PROBLEM SOLVING TECHNIQUES OF PHYSICAL CHEMISTRY FOR NEET

BY

JITENDRA HIRWANI

ELECTROCHEMISTRY

ETOOSINDIA
INDIA'S NO. 1 ONLINE COACHING

Plot No. 38, Near Union Bank of India, Rajeev Gandhi Nagar,
Kota, Rajasthan – 324005 Mob. : 9214233303

BASIC EXERCISE

ELECTROLYTIC CONDUCTANCE

1. Strong electrolyte are those which :

(1) dissolve readily in water (2) conduct electricity

(3) dissociate into ions even at high concentration (4) dissociate into ions at high dilution.

Ans. **(3)**

2. Molten sodium chloride conducts electricity due to the presence of :

(1) free electrons (2) free ions (3) free molecules (4) free atoms of Na and Cl

Ans. **(2)**

3. Electrolytic conduction is due to the movement of :

(1) molecules (2) atoms (3) ions (4) electrons

Ans. **(3)**

4. Which of the following solutions of KCl has the lowest value of equivalent conductance ?

(1) 1 M (2) 0.1 M (3) .01 M (4) .001 M

Ans. **(1)**

5. If V, in the equation Λ = sp. cond. × V, is the volume in CC containing 1 eq. of the electrolyte; V for a $\frac{N}{10}$ solution will be :

(1) 10 c.c. (2) 100 c.c. (3) 1000 c.c. (4) 10,000 c.c.

Ans. **(4)**

6. If the specific resistance of a solution of concentration C g equivalent litre^{-1} is R, then its equivalent conductance is :

(1) $\frac{100R}{C}$ (2) $\frac{RC}{1000}$ (3) $\frac{1000}{RC}$ (4) $\frac{C}{1000R}$

Ans. **(3)**

7. The specific conductance of a salt of 0.01 M concentration is 1.061×10^{-4}. Molar conductance of the same solution will be :

(1) 1.061×10^{-4} (2) 1.061 (3) 10.61 (4) 106.1

Ans. **(3)**

8. Which of the following solutions of NaCl will have the highest specific conductance ?

(1) 0.001 N (2) 0.1 N (3) 0.01 N (4) 1.0 N

Ans. **(4)**

9. The value of molar conductivity of HCl is greater than that of NaCl at a particular temperature because :

(1) Molecular mass of HCl is less than that of NaCl.

(2) Velocity of H^+ ions is more than that of Na^+ ions

(3) HCl is strongly acidic

(4) Ionisation of HCl is larger than that of NaCl

Ans. **(2)**

10. Which statement is not correct :–

(1) Conductance of an electrolytic solution increases with dilution

(2) Conductance of an electrolytic solution decreases with dilution

(3) Specific conductance of an electrolytic solution decreases with dilution

(4) Equivalent conductance of an electrolytic solution increases with dilution.

Ans. (2)

11. The resistance of 0.01 N solution of an electrolyte was found to be 210 ohm at 298 K using a conductivity cell of cell constant 0.66 cm^{-1}. The equivalent conductance of solution is :–

(1) 314.28 mho cm^2 eq^{-1} (2) 3.14 mho cm^2 eq^{-1}

(3) 314.28 mho^{-1} cm^2 eq^{-1} (4) 3.14 mho^{-1} cm^2 eq^{-1}

Ans. (1)

12. Electrolytic conduction differs from metallic conduction from the fact that in the former

(1) The resistant increases with increasing temperature

(2) The resistance decreases with increasing temperature

(3) The resistance remains constant with increasing temperature

(4) The resistance is independent of the length of the conductor

Ans. (2)

13. The specific conductance of a 0.01 M solution of KCl is 0.0014 ohm^{-1} cm^{-1}at 25° C. Its equivalent conductance (cm^2 ohm^{-1} $equiv^{-1}$) is :–

(1) 140 (2) 14 (3) 1.4 (4) 0.14

Ans. (1)

KOHLRAUSCH LAW

14. The conductivity of a saturated solution of $BaSO_4$ is 3.06×10^{-6} ohm^{-1} $cm^{-1}$and its molar conductance is 1.53 ohm^{-1} cm^{-1} mol^{-1}. The K_{sp} of $BaSO_4$ will be

(1) 4×10^{-12} (2) 2.5×10^{-9} (3) 2.5×10^{-13} (4) 4×10^{-6}

Ans. (4)

15. The molar conductance at infinite dilution of $AgNO_3$, AgCl and NaCl are 116.5, 121.6 and 110.3 respectively. The molar conductances of $NaNO_3$ is :–

(1) 111.4 (2) 105.2 (3) 130.6 (4) 150.2

Ans. (2)

16. The equivalent conductivity of 0.1 N CH_3COOH at 25 °C is 80 and at infinite dilution 400. The degree of dissociation of CH_3COOH is :

(1) 1 (2) 0.2 (3) 0.1 (4) 0.5

Ans. (2)

17. For HCl solution at 25^0C, equivalent conductance at infinite dilution, is 425 $ohm^{-1}cm^2equiv^{-1}$. The specific conductance of a solution of HCl is 3.825 ohm^{-1} cm^{-1}. If the apparent degree of dissociation is 90% the normality of the solution is :-

(1) 0.90 N (2) 1.0 N (3) 10 N (4) 1.2 N

Ans. (3)

GALVANIC CELL

18. In the galvanic cell Cu $|Cu^{2+}$ (1M)$||Ag^{+}$ (1M) Ag| the electrons will travel in the external circuit :

(1) from Ag to Cu (2) from Cu to Ag

(3) electrons do not travel in the external circuit (4) in any direction

Ans. **(2)**

19. The passage of electricity in the Daniel cell when Zn and Cu electrodes are connected is :

(1) from Cu to Zn in the cell (2) from Cu to Zn out side the cell

(3) from Zn to Cu outside the cell (4) in any direction in the cell

Ans. **(2)**

20. The equation representing the process by which standard reduction potential of zinc can be defined is :

(1) $Zn^{2+}(s) + 2e^{-} \longrightarrow Zn$ (2) $Zn(g) \longrightarrow Zn^{2+}(g) + 2e^{-}$

