Engineering Daily 23 [Set 04] EV

Electrochemistry

Total Marks: 50 **Negative Marks:** 0.25 **Time:** 1 Hour

MCQ 50 marks

1. A $\frac{M}{10}$ solution is placed between two electrodes of cross-sectional area 1.8 cm^2 kept 0.9 cm apart, and its electrical resistance is found to be 60 Ω. What is the specific conductivity of the solution?

(A) $1.20 \times 10^{-2}\ \Omega^{-1}cm^{-1}$ (B) $4.17 \times 10^{-3}\ \Omega^{-1}cm^{-1}$

(C) $8.33 \times 10^{-2}\ \Omega^{-1}cm^{-1}$ (D) $8.33 \times 10^{-3}\ \Omega^{-1}cm^{-1}$

2. If the degree of dissociation and the specific conductivity of each component are identical, what is the correct order of equivalent conductivity of 0.02 M HNO_3, 0.02 M H_2SO_4 and 0.02 M H_3PO_4?

(A) $HNO_3 > H_2SO_4 > H_3PO_4$

(B) $HNO_3 < H_3PO_4 < H_2SO_4$

(C) $HNO_3 < H_2SO_4 < H_3PO_4$

(D) $H_2SO_4 > HNO_3 > H_3PO_4$

3. Which of the following has the lowest electrical conductivity?

(A) Silver (B) Mercury (C) Gold (D) Copper

4. When does NaCl not conduct electricity?

(A) In the molten state

(B) In concentrated aqueous solution

(C) In the solid state

(D) In aqueous solution

5. Which of the following occurs when an aqueous solution of $AgNO_3$ is electrolysed using silver electrodes?

(A) Ag at the anode is oxidised to Ag^+

(B) O_2 is produced at the anode

(C) H_2 is produced at the cathode

(D) Ag at the cathode is consumed and converted into Ag^+

6. What is produced at the cathode when NaCl(aq) is electrolysed using a mercury cathode?

(A) H_2 (B) Cl_2

(C) Sodium amalgam (Na-Hg) (D) NaOH

7. In the electrolysis of acidified water, the ratio of the volumes of gases produced at the cathode and the anode at the same temperature and pressure is—

(A) 1 : 1 (B) 1 : 2 (C) 4 : 1 (D) 2 : 1

8. The standard reduction potentials of X, Y and Z are −0.40 V, +0.80 V and −2.90 V respectively. The order of their reducing power is—

(A) X > Z > Y (B) Z > Y > X

(C) Z > X > Y (D) Y > X > Z

9. Which of the following is used as an inert electrode in electrolysis?

(A) Pt (B) Zn (C) Fe (D) Cu

10. Which of the following ions will be discharged first at the anode during electrolysis?

(A) SO_4^{2-} (B) I^- (C) Cl^- (D) NO_3^-

11. The position of Zn in the electrochemical series is—
(i) above Fe
(ii) above Al
(iii) above H
Which of the following is correct?

(A) i, ii and iii (B) i and ii

(C) ii and iii (D) i and iii

12. When an aqueous solution of potassium iodide is electrolysed in an electrolytic cell using inert electrodes, the products formed will be—

(A) H_2 and O_2 (B) H_2, I_2 and KOH

(C) K and O_2 (D) K and I_2

13. What current is required to liberate 12.7 g of iodine from a KI solution in 45 minutes? (I = 127)

(A) 2.38 A (B) 1.79 A (C) 7.15 A (D) 3.57 A

14. How many grams of chromium will be deposited when a current of 2.5 A is passed through a chromic sulphate solution for 4 hours? (Cr = 52)

(A) 19.40 g (B) 9.70 g

(C) 3.23 g (D) 6.47 g

15. When a current of 3.5 A is passed through a $CuSO_4$ solution for 25 min, the mass of copper deposited at the cathode will be— [Cu = 63.5]

(A) 3.45 g (B) 0.86 g (C) 2.30 g (D) 1.73 g

16. When a current of 1.2 A is passed through a solution of a trivalent metal salt for 30 min, the mass of the cathode increases by 0.2015 g. What is the atomic mass of the metal?

