

ns. The reduction reaction is : $\text{Cu}^{2+} + 2e^{-} \rightarrow \text{Cu}$

\therefore Charge required for reduction of 1 mole of $\text{Cu}^{2+} = 2F = 2 \times 96500 \text{ C} = 193000 \text{ C}$

SHORT ANSWER QUESTIONS

CARRYING 2 or 3 MARKS

1. Define 'Electrochemistry'. [Refer to Art. 3.1]
2. What is electrolysis ? Discuss its mechanism by taking the electrolysis of lead bromide as an example. [Refer to Art. 3.2]
3. What is one faraday ? How is its value calculated in Coulombs ? [Refer to Art. 3.3]
4. Define electrochemical equivalent. How is it related to the equivalent weight of the element ? [Refer to Art. 3.3]
5. On the basis of electrolytic conduction, how are the electrolytes classified ?
Or Distinguish between strong electrolyte and weak electrolyte. (P.S.B. 2002) [Refer to Art. 3.4]
6. List the points of difference between metallic conductors and electrolytic conductors ? [Refer to Art. 3.4]
7. What do you understand by the term 'conductance' ? What are its units ? [Refer to Art. 3.5]
8. How are equivalent conductivity and molar conductivity related to specific conductivity ? [Refer to Art. 3.6]
9. Write down the expression for equivalent conductivity. State meanings of the symbols used. (C.B.S.E. Sample Paper 1990) [Refer to Art. 3.6.1]
10. Why is it necessary to platinize the electrodes of a conductivity cell before it is used for conductance measurement ? [Refer to Art. 3.7]
11. What is cell constant ? How is it determined ? [Refer to Art. 3.7]
12. What is conductivity water ? [Refer to Art. 3.7]
13. How is molar conductivity related to the concentration of an electrolyte ? How will you explain a weak and a strong electrolyte based on their conductivity values ? [Refer to Art. 3.8]
14. With the help of a graph explain why it is not possible to determine Λ_m^{∞} for a weak electrolyte by extrapolating the concentration-molar conductance curve as for strong electrolytes. (D.S.B. 1998) [Refer to Art. 3.9]
15. What is the effect of dilution on specific conductivity and equivalent conductivity ? Explain briefly giving reasons. [Refer to Art. 3.8]
16. How does molar conductivity vary with concentration for (i) weak electrolyte (ii) strong electrolyte ? Give reasons for these variations. (A.I.S.B. 2004) [Refer to Art. 3.9]
17. Why is it not possible to determine Λ^0 for a weak electrolyte ? Explain. (P.S.B. 2000) [Refer to Art. 3.9]
18. Define Kohlrausch's law. How can it be used to find the degree of dissociation of a weak electrolyte ? [Refer to Art. 3.10]

19. Why is the molar conductivity of a weak electrolyte at infinite dilution determined? [Refer to Art. 3.10]
 20. State and explain Kohlrausch's law. (A.I.S.B. 1995) [Refer to Art. 3.10]
 21. Explain Kohlrausch's law of independent migration of ions. Mention one application of Kohlrausch's law. (A.I.S.B. 1998) [Refer to Art. 3.10 & 3.11]
 22. Define molar conductivity. Express the relationship between degree of dissociation of an electrolyte and its molar conductivities. (H.S.B. 2005) [Refer to Art. 3.11]
 23. What is an electrochemical cell? How does it differ from an electrolytic cell? [Refer to Art. 3.12]
 24. Write down the half reactions and the net reaction for the Daniell cell:

$$\text{Zn}(s) | \text{Zn}^{2+}(aq) (1M) || \text{Cu}^{2+}(aq) (1M) | \text{Cu}(s)$$
 (A.I.S.B. 1989) [Refer to Art. 3.12]
 25. What is a Galvanic cell? Give the symbolic representation of the Daniell cell? (A.I.S.B. 1984 C, H.S.B. 1990) [Refer to Art. 3.12]
 26. What is a salt bridge and how is its use indicated in representing a Galvanic cell? (A.I.S.B. 79 C, 80 C, 83) [Refer to Art. 3.12]
 27. What is a salt bridge? What is it used for? (A.I.S.B. 1987, H.P.S.B. 1992) [Refer to Art. 3.12]
 28. What is difference between Galvanic cell (Electrochemical cell) and Electrolytic cell? (A.I.S.B. 1986, H.P.S.B. 1992, 2004, P.S.B. 2000) [Refer to Art. 3.13]
 29. Depict the electrochemical cell in which the reaction is

$$\text{Zn}(s) + 2\text{Ag}^+(aq) \longrightarrow \text{Zn}^{2+}(aq) + 2\text{Ag}(s)$$

 Also (a) mark the anode and the cathode (b) show movement of ions and electrons
 (c) electrode reactions (d) direction of conventional current. (J. & K. 1997, H.S.B. 1998) [Refer to Art. 3.12]
 30. Explain the function of salt bridge in an electrochemical cell.

