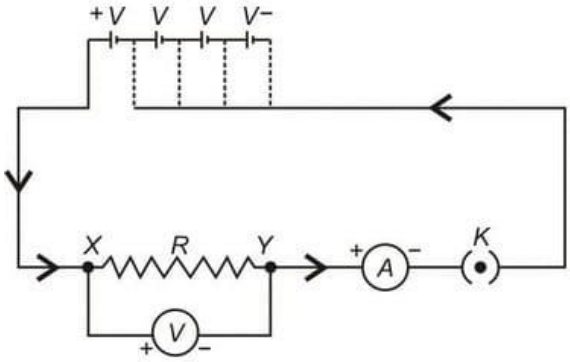
21. Explain OHM'S LAW with an experiment?

A) **Aim**: Study about Ohm 's law

Apparatus:

A nichrome wire of length 0.5 m, an ammeter, a voltmeter and four cells of 1.5 V each.



Procedure:

i. Arrange the circuit as shown in the picture.

ii. First use only one cell as the source in the circuit. Note the reading in the ammeter I, for the current and reading of the voltmeter V for the potential difference across the nichrome wire. Tabulate them.

Sl. No	Potential Difference (V in volts)	Current (I in amperes)	V / I
1.			
2.			

iii. Next connect two cells in the circuit and note the respective readings of the ammeter and voltmeter for the values of current through the nichrome wire and potential difference across the nichrome wire.

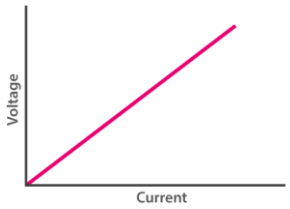
iv. Repeat the above steps using three cells and then four cells in the circuit separately.

v. Calculate the ratio of V to I for each pair of potential difference (V) and current (I).

vi. Here we are observed that flow of current in the conductor increases with increase in potential difference

V--I graph:

Plot a graph between V and I, and observe the nature of the graph.



Conclusion:

1.Thus, V/I is a constant ratio which is called resistance (R).

Hence Ohm's Law is proved.

Note: Slope of V-I graph refers Resistance of the conductor.

22. Define one ohm.

A) The resistance of a conductor is said to be one ohm if a current of one ampere flows through it when a potential difference of one volt is applied across its ends.

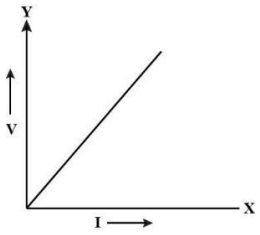
23. Write the differences between ohmic conductors and non-ohmic conductors.

A)

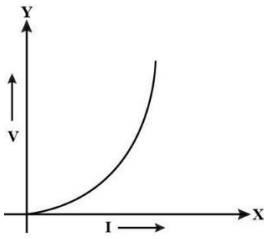
Sl. No	Ohmic Conductors	Non-Ohmic Conductors
1.	Substances obey ohm's law are called 'Ohmic Conductors'.	Substances doesn't obey ohm's law are called Non-Ohmic Conductors.
2.	Resistance remains constant regardless of voltage or current	Resistance varies with voltage or current
3.	V-I graph is a straight line passing through the origin	V-I graph is a non-linear curve that does not pass through the origin
4.	These are called linear conductors.	These are called non-linear conductors
5.	Examples of ohmic conductors include metals like copper and alloys like nichrome.	Examples of non-ohmic conductors include junction diodes and electrolytes

24. Draw the V-I graph for Ohmic and Non-Ohmic conductors.

A)



Ohmic Conductor



Non-Ohmic Conductor

25. If an electric iron has a resistance of 50 Ω and a current of 3.2 A flows through it, what is the voltage between two points?

A) Given: Resistance (R) = 50 Ω

Current (I) = 3.2A

Voltage (potential difference - V) =?

By Ohm 's law. $V=I\times R$

. $=3.2\times 50$

$=160V$

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26. What is the current flowing through a circuit with a 9-volt battery and a 3 Ω resistor?

A) Given: potential difference (V)=9V

Resistance (R)=3 Ω Current (I)=?