(3) $Zn^{2+}(g) + 2e^{-} \longrightarrow Zn$ (4) $Zn^{2+}(aq.) + 2e^{-} \longrightarrow Zn(s)$

Ans. **(4)**

21. A standard hydrogen electrode has zero electrode potential because :

(1) Hydrogen is easiest to oxidize

(2) This electrode potential is assumed to be zero

(3) Hydrogen atom has only one electron

(4) Hydrogen is the lightest element

Ans. **(2)**

22. Which is not true for a standard hydrogen electrode ?

(1) The hydrogen ion concentration is 1 M

(2) Temperature is 25°C

(3) Pressure of hydrogen is 1 atmosphere

(4) It contains a metallic conductor which does not adsorb hydrogen.

Ans. **(4)**

23. $Cu \mid Cu^{+2}(1M) \mid\mid Zn^{+2}(1\,M) \mid Zn$

A cell represented above should have emf.

(1) Positive (2) Negative (3) Zero (4) Cannot be predicted

Ans. **(2)**

24. Given electrode potentials :

$Fe^{3+} + e \longrightarrow Fe^{2+}$; $E° = 0.771$ volts

$I_2 + 2e \longrightarrow 2I^{-}$; $E° = 0.536$ volts

E° cell for the cell reaction

$2Fe^{3+} + 2I^{-} \rightarrow 2Fe^{2+} + I_2$ is -

(1) $(2 \times 0.771 - 0.536) = 1.006$ volts (2) $(0.771 - 0.5 \times 0.536) = 0.503$ volts

(3) $0.771 - 0.536 = 0.235$ volts (4) $0.536 - 0.771 = -0.235$ volts

Ans. **(3)**

25. Which of the following is not an anodic reaction–

(1) $Ag^{+} \rightarrow Ag - e^{-}$ (2) $Cu \rightarrow Cu^{2+} + 2e^{-}$

(3) $Fe^{2+} \rightarrow Fe^{3+} + e^{-}$ (4) $4OH^{-} \rightarrow 2H_2O + O_2 + 4e^{-}$

Ans. **(1)**

26. Which of the following statements is correct :–

(1) Oxidation occur at anode in both galvanic and electrolytic cell

(2) Reduction occurs at anode in both galvanic and electrolytic cell

(3) Reduction occur at anode in electrolytic cell where as oxidation occur at cathode in galvanic cell

(4) Oxidation occur at anode in electrolytic cell where as reduction occur at anode in a galvanic cell

Ans. **(1)**

27. Other things being equal, the life of a daniel cell may be increased by :–

(1) Keeping low temperature

(2) Using large copper electrode

(3) Decreasing concentration of copper ions

(4) Using large zinc electrodes

Ans. **(4)**

ELECTROCHEMICAL SERIES

28. The standard reduction potentials at 25°C for the following half reactions are given against each :

$Zn^{2+}(aq) + 2e^{-} \rightleftharpoons Zn(s), -0.762$

$Cr^{3+}(aq) + 3e^{-} \rightleftharpoons Cr(s), -0.740$

$2H^{+} + 2e^{-} \rightleftharpoons H_2(g), 0.00$

$Fe^{3+} + 2e^{-} \rightleftharpoons Fe^{2+}, 0.77$

Which is the strongest reducing agent ?

(1) Zn (2) Cr (3) $H_2(g)$ (4) $Fe^{2+}(aq)$

Ans. **(1)**

29. Red hot carbon will remove oxygen from the oxide XO and YO but not from ZO. Y will remove oxygen from XO. Use this evidence to deduce the order of activity of the three metals X, Y and Z putting the most active first.

(1) XYZ (2) ZYX (3) YXZ (4) ZXY

Ans. **(2)**

30. If a spoon of copper metal is placed in a solution of ferrous sulphate :

(1) Cu will precipitate out (2) Iron will precipitate

(3) Cu and Fe will precipitate (4) No reaction will take place

Ans. **(4)**

31. Which one will liberate Br_2 from KBr ?

(1) HI (2) I_2 (3) Cl_2 (4) SO_2

Ans. **(3)**

32. Using the standard electrode potential values given below, decide which of the statements, I, II, III and IV are correct. Choose the right answer from (1), (2), (3) and (4).

$Fe^{2+} + 2e^- \rightleftharpoons Fe^0$; $E° = -0.44\,V$

$Cu^{2+} + 2e^- \rightleftharpoons Cu^0$; $E° = +0.34\,V$

$Ag^+ + e^- \rightleftharpoons Fe^0$; $E° = +0.80\,V$

I. Copper can displace iron from $FeSO_4$ solution.

II. Iron can displace copper from $CuSO_4$ solution.

III. Silver can displace copper from $CuSO_4$ solution.

IV. Iron can displace silver from $AgNO_3$ solution.

(1) I and II (2) II and III (3) II and IV (4) I and IV

Ans. **(3)**

33. The standard electrode potential value of the elements A, B and C are 0.68, –2.50 and 0.50 V respectively. The order of their reducing power is :

(1) A > B > C (2) A > C > B (3) C > B > A (4) B > C > A

Ans. **(4)**

34. Zn can not displace following ions from their aqueous solution :

(1) Ag^+ (2) Cu^{2+} (3) Fe^{2+} (4) Na^+

Ans. **(4)**

35. A gas X at 1 atm. is bubbled through a solution containing a mixture of 1 MY^- and 1 MZ^- at 25 °C. If the reduction potential of Z > Y > X then :

(1) Y will oxidise X and not Z (2) Y will oxidise Z and not X

(3) Y will oxidise both X and Z (4) Y will reduce both X and Z

Ans. **(1)**

36. The standard electrode potential of Zn, Ag and Cu are –0.76, 0.80 and 0.34 volt respectively, then :

(1) Ag can oxidise Zn and Cu

(2) Ag can reduce Zn^{2+} and Cu^{2+}

(3) Zn can reduce Ag^+ and Cu^{2+}

(4) Cu can oxidise Zn and Ag

Ans. **(3)**

37. Each of the three metals x, y and z were put in turn into aqueous solution of the other two. x + salt of y (or z) = y (or z) + salt of x. Which one of the following observation is probably incorrect ?