31. Write the symbolic representation of the electrochemical cell with the cell reaction
 (P.S.B. 1993, H.P.S.B. 2004) [Refer to Art. 3.12]



Indicate the oxidation electrode and the direction of the movement of electrons and write the electrode reactions.

(C.B.S.E. Sample Paper 1997) [Refer to Art. 3.14]

32. Write short notes on reduction and oxidation potentials. [Refer to Art. 3.15]

33. How are standard electrode potentials measured? [Refer to Art. 3.16]

34. What is understood by a normal hydrogen electrode? Give its significance. (A.I.S.B. 1984 C, 1992) [Refer to Art. 3.16]

35. Define electrode potential. Why absolute value of reduction potential of electrode cannot be determined? (P.S.B. 1992) [Refer to Art. 3.16]

36. What do you understand by the following?

(i) negative standard electrode potential

(ii) positive standard electrode potential.

37. What is meant by reduction electrode potentials of zinc and copper being -0.76 V and $+0.34$ V respectively? Can an aqueous solution of CuSO_4 be stored in a zinc vessel? Answer with reason. [Refer to Art. 3.16]

(D.S.B. 1989) [Refer to Art. 3.15]

38. What do you understand by Normal Hydrogen Electrode? Give its construction and working.

(P.S.B. 1992, H.P.S.B. 2002, 2004) [Refer to Art. 3.16]

39. What is standard electrode potential? How does it arise? (A.I.S.B. 1991 C) [Refer to Art. 3.15]

40. What is the difference between e.m.f. and potential difference?

(H.P.S.B. 1992, H.S.B. 2001) [Refer to Art. 3.17]

41. Define electrode potential, oxidation potential and reduction potential. Why is it not possible to calculate the absolute value of electrode potential? (P.S.B. 1996) [Refer to Art. 3.16]

42. What is an electrochemical series? List its two uses. (A.I.S.B. 1984) [Refer to Art. 3.18]
43. What is an electrochemical series? How does it help us in predicting whether a redox reaction is feasible in a given direction or not? (A.I.S.B. 1984, H.P.S.B. 1992) [Refer to Art. 3.18 & 3.19]
44. What is an electrochemical series? How does it help in calculating the e.m.f. of a standard cell? (H.S.B. 1995) [Refer to Art. 3.18 & 3.19]
45. The standard electrode potentials of a number of half cells are provided in the increasing order. Mention three tendencies in properties of elements from such data. (C.B.S.E. Sample Paper 1990) [Refer to Art. 3.19]
46. Give the reason why blue colour of copper sulphate solution is discharged slowly when an iron rod is dipped in it. Given $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = 0.34\text{V}$, $E^\circ_{\text{Fe}^{2+}/\text{Fe}} = -0.44\text{V}$ (A.I.S.B. 1982) [Refer to Art. 3.19]
47. The cell reaction as written is spontaneous if the overall EMF of the cell is positive. Comment on this statement. [Refer to Art. 3.19]
48. What does positive value of E°_{cell} in case of galvanic cell like $\text{Zn} | \text{Zn}^{2+} || \text{Cu}^{2+} | \text{Cu}$ indicate? (D.S.B. 1986, A.I.S.B. 1987) [Refer to Art. 3.19]
49. Write Nernst equation for the general electrode reaction: $\text{M}^{n+} + ne^- \longrightarrow \text{M}$. [Refer to Art. 3.20]
50. What is the effect of change in (a) concentration (b) temperature on the electrode potential of a given half-cell? (C.B.S.E. Sample Paper 1990) [Refer to Art. 3.20]
51. Write Nernst equation for the general electro-chemical change of the following type at 25°C .

$$a\text{A} + b\text{B} \xrightarrow{ne^-} c\text{C} + d\text{D}$$
 [Refer to Art. 3.21]
52. What is a concentration cell? Give one example. How is the emf of such a cell calculated? [Refer to Art. 3.22]
53. How Nernst equation can be applied in the calculation of equilibrium constant of any cell reaction? (P.S.B. 2000) [Refer to Art. 3.23]
54. Derive the relationship between Gibb's free energy change and the cell potential. [Refer to Art. 3.24]
55. What is free energy and free energy change? Explain how is free energy related to cell potential? Also explain its significance in predicting the feasibility of the cell reaction. (H.P.S.B. 1993) [Refer to Art. 3.24]
56. What are the conditions which a commercial battery must satisfy or why every electrochemical cell cannot be used as commercial cell? [Refer to Art. 3.26]
57. Draw a well labelled diagram of "Dry cell". Give the reactions taking place at the anode and the cathode. [Refer to Art. 3.26]
58. Which cell is generally used in the hearing aids? Name the material of the anode, cathode and the electrolyte. Write the reactions involved. [Refer to Art. 3.26]
59. Give the reactions taking place during discharge and recharging of lead storage battery. Why is it rechargeable? [Refer to Art. 3.26]
60. Give following information about 'Nickel-Cadmium storage cell':
 (i) Material of the cathode (ii) Material of the anode (iii) Electrolyte used
 (iv) Reactions involved at the anode and cathode (v) Approximate voltage of the cell. [Refer to Art. 3.26]
61. What is a fuel cell? Give the construction and working of a fuel cell. (P.S.B. 1992, H.S.B. 2001) [Refer to Art. 3.26]
62. What are fuel cells? Write oxygen-hydrogen fuel cell. (A.I.S.B. 1994, H.S.B. 2002) [Refer to Art. 3.26]
63. What are the difficulties in the construction of a fuel cell? What are its advantages over the other cells? [Refer to Art. 3.26]
64. What is mercury cell? Give the electrode reactions. (A.I.S.B. 1996) [Refer to Art. 3.26]
- or What is a Battery? Describe the mercury cell. (H.S.B. 2002) [Refer to Art. 3.26]
65. What are primary cells? How does a dry cell function? (P.S.B. 1999, H.S.B. 2002) [Refer to Art. 3.26]
- or What are secondary cells? Describe the Nickel-Cadmium cell. (H.S.B. 2002) [Refer to Art. 3.26]