(A) 27 (B) 81 (C) 54 (D) 9

17. What volume of H_2 gas (at STP) will be produced at the cathode when 0.5 F of electricity is passed through dilute H_2SO_4 solution?

(A) 11.2 L (B) 2.8 L (C) 5.6 L (D) 22.4 L

18. How many kilograms of aluminium will be produced when a current of 5.0×10^4 A is passed for ten hours through a molten mixture of aluminium oxide and cryolite?

(A) 503.6 kg (B) 251.8 kg

(C) 167.9 kg (D) 83.9 kg

19. If a current of 50.0 mA is passed through molten $CaCl_2$ for 90 s, how many Ca atoms will be deposited on the electrode?

(A) 1.40×10^{22} (B) 1.40×10^{19}

(C) 7.02×10^{18} (D) 2.81×10^{19}

20. What is the electrochemical equivalent of Ni? (Ni = 58.7)

(A) $3.04 \times 10^{-7}\ gC^{-1}$ (B) $3.04 \times 10^{-4}\ gC^{-1}$

(C) $6.08 \times 10^{-4}\ gC^{-1}$ (D) $1.52 \times 10^{-4}\ gC^{-1}$

21. What mass of zinc will be deposited at the cathode when a current of 1.75 ampere is passed through a zinc chloride solution for 40 minutes? (Atomic mass of zinc = 65.37)

(A) 1.42 g (B) 0.71 g (C) 1.07 g (D) 2.85 g

22. If a current of 4.5 A flows through a conductor for 3 hours, how many faradays of charge have flowed in total?

(A) 1.008 F (B) 0.252 F

(C) 0.168 F (D) 0.504 F

23. On passing electricity through $H_2SO_4(aq)$ for 50 minutes, 600 mL of H_2 gas is produced at 27°C and 1.5 atm. What is the current? (R = $0.0821\ LatmK^{-1}mol^{-1}$)

(A) 1.57 A (B) 1.18 A (C) 4.70 A (D) 2.35 A

24. When 1 F of electricity is passed through molten KCl, $CaCl_2$, $AlCl_3$ and $ZnCl_2$, which metal will be deposited in the greatest amount at the cathode? (K = 39.1, Ca = 40, Al = 27, Zn = 65.4)

(A) K (B) Zn (C) Ca (D) Al

25. In an electroplating process, passing a current of 3 A for 4 minutes deposits m grams of Ag. If a current of 2 A is passed for 9 minutes in the same set-up, the amount of Ag deposited will be—

(A) 1.5m (B) 2m (C) $\frac{2m}{3}$ (D) $\frac{m}{2}$

26. A solution of $AgNO_3$ is electrolysed by passing a current of 1.5 A for 15 min using an Ag anode of mass 12.0 g and an Ag cathode of mass 12.0 g. What will be the masses of the two electrodes?

(A) Anode 10.49 g, cathode 12.0 g

(B) Anode 12.0 g, cathode 13.51 g

(C) Anode 10.49 g, cathode 13.51 g

(D) Anode 13.51 g, cathode 10.49 g

27. When 1 F of electricity is passed separately through solutions of X^{2+}, Y^{+} and Z^{3+} ions—

(A) 2 mol of Y will be deposited

(B) 3 mol of Z will be deposited

(C) $\frac{1}{2}$ mol of X will be deposited

(D) 1 mol of X^{2+} will be discharged

28. How many electrons will flow when a current of 0.5 mA is passed through a copper wire for 8 min?

(A) 1.5×10^{15} (B) 1.5×10^{18}

(C) 2.5×10^{16} (D) 3.0×10^{18}

29. How much electric charge is needed to deposit 54 g of Al at the cathode?

(A) 3 F (B) 6 F (C) 9 F (D) 2 F

30. What is the total charge of one mole of Cu^{2+} ions?

(A) 193000 C (B) 96500 C

(C) 6.022×10^{23} C (D) 3.2×10^{-19} C

31. When a current of 0.0402 A is passed through a metal salt solution for 2.0 h, 0.0880 g of metal is deposited at the cathode. What is the charge of the metal ion? [M = 58.7 for the metal]

