

EXERCISE - 1 : BASIC OBJECTIVE QUESTIONS

Basics of electrochemical Cell

- Which of the following has been universally accepted as a reference electrode at all temperatures and has been assigned a value of zero volt ?
(a) platinum electrode (b) copper electrode
(c) graphite electrode (d) standard hydrogen electrode
- The reaction $\frac{1}{2}\text{H}_2(\text{g}) + \text{AgCl}(\text{s}) = \text{H}^+(\text{aq}) + \text{Cl}^-(\text{aq}) + \text{Ag}(\text{s})$ occurs in the galvanic cell :
(a) $\text{Ag} | \text{AgCl}(\text{s}) | \text{KCl}(\text{sol.}) || \text{AgNO}_3(\text{sol.}) | \text{Ag}$
(b) $\text{Pt} | \text{H}_2(\text{g}) | \text{HCl}(\text{sol.}) || \text{AgNO}_3(\text{sol.}) | \text{Ag}$
(c) $\text{Pt} | \text{H}_2(\text{g}) | \text{HCl}(\text{sol.}) || \text{AgCl}(\text{s}) | \text{Ag}$
(d) $\text{Pt} | \text{H}_2(\text{g}) | \text{KCl}(\text{sol.}) || \text{AgCl}(\text{s}) | \text{Ag}$
- The equation representing the process by which standard reduction potential of zinc can be defined is :
(a) $\text{Zn}^{2+}(\text{s}) + 2\text{e}^- \longrightarrow \text{Zn}$
(b) $\text{Zn}(\text{g}) \longrightarrow \text{Zn}^{2+}(\text{g}) + 2\text{e}^-$
(c) $\text{Zn}^{2+}(\text{g}) + 2\text{e}^- \longrightarrow \text{Zn}$
(d) $\text{Zn}^{2+}(\text{aq.}) + 2\text{e}^- \longrightarrow \text{Zn}(\text{s})$
- Which of the following statement is wrong about galvanic cell ?
(a) cathode is positive charged
(b) anode is negatively charged
(c) reduction takes place at the anode
(d) reduction takes place at the cathode
- Which are used as secondary reference electrodes ?
(a) Calomel electrode (b) Ag/AgCl electrode
(c) $\text{Hg}/\text{Hg}_2\text{Cl}_2 - \text{KCl}$ electrode
(d) All of the above

Applications of Electrochemical Series

- The standard electrode potentials (reduction) of Pt/Fe^{3+} , Fe^{2+} and Pt/Sn^{4+} , Sn^{2+} are +0.77 V and 0.15 V respectively at 25°C. The standard EMF of the reaction $\text{Sn}^{4+} + 2\text{Fe}^{2+} \longrightarrow \text{Sn}^{2+} + 2\text{Fe}^{3+}$ is
(a) -0.62 V (b) -0.92 V
(c) +0.31 V (d) +0.85 V

- Adding powdered Pb and Fe to a solution containing 1.0 M is each of Pb^{2+} and Fe^{2+} ions would result into the formation of ($E^\circ \text{Pb}^{2+}/\text{Pb} = -0.13\text{V}$, $E^\circ \text{Fe}^{2+}/\text{Fe} = -0.44\text{V}$)
(a) More of Pb and Fe^{2+} ions
(b) More of Fe and Pb^{2+} ions
(c) More of Fe and Pb (d) More of Fe^{2+} and Pb^{2+} ions
- Strongest reducing agent is :
(a) K (b) Mg
(c) Al (d) I
- Zn can not displace following ions from their aqueous solution :
(a) Ag^+ (b) Cu^{2+}
(c) Fe^{2+} (d) Na^+
- Which of the following displacement does not occur :
(a) $\text{Zn} + 2\text{H}^+ \rightarrow \text{Zn}^{2+} + \text{H}_2 \uparrow$
(b) $\text{Fe} + 2\text{Ag}^+ \rightarrow \text{Fe}^{2+} + \text{Ag} \downarrow$
(c) $\text{Cu} + \text{Fe}^{2+} \rightarrow \text{Cu}^{2+} + \text{Fe} \downarrow$
(d) $\text{Zn} + \text{Pb}^{2+} \rightarrow \text{Zn}^{2+} + \text{Pb} \downarrow$
- 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 ?
(a) $\text{Zn} + \text{Cu}^{2+} \longrightarrow \text{Cu} + \text{Zn}^{2+}$
(b) $\text{Zn} + 2\text{Ag}^+ \longrightarrow 2\text{Ag} + \text{Zn}^{2+}$
(c) $\text{H}_2 + \text{Cu}^{2+} \longrightarrow 2\text{H}^+ + \text{Cu}$
(d) $\text{H}_2 + \text{Ni}^{2+} \longrightarrow 2\text{H}^+ + \text{Ni}$
- The position of some metals in the electrochemical series in decreasing electropositive character is given as $\text{Mg} > \text{Al} > \text{Zn} > \text{Cu} > \text{Ag}$. What will happen if a copper spoon is used to stir a solution of aluminium nitrate ?
(a) The spoon will get coated with aluminium
(b) An alloy of copper and aluminium is formed
(c) The solution becomes blue
(d) There is no reaction

13. The standard reduction electrode potential values of the element A, B and C are +0.68, -2.50, and -0.50 V respectively. The order of their reducing power is :

(a) $A > B > C$ (b) $A > C > B$
(c) $C > B > A$ (d) $B > C > A$

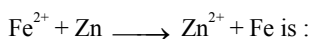
14. A metal having negative reduction potential when dipped in the solution of its own ions, has a tendency :

(a) to pass into the solution
(b) to be deposited from the solution
(c) to become electrically positive
(d) to remain neutral

15. E° for the half cell reactions are as,

(a) $Zn = Zn^{2+} + 2e^-$; $E^\circ = +0.76$ V
(b) $Fe = Fe^{2+} + 2e^-$; $E^\circ = +0.41$ V

The E° for half cell reaction,



(a) -0.35 V (b) +0.35 V
(c) +1.17 V (d) -0.17 V

16. An aqueous solution containing 1 M each of Au^{3+} , Cu^{2+} , Ag^+ , Li^+ is being electrolysed by using inert electrodes. The value of standard potentials are :

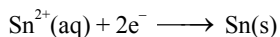
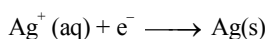
$E^\circ_{Ag^+/Ag} = 0.80$ V, $E^\circ_{Cu^{2+}/Cu} = 0.34$ V and $E^\circ_{Au^{3+}/Au} = 1.50$ V,

$E^\circ_{Li^+/Li} = -3.03$ V

with increasing voltage, the sequence of deposition of metals on the cathode will be :

(a) Li, Cu, Ag, Au (b) Cu, Ag, Au
(c) Au, Ag, Cu (d) Au, Ag, Cu, Li

17. The standard electrode potential for the reaction



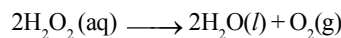
at 25°C are 0.80 volt and -0.14 volt, respectively. The emf of the cell.



(a) 0.66 volt (b) 0.80 volt
(c) 1.08 volt (d) 0.94 volt

Relationship between emf and gibb's free energy change

18. The standard free energy change for the following reaction is -210 kJ. What is the standard cell potential ?



(a) +0.752 (b) +1.09
(c) +0.420 (d) +0.640

19. Calculate the standard free energy change for the reaction, $2Ag + 2H^+ \rightarrow H_2 + 2Ag^+$,

E° for $Ag^+ + e^- \rightarrow Ag$ is 0.80 V

(a) +154.4 kJ (b) +308.8 kJ
(c) -154.4 kJ (d) -308.8 kJ

20. The standard EMF of Daniell cell is 1.10 volt. The maximum electrical work obtained from the Daniell cell is

(a) 212.3 kJ (b) 175.4 kJ
(c) 106.15 kJ (d) 53.07 kJ

21. What is the free energy change for the half reaction $Li^+ + e^- \rightarrow Li$?

Given $E^\circ_{Li^+/Li} = -3.0$ V, $F = 96500$ C mol⁻¹ and $T = 298$ K.

(a) 289.5 kJ mol⁻¹ (b) -298.5 kJ mol⁻¹
(c) 32.166 CV⁻¹ mol⁻¹ (d) -289500 CV mol⁻¹

22. The emf of Daniell cell is 1.1 volt. If the value of Faraday is 96500 coulombs per mole, the change in free energy in kJ is

(a) 212.30 (b) -212.30
(c) 106.15 (d) -106.15

Nernst Equation

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

(a) E°_{red} (b) $(E^\circ_{red} + 0.059)$
(c) $(E^\circ_{ox} - 0.059)$ (d) $(E^\circ_{red} - 0.059)$

24. Consider the cell $H_2(Pt) | H_3O^+(aq) | Ag^+ | Ag$. The measured

EMF of the cell is 1.023 V. What is the value of x ?

