CHAPTER-3

CURRENT ELECTRICITY

ASSIGNMENT-1

1-MARK QUESTIONS

Q1.What is meant by current and conventional current?

Q2. Define SI unit of current.

Q3. 1 Ω=1V/1A from this what do you mean by 1 ohm?

Q4.How does drift velocity of electrons change with temperature?

Q5.What is the effect of temperature on the relaxation time of electrons in a metal?

Q6. A wire or resistivity ρ is stretched to double its length. What will be its new resistivity?

Q7.Which physical quantity does the voltage versus current graph for a metallic conductor depict? Give its SI unit.

Q8. Draw the graph showing the variation of resistance of a cylindrical conductor with its radius

Q9.Draw the graph showing the variation of resistance of a conductor with rise in temperature.

Q10.Answer the following questions:

(a) Alloys of metals usually have_____resistivity than that of their constituent metals.

(b) Alloys usually have much_____temperature coefficients of resistance than pure metals.

(c) The resistivity of the alloy manganin is_____rapidly with increase of temperature.

(d) The resistivity of a typical insulator (e.g., amber) is greater than that of a metal by a factor of the order of _____

Q11. If 2.25×10^{20} electrons pass through a wire in one minute, find the magnitude of the current flowing through the wire.

Q12. Define EMF of a cell.

Q13. What happens to the conductivity of electrolytes as temperature is increased?

Q14. What are ohmic conductors? Give two examples.

Q15. What are non ohmic devices. Give two examples.

Q16. Draw V-I graph for GaAs.

Q17. How temperature coefficient of resistivity for metals is different from temperature coefficient of resistivity for semiconductor.

Q18. Name two substances for which temperature coefficient of resistivity is positive.

Q19. Name two materials for which temperature coefficient of resistivity is negative.

Q20. How is temperature coefficient of resistivity different for metals and alloys.

Q21.What happens to resistivity of metals with increase in temperature?

Q22. What happens to resistivity of semiconductors or insulators with increase in temperature?

Q23. Define terminal potential difference of a cell.

Multiple Choice Questions (Each 1M)

Choose the correct option(s) in the following questions.

Q24**.** The resistance of a metal wire increases with increasing temperature on account of

(a) decrease in free electron density.

(b) decrease in relaxation time.

(c) increase in mean free path.

(d) increase in the mass of electron.

Q25. $m^2 V^{-1} s^{-1}$ is the SI unit of which of the following?

(a) Drift velocity (b) Mobility (c) Resistivity (d) Potential gradient

Q26. Resistivity of a given conductor depends upon

(a) temperature. (b) length of conductor. (c) area of cross-section. (d) shape of the conductor.

Q27. The carriers of electricity in a metallic conductor are

(a) holes (b) negative ions (c) positive ions (d) electrons

Q28. The time rate of flow of charge through any cross section of a conductor is _____

(a) electric potential (b) electric current(c) electric intensity (d) electric charge

Q29. When no current is passed through a conductor:

(a) the free electrons do not move

(b) the average speed of a free electron over a large period of time is not zero

(c)the average velocity of a free electron over a large period of time is zero

(d) the average of the velocities of all the free electrons at an instant is non-zero

Q30. A steady current is flowing through a conductor of non-uniform cross-section. The charge passing through any cross-section of it per unit time is:

(a) directly proportional to the area of cross-section

(b) inversely proportional to the area of cross-section

(c) proportional to square of the area of cross-section

(d) independent of the area of cross-section

Q31. Drift velocity of electrons is due to:

(a) motion of conduction electrons due to random collisions.

(b) motion of conduction electrons due to electric field *E*.

(c) repulsion to the conduction electrons due to inner electrons of ions.

(d) collision of conduction electrons with each other.

Q32.Identify the set in which all the three materials are good conductors of electricity:

(a)Cu, Ag and Au (b) Cu, Si and diamond (c) Cu, Hg and NaCl (d) Cu, Ge and Hg

Q33.The I-V characteristics shown in figure represents:

(a)ohmic conductors (b)non-ohmic conductors (c)insulators (d)superconductors

Q34. In the equation AB = C, A is the current density, C is the electric field, Then B is:

(a)resistivity (b) conductivity (c) potential difference (d) resistance

Q35.If a current of 0.5 A flows in a 60 W lamp, then the total charge passing through it in two hours will be:

(a)1800 C (b) 2400 C (c) 3000 C (d) 3600 C

Q36.The relaxation time in conductors:

(a)increases with the increases of temperature (b)decreases with the increases of temperature

(c)it does not depend on temperature (d)all of sudden changes at 400 K

Q37. A steady current of 1 A is flowing through the conductor. The number of electrons flowing through the cross-section of the conductor in 1 sec is:

(a)6.25×10^{15} (b) 6.25×10^{17} (c) 6.25×10^{19} (d) 6.25×10^{18}

Q38. Drift speed of electrons, when 1.5 A of current flows in a copper wire of cross-sectional area 5 mm^2 is v. If the electron density of copper is $9 \times 10^{28}/m^3$ the value of v in mm/s is close to (Take charge of electron to be = 1.6×10^{-19} C)

(a) 3 (b) 0.2 (c) 2 (d) 0.02

Q39. A current of 2 mA was passed through an unknown resistor which dissipated a power of 4.4 W. Dissipated power when an ideal power supply of 11 V is connected across it is

(a) 11×10^{-4} W (b) 11×10^{-5} W (c) 11×10^{5} W (d) 11×10^{-3} W

Q40. Nichrome and copper wires of same length and area of cross section are connected in series, current is passed through them, which wire gets heated first?

(a) Nichrome (b) copper (c) both equally (d) none of them

Q41. The specific resistance of a conductor increases with

(a) increase in temperature (b)increase in cross-sectional area

(c) decrease in length (d)decrease in cross-sectional area

Q42. Nichrome or Manganin is widely used in wire bound resistors because of their

(a)temperature independent resistivity (b)very weak temperature dependent resistivity

(c)strong dependence of resistivity with temperature (d)mechanical strength

Q43.EMF is electromotive force, what is its SI unit:

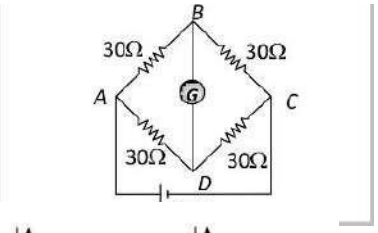
a) Newton b) Newton sec c) Joule / coulomb d) Newton meter

Q44. Kirchhoff's laws are based upon

a) Law of conservation of energy b) law of conservation of charge

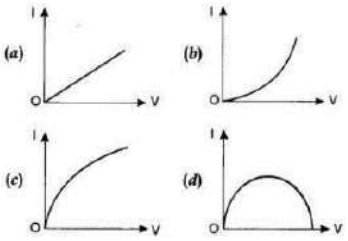
c) both of these d) none of these

Q45. In the following figure current flowing through BD is



(a) 0 (b)0.033 A (c) 0.066 A
(d) None of these

Q46. Which of the following I-V graph represents ohmic conductors?



Q47.The specific resistance of a rod of Aluminium as compared to that of thin wire of Aluminium is:

(a) less (b) more (c) same (d) depends upon the length and area of cross-section

Q48. A current passes through a wire of non-uniform cross section. Which of the following quantities are independent of cross section

(a) the charge crossing (b)Drift velocity (c)current density
(d)number density of free electrons

Q49. When a battery of internal resistance 0.5 ohm is connected to a thick copper slab, a current of 12A passes through it. The emf of the cell is

(a) 6V (b) 24V (c) 12V (d) 4V

ASSERTION AND REASONS (Each 1M)

Directions: In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true but reason is not the correct explanation of assertion.

(c) If assertion is true but reason is false.

(d) If both assertion and reason are false.

Q50.**Assertion:** The current density *j* at any point in ohmic resistor is in direction of electric field *E* at that point.

Reason: A point charge when released from rest in a region having only electrostatic field always moves along electric lines of force.

Q51.**Assertion:** The 200 W bulbs glows with more brightness then 100 W bulbs.

Reason: A 100 W bulb has more resistance than a 200 W bulb.

Q52. **Assertion:** Bending a wire does not affect electrical resistance.

Reason: Resistance of wire is proportional or resistivity of material.

Q53. **Assertion:** Fuse wire must have high resistance and low melting point.

Reason: Fuse is used for small current flow only.

Q54. **Assertion**: Two electric bulbs of 50 W and 100 W are given. When connected in series 50 W bulb glows more but when connected parallel 100 W bulb glows more.

Reason: In series combination, power is directly proportional to the resistance of circuit. But in parallel combination, power is inversely proportional to the resistance of the circuit.

Q55.**Assertion**: When current through a bulb decreases by 0.5%, the glow of bulb decreases by1%.