By Ohm 's law. $V = I R$

Then $I = V / R = 9/3 = 3A$

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27. When a 12 V battery is connected across an unknown resistor, there is a current of 2.5 mA in the circuit. Find the value of the resistance of the resistor?

A) Given: voltage of battery V = 12 V

Circuit current $I = 2.5\ mA = 2.5 \times 10^{-3}\ A$

We know that, By Ohm 's law $V= I\times R$

$\therefore$ Value of resistance $R = V / I = 12/ 2.5 \times 10^{-3} = 12 \times 10^{3} / 2.5$

$= 4.8 \times 10^{3}$

$= 4800\ \Omega$

Note:

i. substances which have very low electrical resistance are called conductors. A conductor allows the electricity to flow through it easily.

Examples: Silver, Copper and Aluminium

ii. substances which have comparatively high electrical resistance, are called resistors.

Examples: The alloys like nichrome, Manganin and constantan

iii. substances which have infinitely high electrical resistance are called insulators. An insulator does not allow electricity to flow through it.

Examples: Rubber, Wood, glass etc

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28. List the factors affecting resistance of a conductor.

A) Resistance depends upon the following factors:

(i) Length of the conductor.

(ii) Area of cross-section of the conductor (or thickness of the conductor).

(iii) Nature of the material of the conductor. i. e. Resistivity

(iv) Temperature of the conductor

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29. Write the laws of resistance of a conductor

A) The resistance of a given conductor is directly proportional to its length i.e.

$R \propto l$ …. (i)

(ii) The resistance of a given conductor is inversely proportional to its area of cross-section i.e.

$R \propto 1/A$ …. (ii)

30. Derive resistance of a conductor is $R = \rho \times l / A$

A) The resistance of a given conductor is directly proportional to its length i.e.

$R \propto l$ …. (i)

(ii) The resistance of a given conductor is inversely proportional to its area of cross-section i.e.

$R \propto 1/A$ …. (ii)

From (i) and (ii),

$R \propto l/A$

$R = \rho \times l/A$…(iii)

Where ρ (rho) is a constant known as resistivity of the material of the conductor. Resistivity is also known as specific resistance.

31. Write a short note on resistivity.

A) i. Resistance offered by a conductor of unit volume is called resistivity

ii. The S.I. unit of resistivity is ohm-meter which is written in symbols as Ω - m.

iii. factors doesn't affect the resistivity of a substance are length or thickness.

iv. Factors affect the resistivity of a substance are the nature of the substance and temperature.

32. Derive equation for resistivity, $\rho = R \times A/ l$.

A) The resistance of a given conductor is directly proportional to its length i.e.

$R \propto l$ …. (i)

(ii) The resistance of a given conductor is inversely proportional to its area of cross-section i.e.

$R \propto 1/A$ ….(ii)

From (i) and (ii),

$R \propto l/A$

$R = \rho \times l/A$…(iii)

Where ρ (rho) is a constant known as resistivity of the material of the conductor. Resistivity is also known as specific resistance

Therefore, $\rho = R \times A/ l$.

Note: i. A good conductor of electricity should have a low resistivity.

ii. A poor conductor of electricity should have a high resistivity.

iii. The resistivities of alloys are much higher than those of the pure metals.

33. What are used for making of heating elements? Why? (OR) Why are coils of electric toasters and electric irons is made of an alloy rather than a pure metal?

A) i. Generally, alloys like Nichrome are used for making the heating elements of electrical appliances like electric irons, room-heaters, water-heaters and toasters etc.

ii. Because it has

a) very high resistivity

b) And does not undergo oxidation (or burn) even when red-hot.

34. What is the effect of temperature on resistivity?

A) The resistivity of conductors (like metals) is very low. The resistivity of most of the metals increases with temperature.

35. Will current flow more easily through a thick wire or a thin wire of the same material, when connected to the same source? Why?

A) i. The current will flow more easily through a thick wire than through a thin wire of the same material when connected to the same source.

ii. The resistance of a wire is inversely proportional to the square of its diameter.

iii. A thick wire has greater diameter and hence lesser resistance making the current to flow through it more easily.