$E^\circ_{Ag^+/Ag} = +0.799$ V [$T = 25^\circ C$]

(a) 2×10^{-2} M (b) 2×10^{-3} M
(c) 1.5×10^{-3} M (d) 1.5×10^{-2} M

25. The emf of the cell
 $\text{Ti}/\text{Ti}^{+} (0.0001 \text{ M}) || \text{Cu}^{2+} (0.01 \text{ M})/\text{Cu}$ is 0.83 V
 The emf of this cell will be increased by :
 (a) Increase the concentration of Cu^{++} ions
 (b) Decreasing the concentration of Ti^{+}
 (c) Increasing the concentration of both
 (d) (a) and (b) both
26. $\text{Co} | \text{Co}^{2+} (C_2) || \text{Co}^{2+} (C_1) | \text{Co}$ for this cell, ΔG is negative if :
 (a) $C_2 > C_1$ (b) $C_1 > C_2$
 (c) $C_1 = C_2$ (d) unpredictable
27. What will be the emf for the given cell ?
 $\text{Pt} | \text{H}_2 (\text{g}, P_1) | \text{H}^{+} (\text{aq}) || \text{H}_2 (\text{g}, P_2) | \text{Pt}$
 (a) $\frac{RT}{F} \ln \frac{P_1}{P_2}$ (b) $\frac{RT}{2F} \ln \frac{P_1}{P_2}$
 (c) $\frac{RT}{2F} \ln \frac{P_2}{P_1}$ (d) None of these
28. If the pressure of hydrogen gas is increased from 1 atm. to 100 atm., keeping the hydrogen ion concentration constant at 1 M, the voltage of the hydrogen half-cell is at 25°C will be
 (a) 0.059 V (b) -0.059 V
 (c) 0.295 V (d) 0.118 V
29. The EMF of the cell
 $\text{Mg} | \text{Mg}^{2+} (0.01 \text{ M}) || \text{Sn}^{2+} (0.1 \text{ M}) | \text{Sn}$ at 298 K is (Given
 $E^{\circ}_{\text{Mg}^{2+}, \text{Mg}} = -2.34 \text{ V}$, $E^{\circ}_{\text{Sn}^{2+}, \text{Sn}} = -0.14 \text{ V}$)
 (a) 2.17 V (b) 2.23 V
 (c) 2.51 V (d) 2.45 V
30. The potential of the cell containing two hydrogen electrodes as represented below
 $\text{Pt}, \text{H}_2 (\text{g}) | \text{H}^{+} (10^{-6} \text{ M}) || \text{H}^{+} (10^{-4} \text{ M}) | \text{H}_2 (\text{g}), \text{Pt}$ at 298 K is
 (a) -0.118 V (b) -0.0591 V
 (c) 0.118 V (d) 0.0591 V
31. The emf of the cell $\text{H}_2 (1 \text{ atm}) | \text{Pt} | \text{H}^{+} (a = x) || \text{H}^{+} (a = 1) | \text{H}_2 (1 \text{ atm}) | \text{Pt}$ at 25°C is 0.59 V. The pH of the solution is
 (a) 1 (b) 4
 (c) 7 (d) 10

32. The hydrogen electrode is dipped in a solution of pH = 3 at 25°C. The potential of the cell would be (the value of $2.303 RT/F$ is 0.059 V)
 (a) 0.177 V (b) 0.087 V
 (c) -0.177 V (d) 0.059 V

Relating half cell potential using dG

33. When two half-cells of electrode potential of E_1 and E_2 are combined to form a cell of electrode potential E_3 , then (when n_1, n_2 and n_3 are no. of electrons exchanged in first, second and combined half-cells) :

$$(a) E_3 = E_2 - E_1 \quad (b) E_3 = \frac{E_1 n_1 + E_2 n_2}{n_3}$$

$$(c) E_3 = \frac{E_1 n_1 - E_2 n_2}{n_3} \quad (d) E_3 = E_1 + E_2$$

34. If $E^{\circ}_{\text{Au}^{+}/\text{Au}}$ is 1.69 V and $E^{\circ}_{\text{Au}^{3+}/\text{Au}}$ is 1.40 V, then $E^{\circ}_{\text{Au}^{+}/\text{Au}^{3+}}$
 (a) 0.19 V (b) 2.945 V
 (c) 1.255 V (d) None of these

Electrolytic cell

35. Which reaction occur at cathode during electrolysis is fused lead bromide ?
 (a) $\text{Pb} \longrightarrow \text{Pb}^{2+} + 2\text{e}^{-}$ (b) $\text{Br} + \text{e}^{-} \longrightarrow \text{Br}^{-}$
 (c) $\text{Br}^{-} \longrightarrow \text{Br} + \text{e}^{-}$ (d) $\text{Pb}^{2+} + 2\text{e}^{-} \longrightarrow \text{Pb}$
36. By the electrolysis of aqueous solution of CuSO_4 , the products obtained at both the electrodes are
 (a) O_2 at anode and H_2 at cathode
 (b) H_2 at anode and Cu at cathode
 (c) O_2 at anode and Cu at cathode
 (d) $\text{H}_2\text{S}_2\text{O}_8$ at anode and O_2 at cathode
37. During the electrolysis of fused NaCl, the reaction that occurs at the anode is :
 (a) Chloride ions are oxidized
 (b) Chloride ions are reduced
 (c) Sodium ions are oxidized
 (d) Sodium ions are reduced

38. In electroplating the article to be electroplated is made :
(a) cathode (b) anode
(c) either cathode or anode
(d) simply suspended in the electrolytic bath.
39. On electrolysis a solution of dilute H_2SO_4 between platinum electrodes, the gas evolved at the anode is
(a) SO_2 (b) SO_3
(c) O_2 (d) H_2 .
40. A spoon to be electroplated with gold should be :
(a) cathode (b) anode
(c) electrolyte (d) none of these
- Faraday's Laws**
41. Three faradays of electricity was passed through an aqueous solution of iron (II) bromide. The mass of iron metal (at. mass 56) deposited at the cathode is -
(a) 56 g (b) 84 g
(c) 112 g (d) 168 g
42. The electric charge for electrode deposition of one gram equivalent of a substance is :
(a) one amp/sec (b) 96,500 C/sec
(c) one amp/hour (d) 96,500 C
43. Number of electrons involved in the electrodeposition of 63.5 g of Cu from a solution of CuSO_4 is :
(a) 6.022×10^{23} (b) 3.011×10^{23}
(c) 12.044×10^{23} (d) 6.022×10^{22}
44. When one coulomb of electricity is passed through an electrolytic solution the mass deposited on the electrode is equal to :
(a) equivalent weight (b) molecular weight
(c) electrochemical equivalent
(d) one gram
45. W g of copper deposited in a copper voltameter when an electric current of 2 ampere is passed for 2 hours. If one ampere of electric current is passed for 4 hours in the same voltameter, copper deposited will be :
(a) W (b) W/2
(c) W/4 (d) 2W
46. When the same electric current is passed through the solution of different electrolytes in series the amounts of elements deposited on the electrodes are in the ratio of their:
(a) atomic number (b) atomic masses
(c) specific gravities (d) equivalent masses
47. 13.5 g of Al get deposited when electricity is passed through the solution of AlCl_3 . The number of faradays used are :
(a) 0.50 (b) 1.00
(c) 1.50 (d) 2.00
48. The ratio of weights of hydrogen and magnesium deposited by the same amount of electricity from aqueous H_2SO_4 and fused MgSO_4 are :
(a) 1 : 8 (b) 1 : 12
(c) 1 : 16 (d) None of these
49. A current of 2 ampere was passed through solutions of CuSO_4 and AgNO_3 in series. 0.635 g of copper was deposited. Then the weight of silver deposited will be :
(a) 0.59 g (b) 3.24 g
(c) 1.08 g (d) 2.16 g
50. An ion is reduced to the element when it absorbs 6×10^{20} electrons. The number of equivalents of the ion is :
(a) 0.10 (b) 0.01
(c) 0.001 (d) 0.0001
51. Electrolysis can be used to determine atomic masses. A current of 0.550 A deposits 0.55 g of a certain metal in 100 minutes. Calculate the atomic mass of the metal if $n = 3$:
(a) 100 (b) 45.0
(c) 48.25 (d) 144.75
52. How many minutes will it take to plate out 0.50 g of Cr from a $\text{Cr}_2(\text{SO}_4)_3$ solution using a current of 1.50 A ? (Atomic weight : Cr = 52.0)
(a) 254 (b) 30
(c) 152 (d) 103
53. An electrolysis of a oxytungsten complex ion using 1.10 A for 40 min produces 0.838 g of tungsten. What is the charge of tungsten in the material ? (Atomic weight : W = 184)
(a) 6 (b) 2
(c) 4 (d) 1