Reason: Glow (Power) which is directly proportional to square of current.

Q56. **Assertion**: Two bulbs of same wattage, one having a carbon filament and the other having a metallic filament are connected in series. Metallic bulbs will glow more brightly than carbon filament bulb.

Reason: Carbon is a semiconductor.

Q57. **Assertion**: A current flows in a conductor only when there is an electric field within the conductor.

Reason: The drift velocity of electron in presence of electric field decreases.

Q58. **Assertion**: In practical application, power rating of resistance is not important.

Reason: Property of resistance remain same even at high temperature

2 MARK QUESTIONS

Q59. A potential difference of 10 V is applied across a conductor of resistance 1 kΩ. Find the number of electrons flowing through the conductor in 5 minutes.

Q60. Whatis drift velocity of electrons? How do you explain the flow of current in a conductor based on this?

Q61. Establish the relation between drift velocity and electric current.

Q62.What is non-Ohmic device? Give one example.

Q63. Define relaxation time of electrons in a conductor. Give its SI units. Explain, how it varies with increase in temperature of conductor?

Q64. State Ohm's law. Discuss three situations which describe the failures of Ohm's law.

Q65. A negligibly small current is passed through a wire of length 15 m and uniform cross-section 6.0×10^{-7} m^2 , and its resistance is measured to be 5.0 Ω. What is the resistivity of the material at the temperature of the experiment?

Q66. What are the factors on which the resistance of a conductor depends? Give the corresponding relation.

Q67. A potential difference of 6 V is applied across a conductor of length 0.12 m. Calculate the drift velocity of electrons, if the electron mobility is 5.6×10^{-6} m^2 V^{-1} s^{-1} conductor.

Q68. A current of 1 A flows through a wire of length 0.24 m and area of cross-section 1.2 mm^2, when it is connected to a battery of 3 V. Find the number density of free electrons in the wire, if the electron mobility is 4.8×10^{-6} m^2 V^{-1} s^{-1}.

Given that charge on electron = 1.6×10^{-19} C.

Q69. An electron moves in a circle of radius 0.15 m with a constant speed of 3.6×10^6 m s^{-1}. What electric current does this correspond to?

Q70.A silver wire has a resistance of 2.1 Ω at 27.5 °C, and a resistance of 2.7 Ω at 100 °C. Determine the temperature coefficient of resistivity of silver.

Q71. Define electric power and electric energy. Give their SI units.

Q72. Define conductivity of a conductor. State its SI unit. Explain the variation of conductivity with temperature of a metallic conductor.

Q73. Derive an expression for electric energy consumed in a device in terms of V,I and t, where V is the potential difference applied to it, I is the current drawn by it and t is the time for which current flows?

Q74.Is electric current a scalar or vector quantity? Give reason.

Q75. Why is a Wheatstone Bridge so called?

Q76. What do you mean by sensitivity of Wheatstone Bridge? when is wheat stone Bridge most sensitive?

Q77. What are the advantages of a Wheatstone Bridge method of measuring resistances over other methods?

Q78. Draw a circuit of balanced Wheatstone Bridge and label it.

Q79. Why is EMF of a cell always greater than terminal potential difference? Is there a case when terminal potential difference is greater than emf?

3 MARK QUESTIONS

Q80. What are the factors on which internal resistance of a cell depend?

Q81. Show the variation of resistivity of

i) copper with temperature ii) Nichrome with temperature. iii)silicon with temperature

Q82. Two cells of different emfs and internal resistance are connected in series with one another find the expressions for equivalent EMF and equivalent internal resistance of the combination.

Q83. A resistance R is connected across a cell of emf 8V and internal resistance r. A Voltmeter now measures the potential difference between the terminals of the cell as V. Obtain the expression for r in terms of E, V and R. Draw related circuit diagram also.

5 MARK QUESTIONS

Q84.Define resistivity of a conductor and give its SI unit. Plot a graph showing the variation ofresistivity with temperature for (i). Copper (ii).Nichrome (iii).Semiconductor.

How does one explain such a behavior, using the mathematical expression of the resistivity of aconductor?

Q85. Explain the variation of resistivity, of metals, semiconductors, insulators with graphs andhence define temperature coefficient of resistivity, write its si unit.

Q86. State Kirchhoff's laws and explain them using appropriate circuit diagrams. Write about the fundamental principles on which they are based.

Q87. Applying the Kirchhoff's laws in following circuit diagram, Write all relations between I_1,I_2,and I_3