CHAPTER- 3
CURRENT ELECTRICITY

One mark questions

1. Define instantaneous electric current through a conductor. (U)
2. Define steady current in a conductor. (U)
3. Give the SI unit of electric current. (K)
4. In the nature where do the free charged particles exist? (K)
5. Write the relation between coulomb and ampere. (U)
6. How many electrons per second constitute a current of one micro ampere? (U)
7. Is electric current a scalar or vector quantity? (K)
8. How many electrons flow per second through a conductor carrying a current of 0.5 mA? (A)
9. Define free electron density of a conductor. (U)
10. What is the net charge conducted across any section at zero potential difference? (U)
11. What is the conventional direction of electric current? (K)
12. What is the net flow of electric charges in any direction inside the solid conductor? (U)
13. Name the current carriers in metals or solid conductors. (K)
14. Name the current carriers in electrolytic solutions or liquid conductors. (K)
15. Name the current carriers in discharge tubes or gaseous conductors. (K)
16. State Ohm's law. (K)
17. Define resistance of a metallic conductor. (U)
18. Write the SI unit of resistance. (K)
19. Define SI unit of resistance. (U)
20. How does the resistance of a conductor depend on its length? (U)
21. How does the resistance of a conductor depend on its area of cross section? (U)
22. Define electrical conductance. (U)
23. Mention the SI unit of conductance. (K)
24. Define resistivity of a material of a conductor. (K)
25. A wire of given resistivity is stretched to three times its length .What will be its new resistivity? (A)
26. Mention the relation between the resistance and resistivity? (U)
27. Mention the SI unit of resistivity? (K)
28. Define the term current density (j) (U)
29. Write the SI unit of current density. (K)
30. Is current density a scalar or a vector quantity? (K)
31. Define electrical conductivity. (U)
32. Mention the relation between current density and conductivity. (U)
33. Define drift velocity. (U)
34. What is the average velocity of free electrons in a metal at room temperature? (K)
35. What is the effect of temperature on the drift speed of electrons in a metallic conductor? (U)
36. Define relaxation time or mean free time. (U)

37. What is the effect of relaxation time of electrons on the conductivity of a metal? (K)
38. Define electron mobility. (U)
39. Mention the SI unit of mobility. (K)
40. Write the expression for mobility in terms of relaxation time. (U)
41. Name a material whose resistivity decreases with the rise of temperature. (K)
42. How does the resistance of an insulator change with temperature? (K)
43. What will be the value of resistance of a resistor having four colour bands in the order red, red, orange and gold? (U)
44. Write the value of resistance of a resistor having four colour bands in the order brown, red, black and silver? (U)
45. The value of resistance of a resistor is $2.5\times 10^3 \pm 10\%$. Write the colour sequence of the resistor. (A)
46. Write the colour code for the resistors of resistance 500Ω, 5KΩ, 37Ω, $4.5X10^3\Omega$. (U)
(each one mark)
47. The colour sequence is Brown, black, red and gold on a resistor. Write its resistance value. (U)
48. The value of resistance of a resistor is $0.1\pm 10\%$. Write the colour sequence of the resistor.(A)
49. What is the colour of the third band of a coded resistor of resistance $5.5\times 10^5\Omega$? (A)
50. Draw a graph indicating the variation of resistivity of copper with temperature. (S)
51. Represent graphically the variation of resistivity of nichrome with temperature. (S)
52. Draw a graph indicating the variation of resistivity of a semiconductor with temperature.(S)
53. How does the resistance of a conductor vary with temperature?(U)
54. What happens to the resistivity of a conductor when the temperature is increased? (U)
55. How does the resistivity of a semiconductor vary with temperature? (U)
56. Name a material which exhibits very weak dependence of resistivity with temperature? (K)
57. Why manganin or constantan are used to make resistance coils. (U)
58. When are the two resistors said to be in series? (K)
59. When resistors are said to be in parallel? (K)
60. 3Ω and 5Ω resistors are connected in series, if the rate of flow of charge in 3Ω resistor is 5A, what is the rate of flow of charge in 5Ω resistor? (A)
61. If V_1 and V_2 be the potential difference across resistors R_1 and R_2 in series, then what is the potential difference across the combination? (A)
62. What is the equivalent resistance of 'n' resistors each of resistance R connected in series? (U)
63. What happens to the effective resistance of the combination when two or more resistors are connected in series? (K)
64. What happens to the effective resistance when two or more resistors are connected in parallel? (K)
65. Two equal resistors are connected in parallel to the main current 3A source. What is the value of current through each resistor? (A)
66. Define emf of a cell? (U)
67. Define internal resistance of a cell. (U)
68. Give the expression for the potential difference between the electrodes of a cell of emf 'E' and internal resistance 'r'? (U)
69. Write the expression for equivalent emf when two cells of emf E_1 and E_2 connected in series. (U)