36. Let the resistance of an electrical component remain constant while the potential difference across the two ends of the component decreases to half of its former value. What change will occur in the current through it?

A) The current through the component will also decrease to half of its former value.

37. A copper wire of length 2 m and area of cross-section 1.7×10^{-6} m^2 has a resistance of 2×10^{-2} ohms. Calculate the resistivity of copper.

A) Given: Resistance (R) = 2×10^{-2} ohms

Area of cross section (A) = 1.7×10^{-6} m^2

Length (l) = 2 m

Resistivity (ρ) =?

We know that, Resistivity (ρ) = R x A / l

= $(2 \times 10^{-2} \times 1.7 \times 10^{-6}) / 2$

= 1.7×10^{-8} ohm-m

38. Silver a metal of very low resistivity than any other metals but it is not used for connecting wires of hose hold circuits. Why?

A) It is economically more expensive.

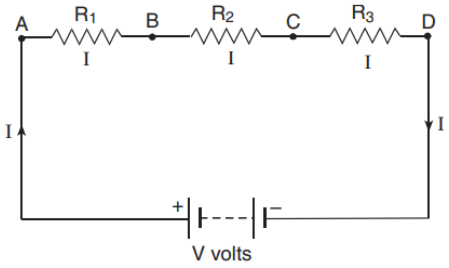
39. Define the following.

A) **Series Circuit**: A series circuit is an electrical circuit in which components are connected end-to-end in a single path, so that the same current flows through all the components

Parallel Circuit: A parallel circuit is an electrical circuit in which components are connected together between two points, providing multiple paths for the current to flow.

40. If three resistors of resistances R_1, R_2 and R_3 connected in series. Derive the equation for resultant resistance of the circuit. (Or) Derive $R = R_1 + R_2 + R_3$.

A)



i. Three resistors R_1, R_2 and R_3 are connected in series.

ii. A battery of 'V' volts has been applied between the ends of the combination of resistors.

iii. In the circuit the flow of current (I) in each resistor is same because there is only one path of the current.

iv. Voltage is divided among the resistors based on their resistances. V_1, V_2 and V_3 are potential differences (Voltage) across resistors R_1, R_2 and R_3 respectively.

v. We are observed that the total voltage across the series circuit is the sum of the individual potential differences (Voltage).

$$V_{total} = V_1 + V_2 + V_3$$

vi. Let the total resistance of the circuit is 'R'. By ohm's law $V_{total} = I\,R$ and $V_1 = I\,R_1$, $V_2 = I\,R_2$ and $V_3 = I\,R_3$

vii. Substitute all these values in the above given equation.

viii. Therefore, $I\,R = I\,R_1 + I\,R_2 + I\,R_3$

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

$$R = R_1 + R_2 + R_3$$

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41. Write the applications of series circuit.

A) i. Used fairy lights to decorate buildings.

ii. Electrical fuses are connected in series with household appliances.

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42. Write the disadvantages of series circuit. (OR) Why is the series arrangements not used for domestic circuits

A) i. Components in series circuit are not functioned efficiently because not able to provide sufficient current to each component by division of voltage.

ii. Not able to provide individual switches to electrical components.

iii. Troubleshooting of components in series circuit is difficult.

iv. If any one of the electrical components in the series circuit are not functioned, the remaining components also do not function.

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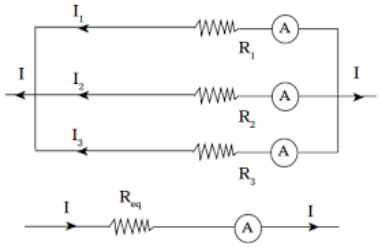
43. If three resistors R_1, R_2 and R_3 are connected in parallel, derive the equation for resultant resistance of the circuit. (Or) Derive $1/R = 1/R_1 + 1/R_2 + 1/R_3$



A) i. In parallel connection of resistors there is same potential difference at the ends of the resistors

ii. Hence the voltage in the circuit is equal to V

iii. In parallel circuit the current I split at the junction with respect to the value of resistance.

iv. Let I_1, I_2 and I_3 be the currents flowing through R_1, R_2 and R_3 resistors respectively.

