Assignment-1
ANSWER KEY

1. Rate of flow of charge is called as current. The current that flows from positive pole to negative pole of a cell in the external circuit is called conventional current.

2. One ampere is that current when one Coulomb of charge flows through the conductor in one second

3.If the potential difference between the ends of conductor is 1 V and if a current of 1 A flow through it, then the resistance of the conductor is 1Ω.

4. Inversely proportional to temperature

5.The relaxation time of electrons decreases with the rise in temperature of the metal.

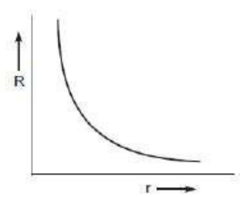
6.The resistivity remains the same as it does not depend upon the length of the wire.

7.It represents resistance. It is measured in ohm.

8.

Resistance of a conductor of length l, and radius r is given by

$R = \rho \frac{\ell}{\pi r^2}$



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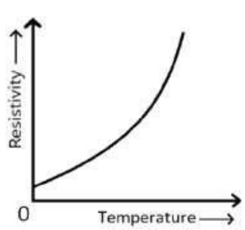
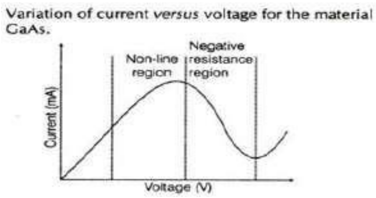


10.(a) greater (b) lower (c) nearly independent of (d) 10^{22}

11.0.6A

I= ne/t = $\frac{2.25 \times 10^{20} \times 1.6 \times 10^{-19}}{60}$= 0.6 A

12.



13. Conductivity increases due to increase in movement of ions with temperature.

14. (a) A metallic conductor for small amounts of current.

(b) Electrolytes such as $CUSO_4$ solution with copper electrodes.

15. Non-ohmic devices are those that do not obey Ohm's law. Vacuum tubes and thermistors are two examples.

16. The maximum potential difference which is present between two electrodes of a cell is defined as the electromotive force of a cell or EMF of a cell.

17. The temperature coefficient of resistivity is positive for metals and negative for semiconductor.

18. Gold, silver

19. silicon, germanium

20. The value of temperature co-efficient of resistance *(alpha) is more for metals than for alloys.*

21. It increases with rise in temperature.

22. Increases

23. Terminal potential difference of a cell is defined as the potential difference between the two electrodes of a cell in a closed circuit

Multiple Choice Questions –answers

24.(b) 25.(b) 26. (a) 27. (d) 28. (b) 29. (d) 30. (d) 31. (b) 32. (a) 33. (b) 34. (a) 35. (d) 36. (b)

37. (d)

38. As $I = neAv_d$

$v_d = I/neA = 1.5/(9 \times 10^{28} \times 1.6 \times 10^{-19} \times 5 \times 10^{-6})$

$v = 0.02 \times 10^{-3}$ m/s = 0.02 mm/s

Answer: (d) 0.02

39. Case (1)As $I^2R = P$

$R = P/I^2$

$R = (4.4)/(2 \times 10^{-3})^2 = 1.1 \times 10^6\ \Omega$

Case (2)$P = V^2/R = (11)^2/(1.1 \times 10^6) = 11 \times 10^{-5}$ W

Answer: (b) 11 × 10^{-5} W

40. (a) Nichrome

41. (a) Increase in temperature

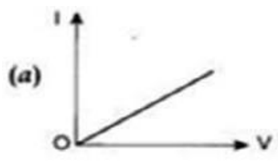
42. (b) very weak temperature dependent resistivity

43. (c) Joule / coulomb

44. (c) both of these

45. (a) 0

46. (a)



47. (c) same

48. (d) number density of free electrons

49. (a) 6V

Assuming copper slab to be ideal conductor i.e. R = 0
⇒E=I x r
E=12×0.5
E=6V

ASSERTION AND REASONS (Each 1M)

50. (C) 51. (A) 52. (A) 53. (C) 54. (A) 55. (A) 56. (D) 57. (C) 58. (D)

2 MARK QUESTIONS

59. 1.875 x 10^{19}

I = V/R = 10^{-2}A = q/t

q = It = ne

n = 1.875 x 10^{19}

60. When electrons are subjected to an electric field they do move randomly, but they slowly drift in one direction, in the direction of the electric field applied. The net velocity at which these electrons drift is known as drift velocity.