54. When molten lithium chloride (LiCl) is electrolyzed, lithium metal is formed at the cathode. If current efficiency is 75% then how many grams of lithium are liberated when 1930 C of charge pass through the cell : (Atomic weight : Li = 7)
- (a) 0.105 (b) 0.120
(c) 0.28 (d) 0.240
55. The weight ratio of Al and Ag deposited using the same quantity of current is :
- (a) 9 : 108 (b) 2 : 12
(c) 108 : 9 (d) 3 : 8
56. The weight of silver (eq. wt. = 108) displaced by that quantity of current which displaced 5600 mL of hydrogen at STP is :
- (a) 54 g (b) 108 g
(c) 5.4 g (d) None of these
57. A current of 9.65 ampere is passed through the aqueous solution NaCl using suitable electrodes for 1000 s. The amount of NaOH formed during electrolysis is
- (a) 2.0 g (b) 4.0 g
(c) 6.0 g (d) 8.0 g
58. How many electrons are delivered at the cathode during electrolysis by a current of 1A in 60 seconds ?
- (a) 3.74×10^{20} (b) 6.0×10^{23}
(c) 7.48×10^{21} (d) 6.0×10^{20}
59. The moles of electrons required to deposit 1 gm equivalent aluminium (at. wt. = 27) from a solution of aluminium chloride will be
- (a) 3 (b) 1
(c) 4 (d) 2
60. Time required to deposit one millimole of aluminium metal by the passage of 9.65 amperes through aqueous solution of aluminium ion is :
- (a) 30 s (b) 10 s
(c) 30,000 s (d) 10,000 s
61. How many coulomb of electricity are consumed when 100 mA current is passed through a solution of AgNO_3 for 30 minute during an electrolysis experiment.
- (a) 108 (b) 18000
(c) 180 (d) 3000
62. A current of 9.65 amp. flowing for 10 minute deposits 3.0 g of a metal. The equivalent wt. of the metal is :
- (a) 10 (b) 30
(c) 50 (d) 96.5
63. 108 g fairly concentrate solution of AgNO_3 is electrolyzed using 0.1 F of electricity. The weight of resulting solution is:
- (a) 94 g (b) 11.6 g
(c) 96.4 g (d) None

Batteries, Fuel Cells and Corrosion

64. When a lead storage battery is discharged
- (a) PbSO_4 is formed (b) Pb is formed
(c) SO_2 is consumed (d) H_2SO_4 is formed
65. A fuel cell is :
- (a) The voltaic cells in which continuous supply of fuels are send at anode to give oxidation
(b) The voltaic cell in which fuels such as : CH_4 , H_2 , CO are used up at anode
(c) It involves the reactions of $\text{H}_2 - \text{O}_2$ fuel cell such as :
- Anode : $2\text{H}_2 + 4\text{OH}^- \longrightarrow 4\text{H}_2\text{O}(l) + 4\text{e}^-$
Cathode : $\text{O}_2 + 2\text{H}_2\text{O}(l) + 4\text{e}^- \longrightarrow 4\text{OH}^-$
(d) All of the above
66. Reaction that takes place at anode in dry cell is
- (a) $\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn}(s)$ (b) $\text{Zn}(s) \rightarrow \text{Zn}^{2+} + 2\text{e}^-$
(c) $\text{Mn}^{2+} + 2\text{e}^- \rightarrow \text{Mn}(s)$
(d) $\text{Mn}(s) \rightarrow \text{Mn}^+ + \text{e}^- + 1.5 \text{ V.}$
67. As lead storage battery is charged
- (a) lead dioxide dissolves
(b) sulphuric acid is regenerated
(c) lead electrode becomes coated with lead sulphate
(d) the concentration of sulphuric acid decreases.

Conductance of Solutions

68. The specific conductance of a N/10 KCl at 25°C is $0.0112 \text{ ohm}^{-1} \text{ cm}^{-1}$. The resistance of cell containing solution at the same temperature was found to be 55 ohms. The cell constant will be
- (a) 6.16 cm^{-1} (b) 0.616 cm^{-1}
(c) 0.0616 cm^{-1} (d) 616 cm^{-1}

69. The specific conductance of a salt of 0.01 M concentration is 1.061×10^{-4} , molar conductance of the same solution will be :
(a) 1.061×10^{-4} (b) 1.061
(c) 10.61 (d) 106.1
70. Which of the following solutions of NaCl will have the highest specific conductance ?
(a) 0.001 N (b) 0.1 N
(c) 0.01 N (d) 1.0 N
71. 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 :
(a) 111.4 (b) 105.2
(c) 130.6 (d) 150.2
72. If x specific resistance (in $\text{S}^{-1} \text{cm}$) of the electrolyte solution and y is the molarity of the solution, then \wedge_m (in $\text{S cm}^2 \text{mol}^{-1}$) is given by :
(a) $\frac{1000x}{y}$ (b) $1000 \frac{x}{y}$
(c) $\frac{1000}{xy}$ (d) $\frac{xy}{1000}$
73. Resistance of 0.1 M KCl solution in a conductance cell is 300 ohm and conductivity is 0.013 Scm^{-1} . The value of cell constant is :
(a) 3.9 cm^{-1} (b) 39 m^{-1}
(c) 3.9 m^{-1} (d) None of these
74. The specific conductance of a saturated solution of silver bromide is $k \text{ Scm}^{-1}$. The limiting ionic conductivity of Ag^+ and Br^- ions are x and y , respectively. The solubility of silver bromide in gL^{-1} is : (molar mass of $\text{AgBr} = 188$)
(a) $\frac{k \times 1000}{x - y}$ (b) $\frac{k}{x + y} \times 188$
(c) $\frac{k \times 1000 \times 188}{x + y}$ (d) $\frac{x + y}{k} \times \frac{1000}{188}$
75. The conductivity of 0.1 N NaOH solution is 0.022 S cm^{-1} . When equal volume of 0.1 N HCl solution is added, the conductivity of resultant solution is decreases to 0.0055 S cm^{-1} . The equivalent conductivity in $\text{S cm}^2 \text{equivalent}^{-1}$ of NaCl solution is
(a) 0.0055 (b) 0.11
(c) 110 (d) none
76. The specific conductivity of a saturated solution of AgCl is $3.40 \times 10^{-6} \text{ ohm}^{-1} \text{ cm}^{-1}$ at 25°C . If $\lambda_{\text{Ag}^+} = 62.3 \text{ ohm}^{-1} \text{ cm}^2 \text{mol}^{-1}$ & $\lambda_{\text{Cl}^-} = 67.7 \text{ ohm}^{-1} \text{ cm}^2 \text{mol}^{-1}$, the solubility of AgCl at 25°C is :
(a) $2.6 \times 10^{-5} \text{ M}$ (b) $4.5 \times 10^{-3} \text{ M}$
(c) $3.6 \times 10^{-5} \text{ M}$ (d) $3.6 \times 10^{-3} \text{ M}$
77. Molar conductance of 0.1 M acetic acid is $7 \text{ ohm}^{-1} \text{ cm}^2 \text{mol}^{-1}$. If the molar cond. of acetic acid at infinite dilution is $380.8 \text{ ohm}^{-1} \text{ cm}^2 \text{mol}^{-1}$, the value of dissociation constant will be
(a) $226 \times 10^{-5} \text{ mol dm}^{-3}$ (b) $1.66 \times 10^{-3} \text{ mol dm}^{-1}$
(c) $1.66 \times 10^{-2} \text{ mol dm}^{-3}$ (d) $3.442 \times 10^{-5} \text{ mol dm}^{-3}$
78. At infinite dilution, the eq. conductances of CH_3COONa , HCl and CH_3COOH are 91, 426 and 391 mho cm^2 respectively at 25°C . The eq. conductance of NaCl at infinite dilution will be :
(a) 126 (b) 209
(c) 391 (d) 908
79. 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
(a) 1 (b) 0.2
(c) 0.1 (d) 0.5

EXERCISE - 2 : PREVIOUS YEAR COMPETITION QUESTIONS

(TOPIC-1)

ELECTROLYTES AND ELECTROLYTIC CONDUCTANCE

2011

- A current is passed through two cells connected in series. The first cell contains $X(NO_3)_3$ (aq) and the second cell contains $Y(NO_3)_2$ (aq). The relative atomic masses of X and Y are in the ratio 1:2. What is the ratio of liberated mass of X to that of Y? [Kerala CEE]
(a) 3:2 (b) 1:2
(c) 1:3 (d) 3:1
- Two different electrolytic cells filled with molten $Cu(NO_3)_2$ and molten $Al(NO_3)_3$ respectively are connected in series. When electricity is passed 2.7 g Al is deposited on electrode. Calculate the weight of Cu deposited on cathode. [Cu = 63.5; Al = 27.0 g mol⁻¹] [Guj. CET]
(a) 190.5 g (b) 9.525 g
(c) 63.5 g (d) 31.75 g

2010

- An increase in equivalent conductance of a strong electrolyte with dilution is mainly due to [CBSE AIPMT]
(a) increase in number of ions.
(b) increase in ionic mobility of ions.
(c) 100% ionisation of electrolyte at normal dilution.
(d) increase in both i.e., number of ions and ionic mobility of ions.
- The compound exhibiting maximum value of equivalent conductance in a fused state is [AMU]
(a) $SrCl_2$ (b) $CaCl_2$
(c) $MgCl_2$ (d) $BeCl_2$
- At 18°C, the conductance of H^+ and CH_3COO^- at infinite dilution are 315 and 35 mho cm² eq⁻¹ respectively. The equivalent conductivity of CH_3COOH at infinite dilution is mho cm² eq⁻¹. [AFMC]
(a) 350 (b) 280
(c) 30 (d) 315