v. Hence $I = I_1 + I_2 + I_3$ ----------->1

vi. According to the Ohm's law $V = I R$ ===> $I = V/R$ (R ----> resistance of the parallel circuit)

vii. On applying Ohm's law to each resistor we have $I_1 = V/R_1$, $I_2 = V/R_2$ and $I_3 = V/R_3$

viii. Substitute values of I, I_1,I_2 and I_3 are in equation 1

$$V/R = V/R_1 + V/R_2 + V/R_3$$
$$= V(1/R_1 + 1/R_2 + 1/R_3)$$
$$1/R = 1/R_1 + 1/R_2 + 1/R_3$$

Here R is the equivalent resistance.

Note: The equivalent resistance of a parallel combination is less than the resistance of each of the resistors.

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44. What are the advantages of parallel circuit?

A) i. In parallel combination each appliance gets the full voltage. Hence each component works efficiently.

ii. Can provide individual switches.

iii. If one appliance is switched on/off others are not affected.

iv. Fault finding is easy in the circuit.

45.Write the applications of parallel circuit in daily life.

A) i. Home wiring

ii. Lighting systems

iii. Computer networks

iv. Car electrical systems: Parallel circuits power things like the headlights, taillights, radio, and dashboard

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46. What is heating effects of electric current?

A) i. The heating effect of electric current is the phenomenon when an electric current pass through a conductor and produces heat.

ii. The amount of heat produced depends on the strength of the current, the resistance of the conductor, and the time for which the current flows.

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47. State Joule 's law of heating

A) i. Joule's law of heating states that power of heating generated by an electrical conductor is proportional to the product of its resistance (R) and square of the electric current passing through the conductor with time.

ii. The mathematical formula for Joule's law of heating is $H = I^2Rt$

where:

H--->The heat produced by the conductor

I----->The electric current flowing through the conductor

R---->The electrical resistance

t----->The time elapsed

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48. What are the applications of joule heating?

A) i. The heating effect of electric current is widely used in our day-to-day life.

ii. The electric iron, kettle, toaster, heater, etc. are used as alternatives to the conventional methods of cooking and laundry

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49. Name the metal used as filament in electric bulb? Why?

A) The metal used as the filament in an electric bulb is tungsten. Because

i. A strong metal with high melting point (3380° C)

ii. Tungsten has a high resistance, so it doesn't burn easily at room temperature.

iii. Tungsten glows when current passes through it.

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50. Name the gases are usually filled in electric bulb. Why?

A) Bulbs are filled with chemically inactive gases like Nitrogen or Argon to prolong the life of filament by prevent the oxidation of tungsten filament used in the bulb.

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51. Write a short note on electric fuse.

A) i. Fuse is a thin and short metal wire of low melting point to protect electrical devices from any unduly high electric current.

ii. Its working principle is heating effect of electric current

iii. The fuse is placed in series with main circuit.

iv. If the current in the circuit exceeded than the prescribed current, the temperature of fuse is increases.

v. This melts the fuse wire and breaks the circuit, then protect the electrical devices.

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52. Write a short note on electric power.

A) i. The rate at which electric energy is consumed is called electric power.

ii. It measures how quickly energy is used in an electrical circuit.

Electric power (p) = work done / time

$P = W/t$ (We know that potential difference (P.D) $V = W/Q \rightarrow W = VQ$)

$P = VQ/t$

$= V(Q/t)$

$= V I$

iii. Electric power can also be expressed as: $P = V^2 / R$ (By ohm's law $I = V/R$)

$P = I^2R$ (By ohm's law $V = IR$)

iv. The S.I unit of electric power is Volt-Ampere and watt.

v. 1 watt = 1Volt-1Ampere (1 W = 1V-1A)

vi. The unit for electric power is the **watt (W)**, which represents one joule of energy used per second.

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53. Define electric power 1 watt.

A) i. One watt of electric power is the amount of power used when one ampere of current flows through an electrical circuit with a potential difference of one volt.

ii. It is also equal to one joule of work being done on an object per second.