(1) y + salt of x = no action observed

(2) y + salt of z = z + salt of y

(3) z + salt of x = x + salt of z

(4) z + salt of y = no action observed

Ans. **(3)**

38. The oxidation potential of Zn, Cu, Ag, H_2 and Ni are 0.76, –0.34, –0.80, 0, 0.55 volt respectively. Which of the following reaction will provide maximum voltage ?

(1) $Zn + Cu^{2+} \longrightarrow Cu + Zn^{2+}$ (2) $Zn + 2Ag^+ \longrightarrow 2Ag + Zn^{2+}$

(3) $H_2 + Cu^{2+} \longrightarrow 2H^+ + Cu$ (4) $H_2 + Ni^{2+} \longrightarrow 2H^+ + Ni$

Ans. **(2)**

39. A standard reduction electrode potentials of four elements are

A = – 0.250 V , B = – 0.140 V

C = – 0.126 V , D = – 0.402 V

The element that displaces A from its compounds aqueous solution is :–

(1) B (2) C (3) D (4) None of the above

Ans. **(3)**

40. Which of the following displacement does not occur

(1) $Zn + 2H^+ \rightarrow Zn^{2+} + H_2 \uparrow$ (2) $Fe + 2Ag^+ \rightarrow Fe^{2+} + Ag \downarrow$

(3) $Cu + Fe^{2+} \rightarrow Cu^{2+} + Fe \downarrow$ (4) $Zn + Pb^{2+} \rightarrow Zn^{2+} + Pb \downarrow$

Ans. **(3)**

41. Adding powdered Pb and Fe to a solution containing 1.0 M in each of Pb^{+2} and Fe^{+2} ions would result into the formation of :–

(1) More of Pb and Fe^{+2} ions (2) More of Fe and Pb^{2+} ions

(3) More of Fe and Pb (4) More of Fe^{+2} and Pb^{2+} ions

Ans. **(1)**

NERNST EQUATION

42. $E°(Ni^{2+}/Ni) = -0.25$ volt,

$E°\ (Au^{3+} / Au) = 1.50$ volt.

The emf of the voltaic cell.

$Ni / Ni^{2+}\ (1.0\ M)\ ||\ Au^{3+}\ (1.0\ M)\ |\ Au$ is :

(1) 1.25 volt (2) –1.75 volt (3) 1.75 volt (4) 4.0 volt

Ans. **(3)**

43. The emf of the cell in which the following reaction

$Zn(s) + Ni^{2+}\ (a = 0.1) \rightleftharpoons Zn^{2+}\ (a = 1.0) + Ni(s)$

occurs, is found to be 0.5105 V at 298 K. The standard e.m.f. of the cell is :-

(1) –0.5105 V (2) 0.5400 V (3) 0.4810 V (4) 0.5696 V

Ans. **(2)**

44. The potential of hydrogen electrode

($P_{H_2} = 1$ atms; $C_{H^+} = 0.1$ M) at 25°C will be -

(1) 0.00 V (2) –0.059 V (3) 0.118 V (4) 0.059 V

Ans. **(2)**

45. Which of the following represents the potential of silver wire dipped in to 0.1 M $AgNO_3$ solution at 25° C ?

(1) $E°_{red}$ (2) $(E°_{red} + 0.059)$ (3) $(E°_{ox} - 0.059)$ (4) $(E°_{red} - 0.059)$

Ans. **(4)**

46. The potential of a hydrogen electrode at pH = 1 is

(1) 0.059 volt (2) 0.00 volt (3) –0.059 volt (4) 0.59 volt

Ans. **(3)**

47. Consider the reaction

$Cl_2(g) + 2Br^-(aq) \longrightarrow 2Cl^-(aq) + Br_2$

The emf of the cell when

$[Cl^-] = [Br_2] = [Br^-] = 0.01$ M and Cl_2 gas at 1 atm pressure will be (E° for the above reaction is = 0.29 volt)

(1) 0.54 volt (2) 0.35 volt (3) 0.24 volt (4) –0.29 volt

Ans. **(2)**

48. The standard emf for the cell reaction $Zn + Cu^{2+} \longrightarrow Zn^{2+} + Cu$ is 1.10 volt at 25 °C. The emf for the cell reaction when 0.1 M Cu^{2+} and 0.1 M Zn^{2+} solution are used at 25°C is:

(1) 1.10 volt (2) 0.110 volt (3) –1.10 volt (4) –0.110 volt

Ans. **(1)**

49. E° for $F_2 + 2e^- = 2F^-$ is 2.8 V, E° for $\frac{1}{2}F_2 + e = F^-$ is ?

(1) 2.8 V (2) 1.4 V (3) –2.8 V (4) –1.4 V

Ans. **(1)**

50. ΔG° of the cell reaction

$AgCl(s) + \frac{1}{2}H_2(g) = Ag(s) + H^+ + Cl^-$ is –21.52 KJ ΔG° of $2AgCl(s) + H_2(g) = 2Ag(s) + 2H^+ + 2Cl^-$ is :

(1) –21.52 KJ (2) –10.76 KJ (3) –43.04 KJ (4) 43.04 KJ

Ans. **(3)**

51. How much will the potential of Zn / Zn^{2+} change if the solution of Zn^{2+} is diluted 10 times

(1) increase by 0.03 V (2) decreases by 0.03 V

(3) increases by 0.059 V (4) decreases by 0.059 V

Ans. **(1)**

52. How much will the potential of a hydrogen electrode change when its solution initially at pH = 0 is neutralised to pH = 7 ?