- How many coulombs are required to deposit 50g of aluminium when the electrode reaction is [RPMT]
 $Al^{3+} + 3e^- \rightarrow Al$
(a) 536111 C (b) 536.111 C
(c) 96500 C (d) 38600 C

- The resistance of 1 N solution of acetic acid is 250 Ω , when measured in a cell having a cell constant of 1.15 cm⁻¹. The equivalent conductance (in ohm⁻¹ cm² equiv⁻¹) of 1 N acetic acid is [Guj. CET]
(a) 2.3 (b) 4.6
(c) 9.2 (d) 18.4

- The conductivity of 0.20 M KCl solution at 298 K is 0.0248 S cm⁻¹. What will be its molar conductivity? [Haryana PMT]

- (a) 124 S cm² (b) 124 cm⁻¹
(c) 124 ohm⁻¹cm² equiv⁻¹ (d) 124 S cm² mol⁻¹

- When same quantity of electricity is passed for half an hour, an amount of Cu and Cr deposited are respectively 0.375 g and 0.30 g. Ratio of electrochemical equivalent of Cu and Cr is [OJEE]

- (a) 0.8 (b) 1.25
(c) 2.5 (d) 1.62

- In electrolysis of dil. H_2SO_4 using platinum electrodes [BVP]

- (a) H_2 is evolved at cathode.
(b) SO_2 is produced at anode.
(c) O_2 is obtained at cathode.
(d) SO_2 is produced at cathode.

2009

- Al_2O_3 is reduced by electrolysis at low potentials and high current. If 4.0×10^4 amperes of current is passed through molten Al_2O_3 for 6 h, what mass of aluminium is produced? (Assume 100% current efficiency, at. wt. of Al=27) [CBSE AIPMT]

- (a) 9.0×10^3 g (b) 8.1×10^4 g
(c) 2.4×10^3 g (d) 1.3×10^4 g

12. The equivalent conductance of $\frac{M}{32}$ solution of a weak monobasic acid is 8.0 mho cm^2 and at infinite dilution is 400 mho cm^2 . The dissociation constant of this acid is [CBSE AIPMT]
- (a) 1.25×10^{-5} (b) 1.25×10^{-6}
(c) 6.25×10^{-4} (d) 1.25×10^{-4}
13. **Assertion** On dilution, the equivalent as well as molar conductivity of solution increases.
Reason With dilution, the number of current carrying particles per cm^3 increases. [AIIMS]
- (a) Both Assertion and Reason are true and Reason is correct explanation of the Assertion.
(b) Both Assertion and Reason are true and Reason is not the correct explanation of the Assertion.
(c) Assertion is true but Reason is false.
(d) Both Assertion and Reason are false.
14. An aqueous solution containing 6.5 g of NaCl of 90% purity was subjected to electrolysis. After the complete electrolysis, the solution was evaporated to get solid NaOH. The volume of 1 M acetic acid required to neutralise NaOH obtained above is [KCET]
- (a) 2000 cm^3 (b) 100 cm^3
(c) 200 cm^3 (d) 1000 cm^3
15. In the electrolysis of acidulated water, it is desired to obtain 1.12 cc of hydrogen per second under STP condition. The current to be passed is [KCET]
- (a) 9.65 A (b) 19.3 A
(c) 0.965 A (d) 1.93 A
16. The one which decreases with dilution is [KCET]
- (a) conductance
(b) specific conductance
(c) equivalent conductance
(d) molar conductance
17. At 25°C , the molar conductances at infinite dilution for the strong electrolytes NaOH, NaCl and BaCl_2 are 248×10^{-4} , 126×10^{-4} and $280 \times 10^{-4} \text{ S.m}^2.\text{mol}^{-1}$ respectively. $\lambda_m^0 \text{Ba(OH)}_2$ in $\text{S.m}^2.\text{mol}^{-1}$ [EAMCET]
- (a) 52.4×10^{-4} (b) 524×10^{-4}
(c) 402×10^{-4} (d) 262×10^{-4}

18. 4.5 g of aluminium (at. mass 27 u) is deposited at cathode from a molten electrolyte containing Al^{3+} ions by a certain quantity of electric charge. The volume of hydrogen produced at STP from H^+ ions in a solution by the same quantity of electric charge will be [Manipal]
- (a) 44.8 L (b) 11.2 L
(c) 22.4 L (d) 5.6 L
19. How many coulombs of electricity are required for the reduction of 1 mole of MnO_4^- to Mn^{2+} ? [Manipal]
- (a) 96500 C (b) $9.65 \times 10^6 \text{ C}$
(c) $4.83 \times 10^5 \text{ C}$ (d) $1.93 \times 10^5 \text{ C}$
20. The correct expression in SI system relating the equivalent conductance (Λ_c), specific conductance (κ) and equivalent concentration (C) is (where, C is the number of gram equivalents in one litre of the solution). [J&K CET]
- (a) $\Lambda_c = \frac{\kappa}{C}$ (b) $\Lambda_c = \frac{\kappa \times 1000}{C}$
(c) $\Lambda_c = \frac{\kappa \times 10^{-3}}{C}$ (d) $\Lambda_c = \frac{\kappa \times 10^{-6}}{C}$

2008

21. Kohlraush's law states that at [CBSE AIPMT]
- (a) finite dilution, each ion makes definite contribution to the equivalent conductance of an electrolyte, whatever be the nature of the other ion of the electrolyte.
(b) infinite dilution, each ion makes definite contribution to equivalent conductance of an electrolyte depending on the nature of the other ion of the electrolyte.
(c) infinite dilution, each ion makes definite contribution to conductance of an electrolyte whatever be the nature of the other ion of the electrolyte.
(d) infinite dilution, each ion makes definite contribution to equivalent conductance of an electrolyte, whatever be the nature of the other ion of the electrolyte.

22. What is the time (in sec) required for depositing all the silver present in 125 mL of 1M AgNO_3 solution by passing a current of 241.25 A? (1 F=96500 C) [AFMC]
(a) 10 (b) 50
(c) 1000 (d) 100
23. Which of the following does not conduct electricity? [AFMC]
(a) Fused NaCl (b) Solid NaCl
(c) Brine solution (d) Copper
24. Which of the following electrolytic solutions has the least specific conductance? [KCET]
(a) 0.02 N (b) 0.2 N
(c) 2 N (d) 0.002 N
25. A direct current deposits 54 g of silver (atomic mass=108) during the electrolysis reaction. How much aluminium (atomic mass = 27) would be deposited from aluminium chloride solution by the same amount of electricity? [Kerala CEE]
(a) 4.5 g (b) 5.4 g
(c) 54 g (d) 2.7 g
26. What will be the proportion of moles of metal (Cu:Ni:Ag) at cathode according to the second law of Faraday? [Guj. CET]
(a) 1 : 2 : 1 (b) 2 : 2 : 1
(c) 1 : 2 : 2 (d) 1 : 1 : 2
- 2007**
27. Which of the following is not a non-electrolyte ? [AFMC]
(a) Acetic acid (b) Glucose
(c) Ethanol (d) Urea
28. A current of 96.5 A is passed for 18 min between nickel electrodes in 500 mL solution of 2M $\text{Ni}(\text{NO}_3)_2$. The molarity of solution after electrolysis would be [AIIMS]
(a) 0.46 M (b) 0.92 M
(c) 0.625 M (d) 1.25 M
29. **Assertion** According to Kohlrausch's law the molar conductivity of a strong electrolyte at infinite dilution is sum of molar conductivities of its ions.
Reason The current carried by cation and anion is always equal. [AIIMS]
- (a) Both Assertion and Reason are true and Reason is correct explanation of the Assertion.
(b) Both Assertion and Reason are true and Reason is not the correct explanation of the Assertion.
(c) Assertion is true but Reason is false.
(d) Both Assertion and Reason are false.
30. The resistance of N/10 solution is found to be $2.5 \times 10^3 \Omega$. The equivalent conductance of the solution is (cell constant=1.25 cm^{-1}) [Kerala CEE]
(a) $2.5 \Omega^{-1} \text{cm}^{-2} \text{equiv}^{-1}$ (b) $5.0 \Omega^{-1} \text{cm}^{-2} \text{equiv}^{-1}$
(c) $2.5 \Omega^{-1} \text{cm}^{-2} \text{equiv}^{-1}$ (d) $50 \Omega^{-1} \text{cm}^{-2} \text{equiv}^{-1}$
31. When 3.86 A current is passed through an electrolyte for 50 min, 2.4 g of a divalent metal is deposited. The gram atomic weight of the metal (in gram) is [EAMCET]
(a) 24 (b) 12
(c) 64 (d) 40
32. How many atoms of calcium will be deposited from a solution of CaCl_2 by a current of 25 mA flowing for 60 s ? [MPPMT]
(a) 4.68×10^{18} (b) 4.68×10^{15}
(c) 4.68×10^{12} (d) 4.68×10^9
33. The specific conductance (κ) of an electrolyte of 0.1 N concentration is related to equivalent conductance (Λ) by the following formula [J&K CET]
(a) $\Lambda = \kappa$ (b) $\Lambda = 10\kappa$
(c) $\Lambda = 100\kappa$ (d) $\Lambda = 10000\kappa$
34. Pure water does not conduct electricity because it is [J&K CET]
(a) basic (b) almost not ionised
(c) decomposed easily (d) acidic
- 2006**
35. In the electrolysis of water, one faraday of electrical energy would evolve [AMU]
(a) one mole of oxygen
(b) one gram atom of oxygen
(c) 8 g of oxygen
(d) 22.4 L of oxygen