66. Give an example of a fuel cell and write the anode and the cathode reaction for it.
 (P.S.B. 2001) [Refer to Art. 3.26]
67. What are the differences between primary commercial cells and secondary commercial cells?
 (H.P.S.B. 2004) [Refer to Art. 3.26]
68. What is rusting? Indicate the chemical changes in rust formation. Give chemical equations for the steps of rusting.
 (A.I.S.B. 1982 C, P.S.B. 2000) [Refer to Art. 3.27]
69. What is sacrificial protection of iron from corrosion? Give one example.
 (A.I.S.B. 1979) [Refer to Art. 3.27]
 (A.I.S.B. 1985) [Refer to Art. 3.27]
 (A.I.S.B. 1990) [Refer to Art. 3.27]
70. Explain 'Iron is galvanised for protecting it from rusting'.
 (A.I.S.B. 1990) [Refer to Art. 3.27]
71. 'Corrosion is an electrochemical phenomenon'. Explain?
 (D.S.B. 2004) [Refer to Art. 3.27]
72. Write the cell reactions which occur in lead storage battery (i) When the battery is in use (ii) When the battery is on charging.
 (A.I.S.B. 1983 S) [Refer to Art. 3.27]
73. Explain briefly the reaction during rusting of iron.
74. Describe any two of the techniques used for preventing corrosion of metals.
 (A.I.S.B. 1979, A.I.S.B. 1983) [Refer to Art. 3.27]
75. Rusting of iron is quicker in saline water than in ordinary water. Explain.
 [Refer to Art. 3.27]
76. We can use aluminium in place of zinc for cathodic protection of rusting. Comment.
 [Refer to Art. 3.27]
77. Explain the mechanism of rusting of iron.
 (P.S.B. 1993, H.S.B. 2000) [Refer to Art. 3.27]
78. Give a brief account of corrosion and its mechanism.
 (D.S.B. 1992, H.P.S.B. 2002) [Refer to Art. 3.27]
79. What is corrosion? Give mechanism (electrochemical phenomenon) of rusting of iron. What do you understand by sacrificial, cathodic and barrier protection of corrosion?
 (P.S.B. 1995, H.S.B. 2002, 2003, D.S.B. 2005 C) [Refer to Art. 3.27]
80. Iron does not rust even if the zinc coating is broken in a galvanised iron pipe but rusting occurs much faster if the tin coating over iron is broken. Explain.
 (C.B.S.E. Sample Paper 1997) [Refer to Art. 3.27]
- Hint. Zinc is more electropositive whereas tin is less electropositive than iron.
81. State reasons for the following:
 (i) Rusting of iron is said to be an electrochemical phenomenon
 (ii) For a weak electrolyte, its molar conductance in dilute solutions increases sharply as its concentration in solution is decreased.
 [Refer to Art. 3.27 & 3.9]
82. Write the chemical equation for all the steps involved in the rusting of iron. Give any one method to prevent rusting of iron.
 (C.B.S.E. Sample Paper | 2007) [Refer to Art. 3.27]

LONG ANSWER QUESTIONS

CARRYING 5 or more MARKS

1. Explain the term electrolysis. Discuss briefly the electrolysis of (i) molten sodium chloride (ii) aqueous sodium chloride solution (iii) molten lead bromide (iv) water.
 [Refer to Art. 3.3]
2. State and explain Faraday's laws of electrolysis. What is electrochemical equivalent?
 [Refer to Art. 3.3]
3. What is Faraday's constant? What is its value and how has it been calculated? How does it help in the determination of the amount of substance deposited on passing a definite amount of current for a definite time?
 [Refer to Art. 3.3]
4. What do you understand by 'electrolytic conduction'? What are the factors on which electrolytic conduction depends? What is the effect of temperature on electrolytic conduction?
 [Refer to Art. 3.4]
5. Briefly explain the terms specific conductivity and molar conductivity.