(1) increase by 0.059 V (2) decrease by 0.059 V

(3) increase by 0.41 V (4) decrease by 0.41 V

Ans. **(4)**

53. Which of the following will increase the voltage of the cell with following cell reaction

$Sn_{(s)} + 2Ag^+_{(aq)} \rightarrow Sn^{+2}_{(aq)} + 2Ag_{(s)}$

(1) Increase in the size of silver rod (2) Increase in the concentration of Sn^{+2} ions

(3) Increase in the concentration of Ag^+ ions (4) Decrease in the concentration of Ag^+ ions

Ans. **(3)**

54. E° for the reaction $Fe + Zn^{2+} \rightarrow Zn + Fe^{2+}$ is –0.35V. The given cell reaction is :

(1) feasible (2) not feasible (3) in equilibrium (4) can't say anything

Ans. **(2)**

55. For a reaction - $A(s) + 2B^+ \rightarrow A^{2+} + 2B$

K_C has been found to be 10^{12}. The E°cell is:

(1) 0.354 V (2) 0.708 V (3) 0.0098 V (4) 1.36 V

Ans. **(1)**

56. The standard electrode potential (E°) for OCl^-/Cl^- and Cl^- / ½ Cl_2 respectively are 0.94 V and –1.36V. The E° value of OCl^- / ½ Cl_2 will be :

(1) –2.20 V (2) –0.42 V (3) 0.52 V (4) 1.04 V

Ans. **(3)**

57. The emf of the cell

Tl/Tl^+ (0.0001 M) || Cu^{2+}(0.01M)/Cu is 0.83 V

The emf of this cell will be increased by :–

(1) Increasing the concentration of Cu^{++} ions (2) Decreasing the concentration of Tl^+

(3) Increasing the concentration of both (4) (1) & (2) both

Ans. **(4)**

58. Consider the cell $Cu/Cu^{+2}||Ag^+/Ag$. If the concentration of Cu^{+2} and Ag^+ ions becomes ten times the emf of the cell:–

(1) Becomes 10 times (2) Remains same

(3) Increase by 0.0295 V (4) Decrease by 0.0295 V

Ans. **(3)**

ELECTROLYSIS

59. When an electric current is passed through acid diluted water, 112 ml. of hydrogen gas at STP collects at the cathode in 965 second. The current passed, in ampere is :

(1) 1.0 (2) 0.5 (3) 0.1 (4) 2.0

Ans. **(1)**

60. Two electrolytic cells one containing acidified ferrous chloride and another acidified ferric chloride are connected in series. The ratio of iron deposited at cathodes in the two cells when electricity is passed through the cells will be :

(1) 3 :1 (2) 2 : 1 (3) 1 : 1 (4) 3 : 2

Ans. **(4)**

61. The same amount of electricity was passed through two separate electrolytic cells containing solutions of nickel nitrate [$Ni(NO_3)_2$]and chromium nitrate [$Cr(NO_3)_3$] respectively. If 0.3 g of nickel was deposited in the first cell, the amount of chromium deposited is :

(at. wt. of Ni = 59, at. wt. of Cr = 52)

(1) 0.1 g (2) 0.17 g (3) 0.3 g (4) 0.6 g

Ans. **(2)**

62. How many coulombs of electricity are required for the oxidation of 1 mole of H_2O to O_2 ?

(1) 9.65×10^4 C (2) 4.825×10^5 C (3) 1.93×10^5 C (4) 1.93×10^4 C

Ans. **(3)**

63. The mass of copper that will be deposited at cathode in electrolysis of 0.2 M solution of copper sulphate when a quantity of electricity equal to that required to liberate 2.24 L of hydrogen at STP from 0.1 M aqueous H_2SO_4 is passed (At. mass of Cu = 63.5) will be :

(1) 1.59 g (2) 3.18 g (3) 6.35 g (4) 12.70 g

Ans. **(3)**

64. 10800 C of electricity through the electrolyte deposited 2.977 g of metal with atomic mass 106.4 g mol^{-1}. The charge on the metal cation is -

(1) +4 (2) +3 (3) +2 (4) +1

Ans. **(1)**

65. On passing electricity through dil. H_2SO_4 solution the amount of substance liberated at the cathode and anode are in the ratio :

(1) 1 : 8 (2) 8 : 1 (3) 16 : 1 (4) 1 : 16

Ans. **(1)**

66. During electrolysis of fused calcium hydride, the hydrogen is produced at :

(1) Cathode

(2) Anode

(3) Hydrogen is not liberated at all

(4) H_2 produced reacts with oxygen to form water

Ans. **(2)**

67. A solution of sodium sulphate in water is electrolysed using inert electrodes. The product at the cathode and anode are respectively :–

(1) H_2, SO_2 (2) O_2, H_2 (3) O_2, Na (4) H_2, O_2

Ans. **(4)**

68. One Faraday of electricity will liberate one mol atomic mass of the metal from the solution of

(1) Auric chloride (2) Silver nitrate (3) Calcium chloride (4) Copper sulphate

Ans. **(2)**

69. When 96500 coulombs of electricity are passed through barium chloride solution, the amounts of barium deposited will be :-

(1) 0.5 mol. (2) 1.0 mol. (3) 1.5 mol. (4) 2.0 mol.

Ans. **(1)**

70. A factory produces 40 kg. of calcium in two hours by electrolysis. How much aluminium can be produced by the same current in two hours :–

(At wt. of Ca = 40, Al = 27)

(1) 22 kgm. (2) 18 kgm. (3) 9 kgm. (4) 27 kgm.