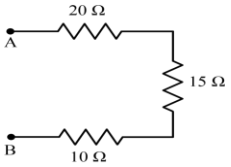
70. Write the expression for equivalent emf when two cells of emf E_1 and E_2 connected in series such that negative electrode of E_1 to negative electrode of E_2. (U)
71. Write the expression for equivalent emf of 'n' cells each of emf ξ connected in series. (U)
72. Give the expression for equivalent internal resistance of 'n' cells each of internal resistance 'r' connected in series. (U)
73. What is an electric network? (K)
74. What is a node or junction in an electrical network? (K)
75. What is a mesh or loop in an electrical network? (K)
76. State Kirchhoff's junction rule. (K)
77. What is the significance of junction rule or KCL? (U)
78. State Kirchhoff's loop rule? (K)
79. What is the significance of KVL or loop rule? (U)
80. Write the balancing condition for Wheatstone's network. (K)
81. What happens to the balancing condition of a balanced Wheatstone's network, if the galvanometer is replaced by a voltmeter of resistance 5000Ω? (U)
82. What happens to the balancing condition of Wheatstone's network, if the position of galvanometer and battery are interchanged? (U)
83. Name the device which works on the principle of Wheatstone network. (K)
84. Is the balance point of Wheatstone network affected by the internal resistance of the cell? (K)
85. What is the principle of Meter Bridge? (K)
86. Mention one use of Meter Bridge. (K)
87. Write the expression for unknown resistance R in terms of standard resistance S and balancing length l of a meter bridge. (U)
88. How the error in finding R the unknown resistance of a wire using Meter Bridge can be minimized? (U)
89. Mention one application of potentiometer. (K)
90. Write the equation used to compare emf of two cells in terms of balancing length in potentiometer experiment. (U)
91. Give the formula to determine the internal resistance of the cell using potentiometer. (U)
92. What is the advantage of potentiometer in the measurement of the internal resistance of a cell? (U)
93. In a potentiometer, potential difference per unit length of the wire in 2 Vm^{-1}. What is the balancing length for a cell of emf 1.4 V? (A)

TWO mark questions

1. Write any two differences between resistance and resistivity. (U)
2. Define the terms (1) drift velocity (2) relaxation time. (U)
3. Obtain an expression for acceleration of an electron in a current carrying conductor. (U)
4. State and explain Ohm's law. (K)
5. Write the limitations of ohm's law. (K)
6. Mention the factors on which resistivity of a metal depend. (U)
7. Write the expression for resistivity in terms of number density and relaxation time. (U)
8. Mention any two factors on which resistance of a conductor depends. (K)