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

32. When a current of 1.5 amp is passed through a dilute NaCl solution for 3 minutes, how many mL of decimolar H_2SO_4 solution are needed to neutralise the alkali produced?

(A) 6.99 (B) 13.99 (C) 20.98 (D) 27.98

33. During the electrolysis of acidified water, how many grams of water will be decomposed when a current of 0.8 A flows for 2.5 hours?

(A) 0.075 g (B) 0.672 g

(C) 0.336 g (D) 1.343 g

34. If a current of 2.5 A is passed for 4 hours through 0.25 dm^3 of 1.5 M $CuSO_4$ solution using copper (Cu) electrodes, what is the concentration of the resulting solution?

(A) 1.5 M (B) 0.75 M (C) 1.87 M (D) 1.13 M

35. The potential of the cell $Co(s) | Co^{2+}(aq) || Ag^{+}(aq) | Ag(s)$ is [$E^0_{Co^{2+}/Co}$ = −0.28 V, $E^0_{Ag^{+}/Ag}$ = 0.80 V]

(A) −0.52 V (B) 0.52 V

(C) −1.08 V (D) 1.08 V

36. If the salt bridge is suddenly removed from a galvanic cell, what change occurs in the cell potential?

(A) It remains unchanged (B) It decreases to half

(C) It increases (D) It becomes zero

37. Which is the negative terminal of the cell $Ni | Ni^{2+} || Ag^{+} | Ag$?

(A) Ni^{2+} (B) Ag^{+} (C) Ag (D) Ni

38. If the cell constant of a conductivity cell is G^* and the resistance of the solution is R, which expression gives the specific conductivity $\varkappa$?

(A) G^*R (B) $\frac{R}{G^*}$ (C) $\frac{G^*}{R}$ (D) $G^{*2}R$

39. If $E^0_{Cr^{3+}/Cr} = -0.72\ V$ and $E^0_{Fe^{2+}/Fe} = -0.44\ V$, what is the emf of the cell
$Cr \mid Cr^{3+}(0.1\ M) \parallel Fe^{2+}(0.05\ M) \mid Fe$ at 25°C?

(A) 0.2613 V (B) 0.2987 V
(C) 0.2426 V (D) 0.2800 V

40. What is the EMF of
$Cu \mid Cu^{2+}(0.1\ M) \parallel Ag^{+}(0.01\ M) \mid Ag$ at 25°C? [$E^0_{Cu^{2+}/Cu} = 0.34\ V$, $E^0_{Ag^{+}/Ag} = 0.80\ V$]

(A) 0.549 V (B) 0.371 V
(C) 0.401 V (D) 0.460 V

41. In a cell reaction, a change of one electron takes place. If the standard emf of the cell at 25°C is 0.3546 V, what is the equilibrium constant of the cell?

(A) 10^3 (B) 10^6 (C) 10^{12} (D) 10^{-6}

42. Standard reduction potentials: $E^0_{Cu^{2+}/Cu} = +0.337\ V$; $E^0_{Zn^{2+}/Zn} = -0.76\ V$; $E^0_{Ag^{+}/Ag} = +0.80\ V$; $E^0_{Mg^{2+}/Mg} = -2.36\ V$
For which of the following cells is the value of ΔG^0 the highest (least negative)?