Ans. **(2)**

71. How many moles each of Ag^+ ion, Cu^{+2}, Fe^{+3} ion would be deposited by passage of same quantity of electricity through solutions of their salts :–

(1) Same number of moles of each (2) $1 : \frac{1}{2} : \frac{1}{3}$ moles

(3) $\frac{1}{3} : \frac{1}{2} : 1$ (4) 1 : 2 : 3

Ans. **(2)**

72. The passage of current liberates H_2 at cathode and Cl_2 at anode the solution is :–

(1) $CuSO_4$ (aq) (2) $CuCl_2$ (aq.) (3) NaCl(aq.) (4) Water

Ans. **(3)**

73. Electrolysis of aq. $CuSO_4$ produces :–

(1) An increase in pH (2) A decrease in pH

(3) Either decrease or increase (4) None

Ans. **(2)**

COMMERCIAL CELLS

74. When lead accumulator is charged it is :

(1) an electrolytic cell (2) a galvanic cell (3) a daniel cell (4) none of the above

Ans. **(1)**

75. When a lead storage battery is charged :

(1) PbO_2 dissolves (2) The lead electrode becomes coated with lead sulphate

(3) Sulphuric acid is regenerated (4) The amount of acid decreases

Ans. **(3)**

ANALATYCAL EXERCISE

1. A current of i ampere was passed for t sec. through three cells P, Q and R connected in series. These contain respectively silver nitrate, mercuric nitrate and mercurous nitrate. At the cathode of the cell P, 0.216 g of Ag was deposited. The weights of mercury deposited in the cathode of Q and R respectively are : (at. wt. of Hg = 200.59)

(1) 0.4012 and 0.8024 g (2) 0.4012 and 0.2006 g (3) 0.2006 and 0.4012 g (4) 0.1003 and 0.2006 g

Ans. **(3)**

2. The electrochemical equivalent of silver is 0.0011180g. When an electric current of 0.5 ampere is passed through an aqueous silver nitrate solution for 200 sec., the amount of silver deposited is:

(1) 1.1180 g (2) 0.11180 g (3) 5.590 g (4) 0.5590 g

Ans. **(2)**

3. A current of 9.65 amp. is passed through an aqueous solution of NaCl using suitable electrodes for 1000 s. Given that 1 faraday equals 96500 coulombs the amount of NaOH (mol wt. 40.00) formed on electrolysis is :

(1) 2.0 g (2) 8.0 g (3) 4.0 g (4) 1.0 g.

Ans. **(3)**

4. Given standard electrode potentials

$Fe^{3+} + 3e^- \longrightarrow Fe$; $E° = -0.036$ Volt

$Fe^{2+} + 2e^- \longrightarrow Fe$; $E° = -0.440$ Volt

The standard electrode potential E° for $Fe^{3+} + e^- \longrightarrow Fe^{2+}$ is :

(1) –0.476 volt (2) –0.404 volt (3) 0.440 volt (4) +0.772 volt

Ans. **(4)**

5. The standard oxidation potential of Zn and Ag in water at 20° C are :–

$Zn(s) = Zn^{2+}(aq.) + 2e^-$ $E° = 0.76\ V$

$Ag(s) \rightarrow Ag^+(aq.) + e^-$ $E° = -0.80\ V$

Which one of the following reactions actually takes place :–

(1) $Zn(s) + 2Ag^+(aq.) \rightarrow Zn^{2+} + 2Ag(s)$ (2) $Zn^{2+}(aq.) + 2Ag(s) \rightarrow 2Ag^+(aq.) + Zn(s)$

(3) $Zn(s) + Ag(s) \rightarrow Zn^{2+}(aq.) + Ag^+(aq.)$ (4) $Zn^{2+}(aq.) + Ag^+(aq.) \rightarrow Zn(s) + Ag(s)$

Ans. **(1)**

6 The thermodynamic efficiency of cell is given by-

(1) $\frac{\Delta H}{\Delta G}$ (2) $\frac{nFE}{\Delta G}$ (3) $-\frac{nFE}{\Delta H}$ (4) Zero

Ans. **(3)**

7. For the redox reaction :

$Zn(s) + Cu^{2+}(0.1M) \rightarrow Zn^{2+}(1M) + Cu(s)$ taking place in a cell,

$E°_{Cell}$ is 1.10 volt. E_{Cell} for the cell will be $\left(2.303\frac{RT}{F} = 0.0591\right)$

(1) 1.07 volt (2) 0.82 volt (3) 2.14 volt (4) 1.80 volt

Ans. **(1)**

8. When during electrolysis of a solution of $AgNO_3$ 9650 coulombs of charge pass through the electroplating bath, the mass of silver deposited on the cathode will be :

(1) 21.6g (2) 108g (3) 1.08g (4) 10.8g

Ans. **(4)**

9. An electric current is passed through silver voltameter connected to a water voltameter. The cathode of the silver voltameter weighed 0.108g more at the end of the electrolysis. The volume of oxygen evolved at STP is :

(1) $56cm^3$ (2) $550\ cm^3$ (3) $5.6\ cm^3$ (4) $11.2\ cm^3$

Ans. **(3)**

10. Specific conductance of 0.1 M Nitric acid is 6.3×10^{-2} $ohm^{-1}\ cm^{-1}$. The molar conductance of the solution is:

(1) 630 $ohm^{-1}\ cm^2\ mol^{-1}$ (2) 315 $ohm^{-1}\ cm^2\ mol^{-1}$

(3) 100 $ohm^{-1}\ cm^2\ mol^{-1}$ (4) 6.300 $ohm^{-1}\ cm^2\ mol^{-1}$

Ans. **(1)**

11. Which of the following statements is TRUE for the electrochemical Daniel cell :

(1) Electrons flow from copper electrode to zinc electrode.

(2) Current flows from zinc electrode to copper electrode.