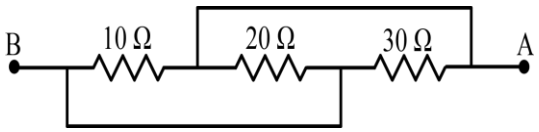
9. State another equivalent form of ohm's law in terms of current density and conductivity and explain the terms. (K)
10. A cell of emf 2V and internal resistance 1 Ω is connected across a resistor of 9 Ω. find the terminal potential difference of the cell. (A)
11. Draw V-I graph for ohmic and non- ohmic materials. (S)
12. How does the resistance of (1) good conductor, (2) semiconductor vary with increase in temperature? (U)
13. Define emf and internal resistance of a cell. (U)
14. Which are the two major types of resistors commercially made? (K)
15. Explain how wire bound resistors are made. (U)
16. To make resistors of high range which material is used and why? (U)
17. Distinguish between terminal potential difference and emf of a cell. (U)
18. Is terminal potential difference equal to the emf of a cell? Justify your answer. (U)
19. Terminal potential difference is less than the emf of a cell. Why? (U)
20. Mention the factors on which internal resistance of a cell depend. (K)
21. For what basic purpose, the cells are connected (1) in series (2) in parallel? (U)
22. Define electrical power and write its S.I unit. (U)
23. State and explain Kirchhoff's junction rule/ current law. (K)
24. State and explain Kirchhoff's loop rule / voltage law (K)
25. State Kirchhoff's laws/rules of electrical network. (K)
26. What is the cause of resistance of a conductor? Explain (U)
27. A large number of free electrons are present in metals. But there is no current in the absence of electric field across. Why? (U)
28. Why high voltage power from power generating station is preferred than high current for transmission of electrical power. (U)
29. Mention two uses of potentiometer. (K)
30. Why the connecting resistors in a meter bridge are made of thick copper strips? (K)
31. A Carbon resistor has three strips of red colour and a gold strip. What is the value of resistance and its tolerance? (U)
32. The potential difference between the terminals of an electric iron is 240 V and the current is 5.0A. What is the resistance of the electric iron? (A) **(48 Ω)**
33. A potential difference of 20 volts is applied across the ends of a resistance of 5 Ω. What current will flow in the resistor? (A) **(4 A)**
34. A current of 5 A flows through a wire whose ends are at a potential difference of 3 volts. Calculate the resistance of the wire.(A) **(0.6Ω)**
35. An electric bulb draws a current of 0.35 A for 20 minutes. Calculate the amount of electric charge that flows through the circuit. (A) **(420 C)**

36. Find the equivalent resistance between points A and B. (A)



(45 Ω)

37. Find the equivalent resistance between the points A and B?



(5.45 Ω)

Three mark questions

1. Arrive at the expression for electric current in terms of drift velocity. Or Derive $I = nAev_d$ where the symbols have their usual meaning (U)
2. Derive **E=J**ρ or $\vec{j} = \sigma\vec{E}$ or derive the expression for current density in terms of electric field and conductivity of the material using ohm's law. (U)
3. Explain how electric current is developed in conductors. (U)
4. Plot the graph of variation of resistivity with temperature for copper and explain why it is so? (S)
5. Explain how and why the transmission of high voltage power from power generating stations to houses and factories is achieved. (U)
6. Arrive at the relation between terminal potential difference and emf of a cell using ohm's law. (U)
7. How does resistivity of a conductor vary with temperature? Define temperature coefficient of resistivity. Draw the graph of variation of resistivity of a conductor with temperature. (S)
8. Obtain the expression for effective resistance of two resistors in series. (U)
9. Obtain the expression for effective resistance of two resistors in parallel. (U)
10. What is the principle of Meter Bridge? Arrive at the expression for the (unknown) resistance using Meter Bridge. (U)

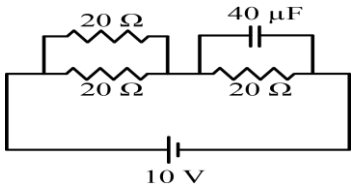
Five mark questions

1. Explain how resistance depends on the dimensions of the conductor and hence arrive at the expression for resistivity. (U)
2. Derive the expression for electrical conductivity. Or derive $\sigma = \frac{ne^2\tau}{m}$ where symbols have usual meaning. (U)
3. Assuming the expression for current in terms of drift velocity, deduce Ohm's law. (U)
4. What is meant by equivalent resistance? Derive the expression for equivalent resistance of two resistors connected in series. Write the expression for the effective resistance of 'n' resistors connected in series. (U)
5. What is meant by equivalent resistance? Derive expression for equivalent resistance of two resistors connected in parallel.(U)

6. Define emf and terminal potential difference of a cell. Derive an expression for main current using Ohm's law. (U)
7. Discuss the grouping of two cells in series and find their equivalent emf and internal resistance.(U)
8. Obtain the expression for the equivalent emf and internal resistance of two cells connected in parallel. (U)
9. Define electrical power. Arrive at an expression for electrical power in terms of current, potential difference and resistance of the conductor. (U)
10. What is a 'node' in electrical network? State and explain Kirchhoff's rules of electrical network. (K)
11. Deduce the condition for balance of Wheat stone's network using Kirchhoff's laws. (U)

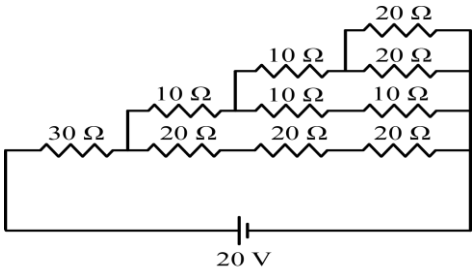
Numerical problems

1. A wire of resistance R is cut into five equal pieces. These five pieces of wire are then connected in parallel. What is the equivalent resistance of this combination in terms of the original resistance R? (A) **[R/25]**
2. A copper wire has a diameter of 0.5 mm and resistivity of 1.68×10^{-8} Ωm. What will be the length of this wire to make its resistance of 2 ohm? (A) **[23.8 m]**
3. What is the main current in the circuit?