36. If the aqueous solution of the following salts are electrolysed for 1 h with 10 A current, which solution will deposit the maximum mass of the metal at the cathode? The atomic weights are $\text{Fe}^{2+}=56$, $\text{Zn}^{2+}=65$, $\text{Ag}^+=108$, $\text{Hf}^{3+}=178$ and $\text{W}^{3+}=184$ [Kerala CEE]

(a) ZnSO_4 (b) FeCl_3
(c) HfCl_4 (d) AgNO_3

37. The ionic conductance of Ba^{2+} and Cl^- are respectively 127 and $76\Omega^{-1}\text{cm}^2\text{eq}^{-1}$ at infinite dilution. The equivalent conductance (in $\Omega^{-1}\text{cm}^2$) of BaCl_2 at infinite dilution will be [MHT CET]

(a) 139.5 (b) 203
(c) 279 (d) 101.5

38. The charge required to liberate one gram equivalent of an element is [BCECE]

(a) 96500 F (b) 1F
(c) 1C (d) None of these

2005

39. A current of strength 2.5 A was passed through CuSO_4 solution for 6 min 26 s. The amount of copper deposited is (Atomic weight of $\text{Cu}=63.5$, $1\text{F}=96500\text{C}$) [Punjab PMET]

(a) 0.3175 g (b) 3.175 g
(c) 0.635 g (d) 6.35 g

40. What is the electrochemical equivalent (in g-C^{-1}) of silver? ($\text{Ag}=108$, $\text{F}=\text{Faraday}$) [EAMCET]

(a) 108 F (b) $\frac{108}{\text{F}}$
(c) $\frac{\text{F}}{108}$ (d) $\frac{1}{108\text{F}}$

2004

41. At 25°C the specific conductivity of a normal solution of KCl is 0.002765 mho. The resistance of cell is 400Ω . The cell constant is [Punjab PMET]

(a) 0.815 (b) 1.016
(c) 1.106 (d) 2.016

2003

42. On passing electric current of one ampere for 16 min and 5 s through one litre solution of CuCl_2 , all copper of solution was deposited at cathode. The strength of CuCl_2

solution was (molar mass of $\text{Cu}=63.5$, Faraday constant $=96500\text{C/mol}$) [AMU]

(a) 0.2 N (b) 0.01 N
(c) 0.1 N (d) 0.02 N

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

(a) 56cm^3 (b) 550cm^3
(c) 5.6cm^3 (d) 11.2cm^3

TOPIC 2

ELECTROCHEMICAL SERIES, ELECTRODE POTENTIAL AND EMF

2011

44. If the E°_{cell} for a given reaction has a negative value, then which of the following gives the correct relationships for the values of ΔG° and K_{eq} ? [CBSE AIPMT]

(a) $\Delta G^\circ > 0$; $K_{\text{eq}} < 1$ (b) $\Delta G^\circ > 0$; $K_{\text{eq}} > 1$
(c) $\Delta G^\circ < 0$; $K_{\text{eq}} > 1$ (d) $\Delta G^\circ < 0$; $K_{\text{eq}} < 1$

45. The electrode potentials for

$\text{Cu}^{2+}(\text{aq}) + \text{e}^- \rightarrow \text{Cu}^+(\text{aq})$ and $\text{Cu}^+(\text{aq}) + \text{e}^- \rightarrow \text{Cu}(\text{s})$ are +0.15 V and +0.50 V respectively. The value of $E^\circ_{\text{Cu}^{2+}/\text{Cu}}$ will be [CBSE AIPMT]

(a) 0.150 V (b) 0.500 V
(c) 0.325 V (d) 0.650 V

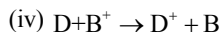
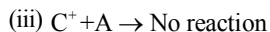
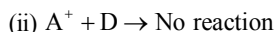
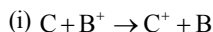
46. Standard electrode potential of three metals X, Y and Z are -1.2 V, +0.5 V and -3.0 V respectively. The reducing power of these metals will be [CBSE AIPMT]

(a) $\text{X} > \text{Y} > \text{Z}$ (b) $\text{Y} > \text{Z} > \text{X}$
(c) $\text{Y} > \text{X} > \text{Z}$ (d) $\text{Z} > \text{X} > \text{Y}$

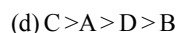
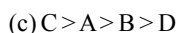
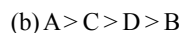
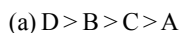
47. Standard electrode potential for $\text{Sn}^{4+}/\text{Sn}^{2+}$ couple is +0.15 V and that for the Cr^{3+}/Cr couple is -0.74 V. These two couples in their standard state are connected to make a cell. The cell potential will be [CBSE AIPMT]

(a) +1.83 V (b) +1.19 V
(c) +0.89 V (d) +0.18 V

48. Given the following reactions involving, A, B, C and D



The correct arrangement of A, B, C, D in order of their decreasing ability as reducing agent [DPMT]



49. The standard emf of a galvanic cell involving 2 moles of electrons in its redox reaction is 0.59 V. The equilibrium constant for the redox reaction of the cell is [KCET]

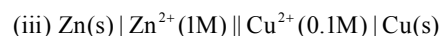
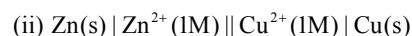
(a) 10^{20}

(b) 10^5

(c) 10

(d) 10^{10}

50. E_1 , E_2 and E_3 are the emfs of the following three galvanic cells respectively



Which one of the following is true? [KCET]

(a) $E_2 > E_1 > E_3$

(b) $E_1 > E_2 > E_3$

(c) $E_3 > E_1 > E_2$

(d) $E_3 > E_2 > E_1$

2010

51. For the reduction of silver ions with copper metals, the standard cell potential was found to be +0.46 V at 25°C. The value of standard Gibbs energy, ΔG° will be ($F=96500 \text{ C mol}^{-1}$) [CBSE AIPMT]

(a) -98.0 kJ

(b) -89.0 kJ

(c) -89.0 J

(d) -44.5 kJ

52. The logarithm of the equilibrium constant of the cell reaction corresponding to the cell $X(s) | X^{2+}(aq) || Y^+(aq) | Y(s)$ with standard cell potential, $E^\circ_{\text{cell}} = 1.12 \text{ V}$ is given by [AMU]

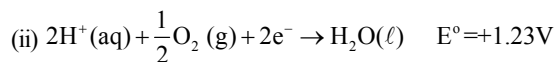
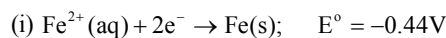
(a) 12.5

(b) 21.5

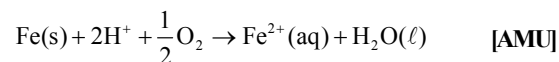
(c) 37.9

(d) 47.2

53. If the half cell reactions are given as



The E° for the reaction



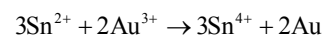
(a) +1.67 V

(b) -1.67 V

(c) +0.79 V

(d) -0.79 V

54. Given for Sn^{4+}/Sn^{2+} , standard reduction potential is 0.15 V and for Au^{3+}/Au , standard reduction potential is 1.5 V. For the reaction,



the value of E°_{cell} is [MHTCET]

(a) +1.35

(b) +2.55

(c) -1.35

(d) -2.55

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

(a) Cr

(b) Mn

(c) Fe

(d) Co

56. At 25°C temperature, the cell potential of a given electrochemical cell is 1.92 V. Find the value of x.



$E^\circ_{Mg/Mg^{2+}} = 2.37 \text{ V}; E^\circ_{Fe/Fe^{2+}} = 0.45 \text{ V}$

[Guj. CET]