(3) Cations move toward copper electrode.

(4) Cations move toward zinc electrode.

Ans. **(3)**

12. Consider the following E^0 values

$E^0_{Fe^{3+}/Fe^{2+}} = +0.77V$

$E^0_{Sn^{2+}/Sn} = -0.14V$

Under standard conditions the potential for the reaction

$Sn(s) + 2Fe^{3+}(aq) \longrightarrow 2Fe^{2+}(aq) + Sn^{2+}(aq)$ is

(1) 0.91V (2) 1.40V (3) 1.68V (4) 0.63V

Ans. **(1)**

13. In a cell that utilises the reaction

$Zn(s) + 2H^+(aq.) \rightleftharpoons Zn^{2+}(aq) + H_2(g)$ addition of H_2SO_4 to cathode compartment, will

(1) increase the E_{cell} and shift equilibrium to the right

(2) lower the E_{cell} and shift equilibrium to the right

(3) lower the E_{cell} and shift equilibrium to the left

(4) increase the E_{cell} and shift equilibrium to the left

Ans. **(1)**

14. The $E^0_{M^{3+}/M^{2+}}$ values for Cr, Mn, Fe and Co are $-0.41, +1.57, +0.77$ and $+1.97V$ respectively. For which one of these metals the change in oxidation state from +2 to +3 is easiest ?

(1) Fe (2) Mn (3) Cr (4) Co

Ans. **(3)**

15. Aluminium displaces hydrogen from dilute HCl whereas silver does not, the E.M.F. of a cell prepared by combining Al/Al^{+3} and Ag/Ag^+ is 2.46V. The reduction potential of silver electrode is +0.80V. The reduction potential of aluminium electrode is :

(1) -3.26 V (2) +1.66V (3) -1.66V (4) 3.26 V

Ans. **(3)**

16. For a spontaneous reaction the ΔG, equilibrium constant (K) and E^0_{Cell} will be respectively

(1) –ve, < 1, –ve (2) –ve, >1, –ve (3) –ve, >1, +ve (4) +ve, >1, –ve

Ans. **(3)**

17. Aluminium oxide may be electrolysed at 1000°C to furnish aluminium metal (At. Mass = 27 amu; 1 Faraday = 96500 Coulombs).The cathode reaction is

$A\ell^{3+} + 3e^- \longrightarrow A\ell^0$

To prepare 5.12 kg of aluminium metal by this method would require.

(1) 5.49×10^4 C of electric charge (2) 5.49×10^1 C of electric charge

(3) 5.49×10^7 C of electric charge (4) 1.83×10^7 C of electric charge

Ans. **(3)**

18. The highest electrical conductivity of the following aqueous solution is of

(1) 0.1 M fluoroacetic acid (2) 0.1 M difluoroacetic acid

(3) 0.1 M acetic acid (4) 0.1 M chloroacetic acid

Ans. **(2)**

19.

Electrolyte	KCl	KNO_3	HCl	NaOAC	NaCl
Λ^∞ (S cm^2 mol^{-1})	149.9	145.0	426.2	91.0	126.5

Calculate Λ^∞_{HOAc} using appropriate molar conductances of the electrolytes listed above at infinite dilution in H_2O at 25°C

(1) 390.7 (2) 217.5 (3) 517.2 (4) 552.7

Ans. **(1)**

20. Given the data at 25°C,

$Ag + I^- \rightarrow AgI + e^-$, $E^\circ = 0.152V$

$Ag \rightarrow Ag^+ + e^-$, $E^\circ = -0.800\,V$

What is the value of log Ksp for AgI ? $\left(2.303\frac{RT}{F} = 0.059\,V\right)$

(1) –8.12 (2) +8.612 (3) –37.83 (4) –16.13

Ans. **(4)**

21. Resistance of a conductivity cell filled with a solution of an electrolyte of concentration 0.1M is 100Ω. The conductivity of this solution is 1.29 Sm^{-1}. Resistance of the same cell when filled with .02M of the same solution is 520Ω. The molar conductivity of 0.02M solution of the electrolyte will be.

(1) 124×10^{-4} Sm^2 mol^{-1} (2) 1240×10^{-4} Sm^2 mol^{-1} (3) 1.24×10^{-4} Sm^2 mol^{-1} (4) 12.4×10^{-4} Sm^2 mol^{-1}

Ans. **(1)**

22. The reduction potential of hydrogen half-cell will be negative if :-

(1) $p(H_2) = 2$ atm $[H^+] = 1.0$ M (2) $p(H_2) = 2$ atm and $[H^+] = 2.0$ M

(3) $p(H_2) = 1$ atm and $[H^+] = 2.0$ M (4) $p(H_2) = 1$ atm and $[H^+] = 1.0$ M

Ans. **(1)**

23. Resistance of 0.2 M solution of an electrolyte is 50 Ω. The specific conductance of the solution is 1.3 S m^{-1}. If resistance of the 0.4M solution of the same electrolyte is 260 Ω, its molar conductivity is :-

(1) 6250 S m^2 mol^{-1} (2) 6.25×10^{-4} S m^2 mol^{-1}

(3) 625×10^{-4} S m^2 mol^{-1} (4) 62.5 S m^2 mol^{-1}

Ans. **(2)**

24. The resistance of 0.0025 M solution of K_2SO_4 is 326 ohm. The specific conductance of the solution, if cell constant is 4.