61.Let l is the length of the conductor and A uniforms area of cross-section.

Therefore, the volume of the conductor = Al

If n is the number of free electrons per unit volume of the conductor, then the total number of free electrons in the conductor=Aln.

If e is the charge on each electron, then total charge on all the free electrons in the conductor q=Alne

Let a constant potential differences V is applied across the ends of the conductor with the help of a battery

The electric field set up across the conductor is given by

E=V/l

$t=l/v_d$

As current I=q/t

$I=neAv_d$.

62.A device that does not obey Ohm’s law is non ohmic device. Ex. Semiconductor diode

63. Relaxation time is the time interval between two successive collisions of electrons in a conductor, when current flows

Second Inversely proportional to temperature

64. It states that the current through any two points of the conductor is directly proportional to the potential difference applied across the conductor provided that the physical conditions remains constant.

(a) V ceases to be proportional to I.

(b) The relation between V and I depends on the sign of V. In other words, if I is the current for a certain V, then reversing the direction of V keeping its magnitude fixed, does not produce a current of the same magnitude as I in the opposite direction. This happens, for example, in a diode.

(c) The relation between V and I is not unique, i.e., there is more than one value of V for the same current I. A material exhibiting such behavior is GaAs.

65.Length = 15 m

Area of cross section 6×10^{-7} m^2

R= 5 Ohms

Resistivity $=p=\frac{RA}{l}=2.0 \times 10^{-7}\Omega m$

66. The resistance of a wire depends on its length (l), cross-sectional area (A), number of electrons per m^3 (n) and the relaxation time $R=\frac{m \quad l}{ne^2 cA}$

67.Ans. $2.8 \times 10^{-4} ms^{-1}$

$E = V/l = 50$ V/m

$v_d = \mu E = 2.8 \times 10^{-4} ms^{-1}$

68. $E = V/l = 12.5$ V/m

$v_d = \mu E = 6 \times 10^{-5} ms^{-1}$

$n = \frac{I}{Aev_d} = 8.68 \times 10^{28} m^{-3}$

69. The electron crosses a point on the circle once in every revolution. If v is number of revolutions made by the electron in 1 s, then its motion along circle corresponds to a current,

$I = ef = e/T = \frac{ev}{2\pi r} = 6.1 \times 10^{-13}$ A

70. Temperature coefficient of resistivity of silver = α

$$\alpha = \frac{R_2 - R_1}{R_1(T_2 - T_1)}$$

$$\alpha = \frac{2.7-2.1}{2.1(100-27.5)} = 0.0039^\circ C^{-1}$$

71. **Electric energy**: The total work done by the source of emf in maintaining an electric current in a circuit for a given time is called electric energy consumed in the circuit. Its SI unit is joule.

Electric power: The rate at which work is done by a source of emf in maintaining an electric current through a circuit is called electric power of the circuit. Its SI unit is Watt.

72. Conductivity (or specific conductance) of a conductor is a measure of its ability to conduct electricity. It is also reciprocal of resistivity of the conductor. The SI unit of conductivity is Siemen per meter (S/m). The electrical conductivity of a metallic conductor will decrease with an increase in temperature.

73. Electric energy consumed = $W = Q \times V$

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

$W = I \times t \times V$

$\therefore W = I \times t \times V$

Is also = I^2Rt and $\frac{V^2 t}{R}$

74. Electric current is a scalar quantity the reason is that laws of ordinary algebra are used to add electric currents and laws of vector additions do not apply to the addition of electric currents.

75.It is so called because this method was first suggested by a British physicist Charles Wheatstone in 1843.It is called a bridge because galvanometer circuit forms a kind of bridge by connecting two points having the same potential.

76. Wheatstone bridge is said to be sensitive if it produces more deflection in the galvanometer for a small change of resistance in resistance arm. It is most sensitive when all four resistors P, Q, R, S are nearly of same magnitude and null point is obtained in the middle of alloy wire.

77. a) It is a null point method hence the result is free from the effect of extra resistances of the circuit.

b) As it is null point method so it is easier to detect a small change in deflection.

78.Diagram of Wheatstone bridge.

79. The EMF of a cell is greater than its terminal voltage because there is some potential drop across the cell due to its small internal resistance. During charging of a cell, terminal potential difference is greater than emf

3 MARK QUESTIONS

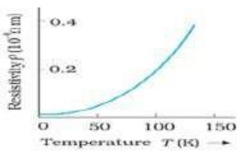
80.i. The surface area of electrodes- Larger the surface area of electrodes, less is the internal resistance.

ii. Distance between electrodes- More the distance between the electrodes, the greater is the internal resistance.