(a) $x=0.01M$

(b) $x<0.01M$

(c) $x>0.01M$

(d) x cannot be predicted

57. The potential of a hydrogen electrode at pH=10 is
[WB JEE]
- (a) 0.59 V (b) 0.00 V
(c) -0.59 V (d) -0.059 V
- 2009**
58. Given : (i) $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$; $E^\circ = 0.337 \text{ V}$
(ii) $\text{Cu}^{2+} + \text{e}^- \rightarrow \text{Cu}^+$; $E^\circ = 0.153 \text{ V}$
Electrode potential, E° for the reaction, $\text{Cu}^+ + \text{e}^- \rightarrow \text{Cu}$, will be
[CBSE AIPMT, AMU]
- (a) 0.52 V (b) 0.90 V
(c) 0.30 V (d) 0.38 V
59. Given, $\text{Pb}^{2+}/\text{Pb} = -0.126 \text{ V}$; $\text{Zn}^{2+}/\text{Zn} = -0.763 \text{ V}$ Find the emf of the following cell $\text{Zn} | \text{Zn}^{2+} (0.1 \text{ M}) || \text{Pb}^{2+} (1 \text{ M}) | \text{Pb}$.
[AFMC]
- (a) -0.637 (b) +0.637
(c) >0.637 (d) +0.889
60. The reduction potential at pH=14 for the Cu^{2+}/Cu couples is
[Given, $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = 0.34 \text{ V}$; $K_{\text{sp}}[\text{Cu}(\text{OH})_2] = 1 \times 10^{-19}$]
[AIIMS]
- (a) 0.34 V (b) -0.34 V
(c) 0.22 V (d) -0.22 V
61. A gas X at 1 atm is bubbled through a solution containing a mixture of 1 M Y^- and 1 M Z^- at 25°C . If the reduction potential of $\text{Z} > \text{Y} > \text{X}$, then
[AIIMS]
- (a) Y will oxidise X but not Z.
(b) Y will oxidise both X and Z.
(c) Y will oxidise Z but not X.
(d) Y will reduce both X and Z.
62. The potential of standard hydrogen electrode is zero. This implies that
[AMU]
- (a) $\Delta G_f^\circ(\text{H}^+, \text{aq}) = 0$ (b) $\Delta H_f^\circ(\text{H}^+, \text{aq}) = 0$
(c) $\Delta G_f^\circ(\text{H}^+, \text{aq}) < 0$ (d) $\Delta G_f^\circ(\text{H}^+, \text{aq}) > 0$
63. E° for $\text{Mg}^{2+}/\text{Mg} = -2.37 \text{ V}$, $\text{Zn}^{2+}/\text{Zn} = -0.76 \text{ V}$, and $\text{Fe}^{2+}/\text{Fe} = -0.44 \text{ V}$. Which statement is correct?
[CPMT]

- (a) Zn reduces Fe^{2+} (b) Zn reduces Mg^{2+}
(c) Mg oxidises Fe (d) Zn oxidises Fe
64. The standard electrode potential for the half cell reactions are
 $\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn}$; $E^\circ = -0.76 \text{ V}$
 $\text{Fe}^{2+} + 2\text{e}^- \rightarrow \text{Fe}$; $E^\circ = -0.44 \text{ V}$
The emf of the cell reaction
 $\text{Fe}^{2+} + \text{Zn} \rightarrow \text{Zn}^{2+} + \text{Fe}$ [KCET]
- (a) -1.20 V (b) +1.20 V
(c) +0.32 V (d) -0.32 V
65. A solution of nickel sulphate in which nickel rod is dipped is diluted 10 times. The reduction potential of Ni at 298 K
[Kerala CEE]
- (a) decreases by 60 mV (b) decrease by 30 mV
(c) decreases by 30 V (d) increases by 30 mV
66. The standard reduction potentials for Cu^{2+}/Cu ; Zn^{2+}/Zn ; Li^+/Li ; Ag^+/Ag and H^+/H_2 are +0.34 V, -0.762 V, -3.05 V, +0.80 V and 0.00 V respectively. Choose the strongest reducing agent among the following.
[Kerala CEE]
- (a) Zn (b) H_2
(c) Ag (d) Li
67. The standard emf of a cell involving one electron charge is found to be 0.591 V at 25°C . The equilibrium constant of the reaction is ($1 \text{ F} = 96500 \text{ C mol}^{-1}$, $R = 8.314 \text{ JK}^{-1}\text{mol}^{-1}$)
[Manipal]
- (a) 1.0×10^1 (b) 1.0×10^{30}
(c) 1.0×10^{10} (d) 1.0×10^5
- 2008**
68. On the basis of the following E° values, the strongest oxidising agent is
 $[\text{Fe}(\text{CN})_6]^{4-} \rightarrow [\text{Fe}(\text{CN})_6]^{3-} + \text{e}^-$; $E^\circ = -0.35 \text{ V}$
 $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+} + \text{e}^-$; $E^\circ = -0.77 \text{ V}$ [CBSE AIPMT]
- (a) $[\text{Fe}(\text{CN})_6]^{4-}$ (b) Fe^{2+}
(c) Fe^{3+} (d) $[\text{Fe}(\text{CN})_6]^{3-}$

69. What is the electrode potential (in volt) of the following electrode at 25°C?
 $\text{Ni}^{2+}(0.1\text{ M})|\text{Ni(s)}$
 (Standard reduction potential of Ni^{2+}/Ni is -0.25 V ,
 $\frac{2.303RT}{F} = 0.06$) [Punjab PMET]
 (a) -0.28 V (b) -0.34 V
 (c) -0.82 V (d) -0.22 V
70. Hydrogen gas is not liberated when the following metal is added to dil HCl [KCET]
 (a) Ag (b) Zn
 (c) Mg (d) Sn
71. The equilibrium constant for the following redox reaction at 298 K of 1×10^8 .
 $2\text{Fe}^{3+}(\text{aq}) + 2\text{I}^{-}(\text{aq}) \rightleftharpoons 2\text{Fe}^{2+}(\text{aq}) + \text{I}_2(\text{s})$
 If the standard reduction potential of iodine becoming iodide is $+0.54\text{ V}$, what is the standard reduction potential of $\text{Fe}^{3+}/\text{Fe}^{2+}$? [Kerala CEE]
 (a) $+1.006\text{ V}$ (b) -1.006 V
 (c) $+0.77\text{ V}$ (d) -0.77 V
72. The cell potential of the following cell at 25°C (in volts) is
 $(\text{pt}) \text{H}_2 | \text{H}^{+} (0.01\text{M}) || \text{Cu}^{2+} (0.1\text{M}) | \text{Cu} (E^{\circ}_{\text{Cu}^{2+}/\text{Cu}} = 0.337\text{V})$ [EAMCET]
 (a) 0.308 (b) 0.427
 (c) -0.308 (d) 0.337
73. $\text{Cu}^{+}(\text{aq})$ is unstable in solution and undergoes simultaneous oxidation and reduction, according to the reaction
 $2\text{Cu}^{+}(\text{aq}) \rightleftharpoons \text{Cu}^{2+}(\text{aq}) + \text{Cu(s)}$
 choose the correct E° for the above reaction if
 $E^{\circ}_{\text{Cu}^{2+}/\text{Cu}} = 0.34\text{ V}$ and $E^{\circ}_{\text{Cu}^{2+}/\text{Cu}^{+}} = 0.15\text{ V}$ [MHTCET]
 (a) -0.38 V (b) $+0.49\text{ V}$
 (c) $+0.38\text{ V}$ (d) -0.19 V

2007

74. Zn gives H_2 gas with H_2SO_4 and HCl but not with HNO_3 [Punjab PMET]
 (a) Zn act as oxidising agent when react with HNO_3 .
 (b) HNO_3 is weaker acid than H_2SO_4 and HCl.
 (c) in electrochemical series Zn is above hydrogen.
 (d) NO_3^{-} is reduced in preference to hydronium ion.
75. EMF of hydrogen electrode in terms of pH is (at 1 atm pressure) [MHTCET]
 (a) $E_{\text{H}_2} = \frac{RT}{F} \text{pH}$ (b) $E_{\text{H}_2} = \frac{RT}{F} \frac{1}{\text{pH}}$
 (c) $E_{\text{H}_2} = \frac{2.303RT}{F} \text{pH}$ (d) $E_{\text{H}_2} = -0.0591 \text{pH}$
76. The standard electrode potential of hydrogen electrode at 1 M concentration and hydrogen gas at 1 atm pressure is [J&K CET]
 (a) 1 V (b) 6 V
 (c) 8 V (d) 0 V

2006

77. A hypothetical electrochemical cell is shown below
 $\text{A} | \text{A}^{+}(\text{xM}) || \text{B}^{+}(\text{yM}) | \text{B}$
 The emf measured is $+0.20\text{V}$. The cell reaction is [CBSE AIPMT]
 (a) $\text{A}^{+} + \text{B} \rightarrow \text{A} + \text{B}^{+}$
 (b) $\text{A}^{+} + \text{e}^{-} \rightarrow \text{A}; \text{B}^{+} + \text{e}^{-} \rightarrow \text{B}$
 (c) the cell reaction cannot be predicted
 (d) $\text{A} + \text{B}^{+} \rightarrow \text{A}^{+} + \text{B}$
78. **Assertion** E° for $\text{Mn}^{3+}/\text{Mn}^{2+}$ is more positive than $\text{Cr}^{3+}/\text{Cr}^{2+}$.
Reason The third ionisation energy of Mn is larger than that of Cr. [AIIMS]
 (a) Both Assertion and Reason are true and Reason is correct explanation of the Assertion.
 (b) Both Assertion and Reason are true and Reason is not the correct explanation of the Assertion.
 (c) Assertion is true but Reason is false.
 (d) Both Assertion and Reason are false.