(1) 4.997×10^{-4} (2) 5.997×10^{-7} (3) 6.997×10^{-4} (4) 1.20×10^{-2}

Ans. **(4)**

25. The conductivity of four electrolytes P, Q, R, S in $ohm^{-1}\ cm^{-1}$ are as follows P (5×10^{-5}); Q (1×10^{-10}); R (7×10^{-8}); S (9.2×10^{-3}). The one which offers highest resistance to the passage of electric current is

(1) P (2) S (3) R (4) Q

Ans. **(4)**

26. Zn rod is placed in 100 ml of 1M $CuSO_4$ solution so that molarity of Cu^{2+} changes to 0.7 M. The molarity of SO_4^{2-} at this stage will be

(1) 0.8 M (2) 1 M (3) 0.7 M (4) 1.8 M

Ans. **(2)**

27. The time taken by the galvanic cell which operates almost ideally under reversible conditions at a current of 10^{-16}A to deliver 1 mole of electron is

(1) 19.30×10^{20} s (2) 4.825×10^{20} s (3) 9.65×10^{20} s (4) 3.14×10^{11} s

Ans. **(3)**

28. A direct current deposits 54 g of silver (atomic mass = 108) during the electrolysis. The same quantity of electricity would deposit aluminium chloride in molten state equal to

(1) 4.5 g (2) 5.4 g (3) 54 g (4) 27 g

Ans. **(1)**

29. During the electrolysis of water 4 mol of electrons were transferred from anode to cathode. The total volume of gases produced at STP will be approximately

(1) 67.2 L (2) 22.4 L (3) 44.8 L (4) 89.4 L

Ans. **(1)**

30. Which of the following can oxidise fluoride ions ?

(1) O_3 (2) Cl_2 (3) Br_2 (4) No chemical substance

Ans. **(4)**

31. Electrolysis of H_2SO_4 (conc.) gives the following at anode

(1) H_2 (2) O_2 (3) $H_2S_2O_3$ (4) $H_2S_2O_8$

Ans. **(4)**

32. If the standard reduction potential E° for four divalent elements X, Y, Z, W are –1.46V, –0.36V, 0.15V and –1.24 V respectively then

(1) X will replace Z^{2+} from aqueous solution (2) Y will replace Z^{2+} from aqueous solution

(3) W will replace Z^{2+} from aqueous solution (4) All statements are correct

Ans. **(4)**

33. In SHE, the pH of the acid solution should be

(1) 7 (2) 14 (3) 0 (4) 4

Ans. **(3)**

34. E.M.F. of $Ni(s)|Ni^{2+}(aq) \,||\, Cu^{2+}_{(aq)}|\, Cu(s)$ cell can be increased by

(1) Adding NH_3 in the right half-cell (2) Increasing the conc. of Ni^{2+} ions

(3) Adding dimethyl glyoxime into the left half-cell (4) Changing the electrolyte present in salt bridge

Ans. **(3)**

35. For given cell; $Zn \mid Zn^{+2}(C_1) \parallel Zn^{+2}(C_2) \mid Zn$; ΔG is negative if

(1) $C_1 = C_2$ (2) $C_1 > C_2$ (3) $C_2 > C_1$ (4) Can't predicted

Ans. **(3)**

36. The emf of the cell, $Zn \mid Zn^{+2} \parallel Ag^{+} \mid Ag$ is independent of

(1) The volume of Zn^{2+} and Ag^{+} solution (2) The molarity of Zn^{2+} ions in solution

(3) The molarity of Ag^{+} ions in solution (4) Temperature

Ans. **(1)**

37. Standard cell voltage for the cell $Pb/Pb^{2+} \parallel Sn^{2+}/Sn$ is –0.01V. If the cell is to exhibit $E_{cell} = 0$, the value of log $[Sn^{2+}]/[Pb^{2+}]$ should be

(1) 0.33 (2) 0.5 (3) 1.5 (4) –0.5

Ans. **(1)**

38. The voltage of a cell whose half cell reactions are given below is

$Mg^{2+} + 2e^{-} \longrightarrow Mg(s)$; $E = -2.37\,V$

$Cu^{2+} + 2e^{-} \longrightarrow Cu(s)$; $+0.34\,V$

(1) –2.03 V (2) 1.36 V (3) 2.71 V (4) 2.03 V

Ans. **(3)**

39. The quantity of electricity required to reduce 12.3 g of nitro benzene to aniline assuming 50% current efficiency is

(1) 115800 C (2) 57900 C (3) 231600 C (4) 28950 C

Ans. **(1)**

40. A 100 watt, 110 volt lamp is connected in series with an electrolytic cell containing $CdSO_4$ solution, the weight of Cd deposited by the current for 10 hrs is (At. wt. Cd = 112.4)

(1) 19.06 g (2) 38.12 g (3) 1.906 g (4) 3.812 g

Ans. **(1)**

41. The two platinum electrodes fitted in a conductance cell are 1.5 cm apart while the cross sectional area of each electrode is 0.75 cm^2. What is the cell constant ?

(1) 1.25 cm (2) 0.5 cm (3) 2.0 cm^{-1} (4) 0.2 cm^{-1}

Ans. **(3)**

42. A current of 2.0 A is passed for 5 hours through a molten metal salt deposits 22.2 g of metal (At. mass : 177). The oxidation state of the metal in metal salt is

(1) +1 (2) +2 (3) +3 (4) +4

Ans. **(3)**

43. The following facts are available

$2A^{-} + B_2 \longrightarrow 2B^{-} + A_2$

$2C^{-} + B_2 \longrightarrow$ No reaction

$2D^{-} + A_2 \longrightarrow 2A^{-} + D_2$

Which of the following statement is correct

(1) $E^{o}_{C^{-}/C_2} > E^{o}_{B^{-}/B_2} > E^{o}_{A^{-}/A_2} > E^{o}_{D^{-}/D_2}$ (2) $E^{o}_{C^{-}/C_2} < E^{o}_{B^{-}/B_2} < E^{o}_{A^{-}/A_2} < E^{o}_{D^{-}/D_2}$

(3) $E^{o}_{C^{-}/C_2} < E^{o}_{B^{-}/B_2} > E^{o}_{A^{-}/A_2} > E^{o}_{D^{-}/D_2}$ (4) Can't predict