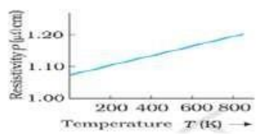
iii. Concentration of electrolyte - less ionic the electrolyte or higher the concentration of electrolyte, greater is the internal resistance.

iv. Temperature of electrolyte - higher the temperature, less is the internal resistance.

81.



Resistivity ρ_T of copper as a function of temperature T.



Resistivity of nichrome wire as a function of temperature

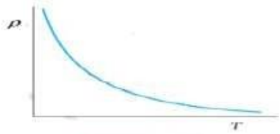


FIGURE 3.11 Temperature dependence of resistivity for a typical semiconductor.

82.$E_{eq} = E_1 + E_2 + E_3$ ———$E_n = nE$

$r_{eq} = r_1 + r_2 + r_3$ ———$r_n = nr$

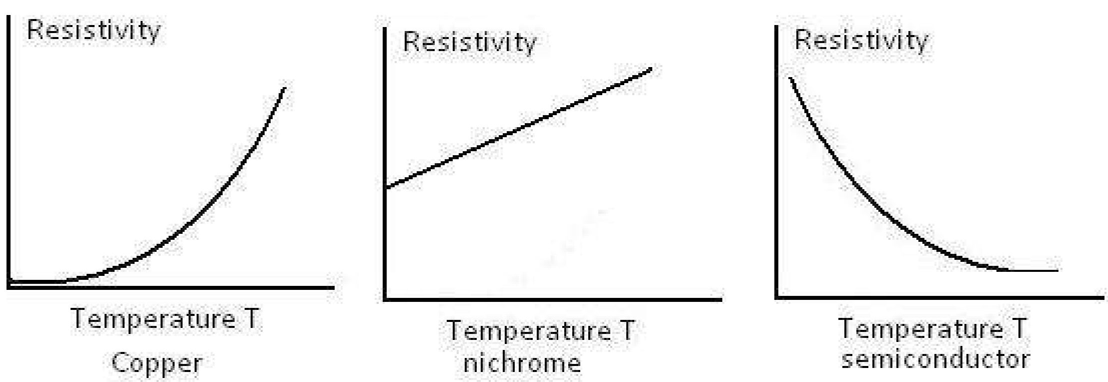
83. Obtain following all the steps $\quad r = \frac{(E-V)R}{V}$

5 MARK QUESTIONS

84. We know that, $R = \frac{pl}{A}$

$l=1m, A=1m^2 \Rightarrow p=R$

Thus, resistivity of a material is numerically equal to the resistance of the conductor having unit length and unit cross-sectional area and its SI unit is Ohm-m



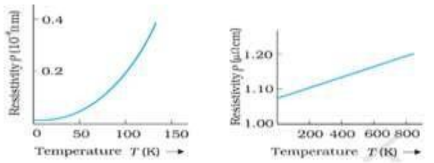
The resistivity of a material is found to be dependent on the temperature. The resistivity of a metallic conductor is given by

$p_T = p_o[1+\alpha (T-T_0)]$ ....(i)

Where p_T is the resistivity at a temperature T and p_0 is the same at a reference temperature T_0,α is called the temperature co-efficient of resistivity. This expression shows that resistivity increaseswith increase in temperature of the conductor

85. Explanation using

$$\rho = \frac{1}{n\tau}$$



Resistivity ρ_T of copper as a function of temperature T.

Resistivity of nichrome wire as a function of temperature

temperature coefficient of resistivity

$$\alpha = \frac{\Delta\rho}{\rho_0 \Delta T}$$

SI unit – K^{-1}

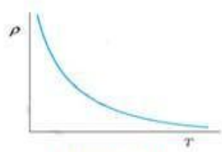


FIGURE 3.11
Temperature dependence of resistivity for a typical semiconductor.

86. Kirchhoff's laws explanations from book.

1st law is based upon law of conservation of charge and 2nd law is based upon law of conservationof energy.

87. $I_1 = I_2 + I_3$...(1) (Using KCL)

$4 I_3 + 2 I_1 - 24 = 0$... (2) (Using KVL)

$4 I_3 - 6 I_2 - 27 = 0$... (3) (Using KVL)