79. For the electrochemical cell, $M | M^+ || X^- | X$, $E^\circ(M^+/M) = 0.44 \text{ V}$ and $E^\circ(X/X^-) = 0.33 \text{ V}$, From this data one can deduce that [BHU]
- (a) $M + X \rightarrow M^+ + X^-$ is the spontaneous reaction
(b) $M^+ + X^- \rightarrow M + X$ is the spontaneous reaction
(c) $E_{\text{cell}} = 0.77 \text{ V}$
(d) $E_{\text{cell}} = -0.77 \text{ V}$
80. The reduction electrode potential, E of 0.1 M solution of M^+ ions ($E_{\text{RP}}^\circ = -2.36 \text{ V}$) is [MHTCET]
- (a) -4.82 V (b) -2.41 V
(c) $+2.41 \text{ V}$ (d) None of these
81. $E^\circ = \frac{RT}{nF} \ln K_{\text{eq}}$
This equation is called [MPPMT]
- (a) Gibbs equation (b) Nernst equation
(c) Gibbs-Helmholtz equation
(d) van der Waals' equation
82. During electrochemical process [Guj. CET]
- (a) Gibbs free energy increases.
(b) Gibbs free energy remains constant.
(c) no prediction can be about Gibbs free energy.
(d) Gibbs free energy decreases.
- 2005**
83. If hydrogen electrode dipped in two solutions of $\text{pH}=3$ and $\text{pH}=6$ and salt bridge is connected, the emf of resulting cell is [DUMET]
- (a) 0.177 V (b) 0.3 V
(c) 0.052 V (d) 0.104 V
84. The standard electrode potential is measured by [KCET]
- (a) electrometer (b) voltmeter
(c) pyrometer (d) galvanometer
85. Na is used in reduction of Zn salt because [MHTCET]
- (a) $E_{\text{Zn(oxi)}}^\circ > E_{\text{Na(oxi)}}^\circ$ (b) $E_{\text{Zn(red)}}^\circ < E_{\text{Na(red)}}^\circ$
(c) $E_{\text{Zn(oxi)}}^\circ < E_{\text{Na(oxi)}}^\circ$ (d) Both (a) and (b)
86. Reduction potentials of A, B, C and D are 0.8 V , 0.79 V , 0.34 V and -2.37 V respectively. Which element displaces all the other three elements? [MHTCET]
- (a) B (b) A
(c) D (d) C
87. The standard emf of Daniell cell is 1.10 V . The maximum electrical work obtained from the cell is [Haryana PMT]
- (a) 212.3 kJ (b) 175.4 kJ
(c) 106.15 kJ (d) 350.8 kJ
88. For cell reaction
 $\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Zn}^{2+} + \text{Cu}$
cell representation is [BCECE]
- (a) $\text{Zn} | \text{Zn}^{2+} || \text{Cu}^{2+} | \text{Cu}$
(b) $\text{Cu} | \text{Cu}^{2+} || \text{Zn}^{2+} | \text{Zn}$
(c) $\text{Cu} | \text{Zn}^{2+} || \text{Zn} | \text{Cu}^{2+}$
(d) $\text{Cu}^{2+} | \text{Zn} || \text{Zn}^{2+} | \text{Cu}$
89. Alkali metals have high oxidation potential and hence, they behave as [JCECE]
- (a) oxidising agents (b) Lewis bases
(c) reducing agents (d) electrolytes
90. What is the potential of platinum wire dipped into a solution of 0.1 M in Sn^{2+} and 0.01 M in Sn^{4+} ? [JCECE]
- (a) E° (b) $E^\circ + 0.059$
(c) $E^\circ + \frac{0.059}{2}$ (d) $E^\circ - \frac{0.059}{2}$
- 2004**
91. **Assertion** Copper metal gets readily corroded in an acidic aqueous solution.
Reason Free energy change for this process is positive. [AIIMS]
- (a) Both Assertion and Reason are true and Reason is correct explanation of the Assertion.
(b) Both Assertion and Reason are true and Reason is not the correct explanation of the Assertion.
(c) Assertion is true but Reason is false.
(d) Both Assertion and Reason are false.

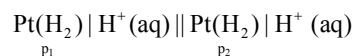
92. Aluminium displaces hydrogen from dilute HCl whereas silver does not. The emf of a cell prepared by combining $\text{Al} / \text{Al}^{3+}$ and $\text{Ag} / \text{Ag}^{+}$ is 2.46 V. The reduction potential of silver electrode is +0.80 V. The reduction potential of aluminium electrode is [KCET]

- (a) +1.66 V (b) -3.26 V
(c) 3.26 V (d) -1.66 V

93. Standard electrode potential of cell $\text{H}_2 / \text{H}^{+} \parallel \text{Ag}^{+} / \text{Ag}$ is ($E^\circ_{\text{Ag}^{+}/\text{Ag}} = 0.80\text{V}$) [Kerala CEE]

- (a) 0.8 V (b) -0.8 V
(c) -1.2 V (d) 1.2 V

94. For the following cell with hydrogen electrode at two different pressures p_1 and p_2



emf is given by [MHTCET]

- (a) $\frac{RT}{F} \log_e \frac{p_1}{p_2}$ (b) $\frac{RT}{2F} \log_e \frac{p_1}{p_2}$
(c) $\frac{RT}{F} \log_e \frac{p_2}{p_1}$ (d) $\frac{RT}{2F} \log_e \frac{p_2}{p_1}$

95. For the cell,
 $\text{Ti} | \text{Ti}^{+}(0.001\text{M}) \parallel \text{Cu}^{2+}(0.1\text{M}) | \text{Cu}$
 E_{cell} at 25°C is 0.83 V. E_{cell} can be increased [Haryana PMT]

- (a) by decreasing $[\text{Cu}^{2+}]$ (b) by increasing $[\text{Cu}^{2+}]$
(c) by increasing $[\text{Ti}^{+}]$ (d) None of these

2003

96. On the basis of information available from the reaction
 $\frac{4}{3}\text{Al} + \text{O}_2 \rightarrow \frac{2}{3}\text{Al}_2\text{O}_3, \Delta G = -827 \text{ kJ mol}^{-1}$
of O_2 , the minimum emf required to carry out an electrolysis of Al_2O_3 , is ($F=96500 \text{ C mol}^{-1}$) [CBSE AIPMT]

- (a) 6.42 V (b) 8.56 V
(c) 2.14 V (d) 4.28 V

97. If the standard electrode potential of $\text{Cu}^{2+} / \text{Cu}$ electrode is 0.34 V, what is the electrode potential at 0.01 M concentration of Cu^{2+} ? ($T = 298 \text{ K}$) [EAMCET]

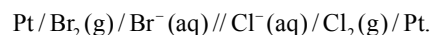
- (a) 0.399 V (b) 0.281 V
(c) 0.222 V (d) 0.176 V

TOPIC 3

ELECTROCHEMICAL CELLS, (INCLUDING FUEL CELLS), CORROSION

2011

98. Which of the following reactions is correct for a given electrochemical cell at 25°C ? [Guj. CET]



- (a) $2\text{Br}^{-}(\text{aq}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{Cl}^{-}(\text{aq}) + \text{Br}_2(\text{g})$
(b) $\text{Br}_2(\text{g}) + 2\text{Cl}^{-}(\text{aq}) \rightarrow 2\text{Br}^{-}(\text{aq}) + \text{Cl}_2(\text{g})$
(c) $\text{Br}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{Br}^{-}(\text{aq}) + 2\text{Cl}^{-}(\text{aq})$
(d) $2\text{Br}^{-}(\text{aq}) + 2\text{Cl}^{-}(\text{aq}) \rightarrow \text{Br}_2(\text{g}) + \text{Cl}_2(\text{g})$

2010

99. When iron is rusted, it is [MPPMT]

- (a) reduced (b) decomposed
(c) oxidised
(d) changed in the fine powder

100. Which of the following statements is true for the electrochemical Daniel cell? [Manipal]

- (a) Electrons flow from copper electrode to zinc electrode
(b) Current flows from zinc electrode to copper electrode.
(c) Cations move toward copper electrode.
(d) Cations move toward zinc electrode.

101. Chemical formula of rust is [OJEE]

- (a) $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ (b) $\text{Fe}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$
(c) $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ (d) None of these

102. When lead storage battery discharges [VMC]

- (a) SO_2 is evolved (b) PbSO_4 is consumed
(c) Lead is formed (d) H_2SO_4 is consumed

103. E°_{cell} and ΔG° are related as [VMC]

- (a) $\Delta G^\circ = nFE^\circ_{\text{cell}}$ (b) $\Delta G^\circ = -nFE^\circ_{\text{cell}}$
(c) $\Delta G^\circ = -nFE^\circ_{\text{cell}}$ (d) $\Delta G^\circ = nFE^\circ_{\text{cell}} = 0$

- 104.** The rusting of iron is catalysed by
[CG PMT, Haryana PMT]

(a) Fe (b) O₂
(c) H⁺ (d) Zn

- 105.** Standard solution of KNO₃ is used to make salt bridge because
[CG PMT, Haryana PMT]

(a) velocity of K⁺ is greater than NO₃⁻.
(b) velocity of NO₃⁻ is greater than K⁺.
(c) velocity of K⁺ and NO₃⁻ are same.
(d) KNO₃ is highly soluble in water.