Ans. **(2)**

44. The hydrogen electrode is dipped in a solution of pH = 3 at 25°C. The reduction potential of the electrode would be

(1) 0.177 V (2) 0.087 V (3) –0.177 V (4) 0.059 V

Ans. **(3)**

45. A current of 0.965 ampere is passed through 500 ml of 0.2 M solution of $ZnSO_4$ for 10 minutes. The molarity of Zn^{2+} after deposition of zinc is

(1) 0.1 M (2) 0.5 M (3) 0.8 M (4) 0.194 M

Ans. **(4)**

46. What will be the emf of the given cell ?

$Pt \mid H_{2(P1)} \mid H^{+}_{(aq)} \mid H_{2(P2)} \mid Pt$

(1) $\frac{RT}{F}\ln\frac{P_1}{P_2}$ (2) $\frac{RT}{2F}\ln\frac{P_1}{P_2}$ (3) $\frac{RT}{F}\ln\frac{P_2}{P_1}$ (4) $\frac{RT}{2F}\ln\frac{P_2}{P_1}$

Ans. **(2)**

ASSERTION & REASON QUESTIONS

These questions consist of two statements each, printed as *Assertion* and *Reason.* While answering these Questions you are required to choose any one of the following four responses.

A. **If both *Assertion* & *Reason* are True & the *Reason* is a correct explanation of the *Assertion*.**

B. **If both *Assertion* & *Reason* are True but *Reason* is not a correct explanation of the Assertion.**

C. **If *Assertion* is True but the *Reason* is False.**

D. **If both *Assertion* & *Reason* are False.**

1. ***Assertion* :–** Electrolysis of molten calcium hydride produces hydrogen gas at anode.
***Reason* :–** Hydrogen in calcium hydride is present as H^- ion.
Ans. **(A)**

2. ***Assertion* :–** Conductance of 0.1 M NH_4OH solution is less than that of 0.001M NH_4OH solution.
***Reason* :–** Dilution increases the degree of ionisation of NH_4OH
Ans. **(A)**

3. ***Assertion* :–** Salt bridge is used generally in the electrochemical cells.
***Reason* :–** The ions of the electrolyte used in the salt bridge should have nearly same transport number.
Ans. **(B)**

4. ***Assertion* :–** The electrode potential of SHE is zero.
***Reason* :–** SHE is a standard reference electrode.
Ans. **(B)**

5. ***Assertion* :–** Copper sulphate solution cannot be stored in iron-vessel.
***Reason* :–** Copper atoms are oxidised by iron ions.
Ans. **(C)**

6. ***Assertion* :–** Absolute value of E^0_{red} of an electrode cannot be determined.
***Reason* :–** Neither oxidation nor reduction can take place alone.
Ans. **(A)**

7. ***Assertion* :–** A dry cell became dead after long time even if it has not been used.
***Reason* :–** The NH_4Cl slowly and gradually corrods the zinc container.
Ans. **(A)**

8. ***Assertion* :–** The molar conductance of weak electrolytes is low as compared to that of strong electrolytes at moderate concentrations.
***Reason* :–** Weak electrolytes at moderate concentration dissociation to a much greater extent as compared to strong electrolytes.
Ans. **(C)**

9. ***Assertion* :–** Galvanised iron does not rust.
***Reason* :–** Zinc has a more negative electrode potential then iron.
Ans. **(A)**

10. ***Assertion* :–** Increase in the concentration of copper half cell in Daniel cell increases the emf of the cell.
***Reason* :–** According to the Nernst equation

emf of cell = $E^0_{cell} + \frac{0.059}{2}\log\frac{\left[Cu^{+2}\right]}{\left[Zn^{+2}\right]}$

Ans. **(A)**

11. ***Assertion* :–** Sodium ions are discharged at the Hg electrode during electrolysis in preference to H^+ ions.
***Reason* :–** The nature of electrode also affect the order of discharge of cations.
Ans. **(A)**

12. ***Assertion* :–** The cell constant of a cell depends upon the nature of the material of the electrodes.
***Reason* :–** The observed conductance depends upon the nature of the electrolyte and the concentration of the solution.
Ans. **(D)**

13. ***Assertion*** **:–** At the end of electrolysis using platinum electrodes, an aqueous solution of copper sulphate turns colourless.

Reason **:–** Copper in $CuSO_4$ is converted to $Cu(OH)_2$ during the electrolysis.

Ans. (C)

14. ***Assertion*** **:–** In electrolysis, the quantity of electricity needed for depositing 1 mole of silver is different from that required for 1 mole of copper.

Reason **:–** The atomic weight of silver and copper are different.

Ans. (B)

15. ***Assertion*** **:-** Reduction potential of Mn (+3 to +2) is more positive than Fe (+3 to +2) **[AIIMS-2011]**

Reason :- Ionisation potential of Mn is more than that of Fe

Ans. (C)

16. ***Assertion*** **:-** A reactions is spontaneous if E_{cell} = +ve **[AIIMS-2011]**

Reason :- For E_{cell} = +ve. ΔG is always –ve

Ans. (A)

17. ***Assertion*** **:–** pH of solution increases during electrolysis of aqueous solution of NaCl.

Reason **:–** Electrolysis is non-spontaneous process.

Ans. (B)

18. ***Assertion*** **:–** Cu is stronger reducing agent than H_2.

Reason **:–** E° of Cu^{+2}/Cu is negative.

Ans. (D)

19. ***Assertion*** **:–** For cell reaction ; at 298 K

$Zn_{(s)} + Cu^{+2}(1M) \rightleftharpoons Zn^{+2}(1M) + Cu(s)$

$E^0_{cell} = 0$

Reason **:–** At standard condition ; cell potential is always zero.

Ans. (D)

20. ***Assertion*** **:–** Li forms ethynide with acetylene.

Reason **:–** $E^0_{Li^+/Li} = +3.04V$

Ans. (C)