Note: 1kW = 1000 watts = 10^3 watts

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54. Write a short note on electric energy

A) i. Electrical energy is flow of charged particles, such as electrons, through a conductor.

ii. It can be used to power devices, generate electricity, or convert energy.

iii. Mathematically, electric energy is the product of power and time. $E = P \times t$

iv. The commercial unit of electric energy is kilowatt hour (kW h), commonly known as unit.

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55. Convert kW h into joule

A) 1 kW h = 1000 watt × 3600 second

$= 3.6 \times 10^6$ watt second $= 3.6 \times 10^6$ joule (J)

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56. An electric bulb is connected to a 220 V generator. The current is0.50 A. What is the power of the bulb?

A) Given: V= 220 V

I = 0.5A P=?

P=VI

=220 V × 0.50 A

=110 J/s

=110 W.

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57. An electric refrigerator rated 400 W operates 8 hour/day. What is the cost of the energy to operate it for 30 days at Rs 3.00 per kW h?

A) i. The total energy consumed by the refrigerator in 30 days would be $E = p \times t$

ii. Energy = 400 W × 8.0 hour/day × 30 days

= 96000 W h = 96 kW h

3.Thus the cost of energy to operate the refrigerator for 30 days is = no of units × cost of one unit

= 96 kW h × Rs 3.00 per kW h = Rs 288.00

58. What determines the rate at which energy is delivered by current?

A) Electric power is the rate at which electrical energy is transferred by an electric circuit per unit of time. The SI unit of electric power is the watt (W).

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

A) i. The cord of an electric heater does not glow because it is designed to have very low electrical resistance, So the heat produced is not sufficient to glow the cords

ii. while the heating element is specifically designed to have high resistance. Because of high resistance more heat is generated. Hence heating elements will glow.

60. How does resistance vary with its area of cross section?

A) When the cross-sectional area (A) increases, the resistance (R) decreases because electrons have more space to move in the wire.

61. Why are copper and aluminium wires are usually employed for electricity transmission?

A) copper and aluminum are preferred for electricity transmission because of their

i. high conductivity

ii. low resistance

iii. economical

iv. durability

all of which contribute to efficient, reliable power distribution.

62. Write the differences between 'Resistance' and 'Resistivity'.

A)

Resistance	Resistivity
i. The nature of opposing the flow of electrons of a conductor is called 'Resistance'	i. Resistance offered by unit volume of a conductor is called 'Resistivity' or 'Specific Resistance' .
ii. It is denoted by 'R'	ii. It is denoted by 'ρ'
iii. R = ρxℓ / A	iii. ρ = R X A / ℓ
iv. The S.I unit is ohm(Ω)	iv. The S.I unit is ohm-metre (Ω-m)
v. Factors influencing the resistance of a conductor is nature of the material, temperature, length and area of cross-section.	v. Factors influencing the resistivity of a conductor is nature of the material and temperature

63. Define Joules law and derive its mathematical equation $H = i^2 Rt$.

A) **Joule's Law**- The heat produced in a conductor is directly proportional to the square of the current(**i**) passing through it, the resistance(R) of the conductor, and the time(t) for which the current flows. i.e $H = i^2Rt$.

Derivation:

We know that potential difference V = W/Q.

Then, W = VQ

We know that work done converts into heat energy. Therefore, W = H

i.e H = V Q ----------> 1

By, the definition of electric current i = Q/t ,

Then Q = i t ----------> 2

Substitute equation 2 in equation 1

H = V i t ----------> 3

By Ohm's law, V = i R, Substitute V value in above equation

H = (i R) x i t

$= i^2Rt$

(Or)

The amount of energy is dissipated by an electric device per unit time is called 'Power'

Therefore, Power(P) = Energy (E) / Time (t)

Hence, Energy (E) = Power (P) x Time (t)

E = P x t

Power (P) is also defined that the product of Provided potential difference and the strength of current of an electric device.

i.e P = V i

Substitute P = Vi in equation E = P x t

E = V i t

So, here Energy is in the form of Heat (H)

Therefore, H = Vit

By Ohm's law, V = i R, Substitute V value in above equation

H = (i R) x i t

$= i^2Rt$

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