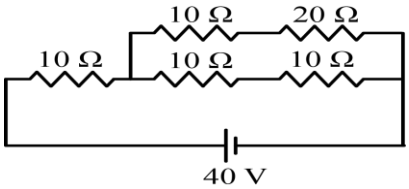
[0.33 A]

4. What is the current through 30 Ω resistors in the given circuit?



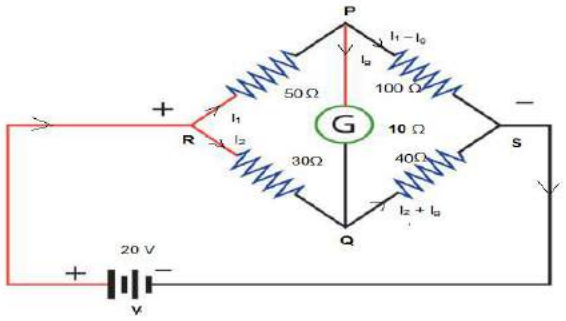
[0.44 A]

5. What is the current through 20 Ω resistor?



[0.72 A]

6. Calculate the current through the galvanometer connected across P and R of 10 Ω resistance with a potential difference of 20 V



[**0.0315A]**

7. A grinder motor is designed to operate at a current of 5 A and at a p.d. of 200 V. What resistance must be connected in series with the motor so as to maintain the rated current when it is operated on a 220 V line? (A) **[4 Ω]**

8. A coil of wire has a resistance of 18 Ω at 10 ℃ and 18.48 Ω at 23 ℃. Find the temperature coefficient of resistance. What is the resistance at 0 ℃. (A) **[0.0021/^{0}C , 17.63 Ω]**

9. How do you arrange 45 cells, each of emf 1.4 V and internal resistance 0.1 Ω so as to send maximum current through an external resistance of 0.5 Ω. What is the maximum current? (A)

[3 branches of 15 cells each, 21 A]

10. A battery of 6V gives a current of 2 A when connected to a resistance of 2 Ω. What is the internal resistance, terminal p.d. and lost voltage of the battery? Explain the term lost voltage. (A)

[1 Ω, 4 V]

11. Two resistors 3 Ω and 6 Ω are connected in parallel. A cell of emf 2 V and internal resistance 1 Ω and a resistor of 7 Ω are connected to the resistor combination. What is the power dissipated across 7 Ω resistor? (A) **[0.28 W]**

12. Two resistances 100 Ω and 200 Ω are connected in series to a 150 V supply. A voltmeter of resistance 200 Ω is connected across 100 Ω resistor. What is the reading of voltmeter? (A)

[37.5 V]

13. 17. Three bulbs are rated 40 W- 220 V, 60 W- 220 V and 100 W- 220 V respectively. (i) Find the resistance of each bulb. (ii) What is the maximum permissible current in each bulb? (A)

[1210 Ω, 806.7 Ω, 484 Ω, 0.45A]

14. Two resistors of 2 Ω and 3 Ω are connected to the left gap of a metre bridge in turn. A standard resistance of 4 Ω is connected to the right gap. Find the balancing lengths in each case. (A)

[0.333m, 0.429 m]

15. Two cells rated as 10 V, 2 Ω and 8 V, 1Ω are connected in parallel to send current in the same direction across a 6 Ω resistor. Find the p.d. across 6 Ω resistor. (A) **[7.8V]**

16. In a typical Wheatstone network, resistances P, Q, R and S are 10 Ω, 20 Ω, 30 Ω and 50 Ω respectively. Is the network balanced? If not, how do you vary (i) the arm R and (ii) the arm S to balance the network? (A) **(No, 150 Ω, 10 Ω)**

****