(A) $Mg \mid Mg^{2+}(1.0\ M) \parallel Ag^{+}(1.0\ M) \mid Ag$
(B) $Zn \mid Zn^{2+}(1.0\ M) \parallel Cu^{2+}(1.0\ M) \mid Cu$
(C) $Cu \mid Cu^{2+}(1.0\ M) \parallel Ag^{+}(1.0\ M) \mid Ag$
(D) $Zn \mid Zn^{2+}(1.0\ M) \parallel Ag^{+}(1.0\ M) \mid Ag$

43. The two half-cell reactions involved in the corrosion of zinc are:
$2H^{+} + \frac{1}{2}O_2 + 2e^{-} \rightarrow H_2O,\ E^0 = +1.23\ V$
$Zn^{2+} + 2e^{-} \rightarrow Zn,\ E^0 = -0.76\ V$
What is the standard free energy change ΔG^0 for this reaction?

(A) −192.04 kJ (B) +384.07 kJ
(C) −384.07 kJ (D) −90.70 kJ

44. Consider a cell consisting of $Zn(s) \mid Zn^{2+}(1.00 \times 10^{-6}\ M) \parallel Ag^{+}(0.010\ M) \mid Ag(s)$ and the standard reduction potentials of the cell are $E^0_{Zn(red)} = -0.76\ V$ and $E^0_{Ag(red)} = 0.80\ V$ at 25°C. For this cell the following parameters are given,
(i) The cell reaction is $Zn(s) + 2Ag^{+}(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$
(ii) $E_{cell} = 1.619\ V$
(iii) $\Delta G^0 = -3.011 \times 10^5\ J$
Which of the following is correct?

(A) (ii) and (iii) (B) (i), (ii) and (iii)
(C) (i) and (iii) (D) (i) and (ii)

45. A $ZnSO_4$ solution is stored in a copper vessel. Under this condition, which of the following statements is true? [$E^0_{Cu^{2+}/Cu} = 0.34\ V$ and $E^0_{Zn^{2+}/Zn} = -0.76\ V$]

(A) Zn^{2+} will not be reduced
(B) Zinc will be deposited
(C) Copper will be oxidised
(D) Copper will be corroded

46. What is the emf of the following cell at 25°C?
$Pt,\ H_2(1\ atm) \mid HA(0.1\ M) \parallel HCl(0.01\ M) \mid H_2(1\ atm),\ Pt$
Here, at the same temperature the equivalent conductivity of 0.1 M HA solution is $5.2\ \Omega^{-1}cm^2(g\text{-}eqv)^{-1}$ and that at infinite dilution is $390\ \Omega^{-1}cm^2(g\text{-}eqv)^{-1}$

(A) 0.0296 V (B) 0.1182 V
(C) 0.0591 V (D) 0.0517 V

47. All the energy produced in the reaction $X \rightarrow Y$, $\Delta G^0 = -241.25\ kJmol^{-1}$ is used to oxidise M^{2+} ions in the reaction $M^{2+} \rightarrow M^{4+} + 2e^{-}$ ($E^0 = -0.50\ V$). How many moles of M^{2+} ions will be oxidised by the energy produced in the conversion of 1 mol of X into Y ?

(A) 5.0 mol (B) 1.25 mol
(C) 2.5 mol (D) 4.0 mol

48. At 300 K, the value of ΔH^0 of the given cell reaction is twice the value of ΔG^0. For the cell $A(s) \mid A^{n+}(aq)(3\ M) \parallel B^{2n+}(aq)(1\ M) \mid B(s)$, if the emf of the cell is zero, find the value of ΔS^0 of the cell reaction (in $JK^{-1}mol^{-1}$) per mole of B produced at 300 K.

(A) −18.27 (B) −9.13
(C) −11.53 (D) +18.27

49. During the discharge of a lead storage battery, the specific gravity of the electrolyte—

(A) remains unchanged
(B) decreases
(C) first increases, then decreases
(D) increases

50. Which gas is produced at the anode of a methanol-oxygen fuel cell (DMFC)?

(A) H_2 (B) O_2 (C) CO_2 (D) CO