2008

- 106.** Standard free energies of formation (in kJ/mol) at 298 K are -237.2, -394.4 and -8.2 for H₂O(ℓ), CO₂(g) and pentane (g), respectively. The value of E°_{cell} for the pentane-oxygen fuel cell is
[CBSE AIPMT]

(a) 1.968 V (b) 2.0968 V
(c) 1.0968 V (d) 0.0968 V

- 107.** **Assertion** The cell potential of mercury cell is 1.35 V, which remains constant.

Reason In mercury cell, the electrolyte is a paste of KOH and ZnO.
[AIIMS]

(a) Both Assertion and Reason are true and Reason is correct explanation of the Assertion.
(b) Both Assertion and Reason are true and Reason is not the correct explanation of the Assertion.
(c) Assertion is true but Reason is false.
(d) Both Assertion and Reason are false.

- 108.** Galvanic cell is a device in which [CBSE AIPMT]

(a) chemical energy is converted into electrical energy.
(b) electrical energy is converted into chemical energy.
(c) chemical energy is seen in the form of heat.
(d) thermal energy from an outside source is used to drive the cell reaction.

2007

- 109.** The efficiency of a fuel cell is given by [CBSE AIPMT]

(a) $\frac{\Delta H}{\Delta G}$ (b) $\frac{\Delta G}{\Delta S}$
(c) $\frac{\Delta G}{\Delta H}$ (d) $\frac{\Delta S}{\Delta G}$

- 110.** When lead storage battery is charge [AFMC]
(a) lead dioxide dissolves.
(b) sulphuric acid is regenerated.
(c) the lead electrode becomes coated with lead sulphate.
(d) the amount of sulphuric acid decreases.

- 111.** Anode in the galvanic cell, is [RPMT]
(a) negative electrode (b) positive electrode
(c) neutral electrode (d) None of these

2006

- 112.** What is the cell reaction occurring in Daniell cell (Galvanic cell)? [J&K CET]

(a) Cu(s) + ZnSO₄(aq) → CuSO₄(aq) + Zn(s)
(b) Zn(s) + CuSO₄(aq) → Cu(s) + ZnSO₄(aq)
(c) Ni(s) + ZnSO₄(aq) → NiSO₄(aq) + Zn(s)
(d) 2Na(s) + CdSO₄(aq) → Na₂SO₄(aq) + Cd(s)

2005

- 113.** When an acid cell is charged then [AFMC]
(a) voltage of cell increases
(b) electrolyte of cell dilutes
(c) resistance of cell increases
(d) None of the above

- 114.** The chemical reaction,
2AgCl(s) + H₂(g) → 2HCl(aq) + 2Ag(s)
taking place in a galvanic cell is represented by the notation [AIIMS]

(a) Pt(s) | H₂(g), 1 bar | 1M KCl(aq) | AgCl(s) | Ag(s)
(b) Pt(s) | H₂(g), 1 bar | 1M HCl(aq) | 1M Ag⁺(aq) | Ag(s)
(c) Pt(s) | H₂(g), 1 bar | 1M HCl(aq) | AgCl(s) | Ag(s)
(d) Pt(s) | H₂(g), 1 bar | 1M HCl(aq) | Ag(s) | AgCl(s)

- 115.** **Assertion** Galvanised iron does not rust.
Reason Zinc has a more negative electrode potential than iron [AIIMS]

(a) Both Assertion and Reason are true and Reason is correct explanation of the Assertion.
(b) Both Assertion and Reason are true and Reason is not the correct explanation of the Assertion.
(c) Assertion is true but Reason is false.
(d) Both Assertion and Reason are false.

2004

116. Iron pipes, lying in acidic soil, are often attached to the blocks of magnesium for their protection from rusting because magnesium **[BHU, DUMET]**
- is lighter than iron
 - is readily converted into positive ion
 - forms a corrosion-resistant alloy with iron
 - prevents air from reaching the surface of iron.
117. Which of the following statements is true for fuel cells? **[Punjab PMET]**
- They run till the reactant are active
 - They are free from pollution.
 - They are more efficient.
 - All of the above.
118. In a hydrogen-oxygen fuel cell, combustion of hydrogen occurs to **[DUMET]**
- generate heat.
 - create potential difference between the two electrodes.
 - produce high purity water
 - remove adsorbed oxygen from electrode surfaces.
- 2003**
119. Which of the following reaction is used to make a fuel cell? **[AIIMS]**
- $\text{Cd(s)} + 2\text{Ni(OH)}_3\text{(s)} \rightarrow \text{CdO(s)} + 2\text{Ni(OH)}_2\text{(s)} + \text{H}_2\text{O(l)}$
 - $\text{Pb(s)} + \text{PbO}_2\text{(s)} + 2\text{H}_2\text{SO}_4\text{(aq)} \rightarrow 2\text{PbSO}_4\text{(s)} + 2\text{H}_2\text{O(l)}$
 - $2\text{H}_2\text{(g)} + \text{O}_2\text{(g)} \rightarrow 2\text{H}_2\text{O(l)}$
 - $2\text{Fe(s)} + \text{O}_2\text{(g)} + 2\text{H}^+\text{(aq)} \rightarrow 2\text{Fe}^{2+}\text{(aq)} + 2\text{H}_2\text{O(l)}$
120. Which cell convert electrical energy into chemical energy? **[Punjab PMET]**
- Voltaic cell
 - Electrolytic cell
 - Galvanic cell
 - Electrochemical cell
121. The cell reaction of the galvanic cell $\text{Cu(s)} | \text{Cu}^{2+}\text{(aq)} || \text{Hg}^{2+}\text{(aq)} | \text{Hg(l)}$ is **[EAMCET]**
- $\text{Hg} + \text{Cu}^{2+} \rightarrow \text{Hg}^{2+} + \text{Cu}$
 - $\text{Hg} + \text{Cu}^{2+} \rightarrow \text{Cu}^+ + \text{Hg}^+$
 - $\text{Cu} + \text{Hg} \rightarrow \text{CuHg}$
 - $\text{Cu} + \text{Hg}^{2+} \rightarrow \text{Cu}^{2+} + \text{Hg}$
122. Which one of the following metal is used in galvanisation? **[RPMT]**
- Cu
 - Ag
 - Zn
 - Fe

ANSWER KEY

EXERCISE - 1 : (Basic Objective Questions)

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1. (d)	2. (c)	3. (d)	4. (c)	5. (d)	6. (a)	7. (a)	8. (a)	9. (d)	10. (c)
11. (b)	12. (d)	13. (d)	14. (a)	15. (b)	16. (c)	17. (d)	18. (b)	19. (a)	20. (a)
21. (a)	22. (b)	23. (d)	24. (a)	25. (d)	26. (b)	27. (b)	28. (b)	29. (b)	30. (c)
31. (d)	32. (c)	33. (b)	34. (d)	35. (d)	36. (c)	37. (a)	38. (a)	39. (c)	40. (a)
41. (b)	42. (d)	43. (c)	44. (c)	45. (a)	46. (d)	47. (c)	48. (b)	49. (d)	50. (c)
51. (c)	52. (b)	53. (a)	54. (a)	55. (a)	56. (a)	57. (b)	58. (a)	59. (b)	60. (a)
61. (c)	62. (c)	63. (d)	64. (a)	65. (d)	66. (b)	67. (b)	68. (b)	69. (c)	70. (d)
71. (b)	72. (c)	73. (a)	74. (c)	75. (c)	76. (a)	77. (d)	78. (a)	79. (b)	

EXERCISE - 2 : (Previous Year Competition Questions)

1. (c)	2. (b)	3. (b)	4. (a)	5. (a)	6. (a)	7. (b)	8. (d)	9. (b)	10. (a)
11. (b)	12. (a)	13. (c)	14. (b)	15. (a)	16. (b)	17. (b)	18. (d)	19. (c)	20. (c)
21. (d)	22. (b)	23. (b)	24. (d)	25. (a)	26. (d)	27. (a)	28. (b)	29. (c)	30. (b)
31. (d)	32. (a)	33. (d)	34. (b)	35. (c)	36. (d)	37. (b)	38. (b)	39. (a)	40. (b)
41. (c)	42. (b)	43. (c)	44. (a)	45. (c)	46. (d)	47. (c)	48. (d)	49. (a)	50. (b)
51. (b)	52. (c)	53. (a)	54. (a)	55. (a)	56. (a)	57. (c)	58. (a)	59. (c)	60. (d)
61. (a)	62. (a)	63. (a)	64. (c)	65. (b)	66. (d)	67. (c)	68. (c)	69. (a)	70. (a)
71. (c)	72. (b)	73. (c)	74. (d)	75. (d)	76. (d)	77. (d)	78. (b)	79. (b)	80. (b)
81. (b)	82. (d)	83. (a)	84. (b)	85. (c)	86. (c)	87. (a)	88. (a)	89. (c)	90. (d)
91. (c)	92. (d)	93. (a)	94. (b)	95. (b)	96. (c)	97. (b)	98. (a)	99. (c)	100. (c)
101. (c)	102. (d)	103. (c)	104. (c)	105. (c)	106. (c)	107. (b)	108. (a)	109. (c)	110. (b)
111. (a)	112. (b)	113. (a)	114. (c)	115. (a)	116. (b)	117. (d)	118. (b)	119. (c)	120. (b)
121. (d)	122. (c)								

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