# Engineering Daily 23 [Home Practice] EV

Electrochemistry

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

## MCQ 50 marks

1. On increasing the temperature, the conductivity of a metallic conductor—
   (A) first increases, then decreases
   (B) increases
   (C) remains the same
   (D) decreases

2. If the specific conductivity of a 0.01 M $Al_2(SO_4)_3$ solution at 25°C is $3.0 \times 10^{-3}\ \Omega^{-1}cm^{-1}$, what is the equivalent conductivity of the solution?
   (A) $150\ \Omega^{-1}cm^2(g\text{-}eqv)^{-1}$ (B) $100\ \Omega^{-1}cm^2(g\text{-}eqv)^{-1}$
   (C) $300\ \Omega^{-1}cm^2(g\text{-}eqv)^{-1}$ (D) $50\ \Omega^{-1}cm^2(g\text{-}eqv)^{-1}$

3. What is the unit of specific conductivity?
   (A) $Scm^2mol^{-1}$ (B) $Scm^{-1}$
   (C) $Scm^2(g\text{-}eqv)^{-1}$ (D) Scm

4. When a concentrated aqueous solution of NaCl is electrolysed using inert electrodes, the pH of the solution—
   (A) remains unchanged (B) increases
   (C) stays fixed at 7 (D) decreases

5. Which of the following reactions takes place at the anode electrode?
   (A) $2Cl^- \longrightarrow Cl_2 + 2e^-$ (B) $Cl_2 + 2e^- \longrightarrow 2Cl^-$
   (C) $Cu^{2+} + 2e^- \longrightarrow Cu$ (D) $2H^+ + 2e^- \longrightarrow H_2$

6. What is the correct order of tendency of discharge at the cathode in aqueous solution?
   (A) $H^+ > Ag^+ > Cu^{2+} > Zn^{2+}$
   (B) $Ag^+ > Cu^{2+} > H^+ > Zn^{2+}$
   (C) $Zn^{2+} > H^+ > Cu^{2+} > Ag^+$
   (D) $Cu^{2+} > Ag^+ > Zn^{2+} > H^+$

7. If the standard reduction potentials are $E^0_{Li^+/Li} = -3.05\ V$; $E^0_{Zn^{2+}/Zn} = -0.76\ V$; $E^0_{Ag^+/Ag} = +0.80\ V$; $E^0_{Cl_2/Cl^-} = +1.36\ V$, which is the strongest oxidising agent?
   (A) Li (B) $Ag^+$ (C) $Cl_2$ (D) $Zn^{2+}$

8. Inside an electrochemical cell (in the electrolyte and the salt bridge), electricity is conducted by—
   (A) protons (B) free electrons
   (C) atoms (D) ions

9. The cell that converts chemical energy into electrical energy is called a—
   (A) conductivity cell (B) electrolytic cell
   (C) galvanic cell (D) electroplating cell

10. Which metal cannot be used as a sacrificial anode in the cathodic protection of an iron pipe?
    (A) Zn (B) Cu (C) Al (D) Mg

11. How many moles of electrons are required to reduce 3.81 g of copper ions from $CuCl_2$? (Cu = 63.5)
    (A) 0.06 mol (B) 0.03 mol
    (C) 0.24 mol (D) 0.12 mol

12. Under which condition is $Cl^-$ oxidised first at the anode, instead of $OH^-$, in the electrolysis of NaCl solution?
    (A) When both concentrations are equal
    (B) When the solution is very dilute
    (C) When the concentration of $Cl^-$ is much greater than that of $OH^-$
    (D) When the concentration of $OH^-$ is greater than that of $Cl^-$

13. A $Ni(NO_3)_2$ solution is electrolysed by passing a current of 3 A for 45 min. How many nickel atoms will be deposited at the cathode?
    (A) $5.06 \times 10^{22}$ (B) $2.53 \times 10^{23}$
    (C) $2.53 \times 10^{22}$ (D) $1.26 \times 10^{22}$

14. For which of the following ions does the greatest number of electrons get exchanged during neutralisation of charge?
    (A) 4 g $O^{2-}$ (B) 4 g $Mg^{2+}$
    (C) 4 g $S^{2-}$ (D) 4 g $F^-$

15. What quantity of electricity is carried by 0.5 mol of a tetravalent metal ion?
    (A) 96500 C (B) 48250 C
    (C) 386000 C (D) 193000 C

16. How many F of charge are required to prepare 3 mol of $Cl_2$ from NaCl?
    (A) 6 F (B) 1.5 F (C) 3 F (D) 12 F

17. For how long must a current of 0.8 A be passed through an $AgNO_3$ solution to deposit 2.16 g of Ag at the cathode? (Ag = 108)
    (A) 33.5 min (B) 20.1 min
    (C) 40.2 min (D) 80.4 min

18. How many grams of chlorine will be produced at the anode when 0.35 faraday of electricity is passed through NaCl solution?
    (A) 12.43 g (B) 6.21 g (C) 8.05 g (D) 24.85 g

19. Which of the following is used as the anode of a lithium-ion battery?
    (A) $Li_xC_6$ (B) $LiCoO_2$ (C) $PbO_2$ (D) $MnO_2$

20. In the reaction $ClO_3^- + H_2O \rightarrow ClO_4^- + 2H^+ + 2e^-$, how many faradays of electricity are needed to produce 0.25 mol of $NaClO_4$?

(A) 0.5 F (B) 1 F (C) 0.25 F (D) 2 F

21. Al metal is extracted by the electrolysis of molten alumina. When different currents are passed through molten $Al_2O_3$ at different times, different amounts of Al are deposited at the cathode.
Current (A): 60, 120, 240; time (days): 1, 2, 2; mass of Al deposited (kg): 1.0, 4.0, 8.0
Based on this, how much Al will be deposited at the cathode when a current of 150 A is passed through molten alumina for 4 days?

(A) 15.0 kg (B) 2.5 kg (C) 6.0 kg (D) 10.0 kg

22. To electroplate an iron key with copper, which of the following arrangements is correct?

(A) Cathode: iron key; anode: carbon; electrolyte: dilute $H_2SO_4$

(B) Cathode: copper; anode: iron key; electrolyte: $CuSO_4$ solution

(C) Cathode: copper; anode: iron key; electrolyte: $FeSO_4$ solution

(D) Cathode: iron key; anode: copper; electrolyte: $CuSO_4$ solution

23. What mass of copper will be deposited at the electrode when a current of 2.5 ampere is passed through a copper sulphate solution for 1 hour 20 minutes? (Atomic mass of copper = 63.5)

(A) 2.47 g (B) 7.90 g (C) 1.97 g (D) 3.95 g

24. What mass of aluminium will be deposited at the cathode when 32400 coulombs of charge is passed through an $AlCl_3$ solution?

(A) 9.07 g (B) 3.02 g (C) 6.04 g (D) 1.01 g

25. What mass of gold will be deposited at the cathode when a current of 2.0 ampere is passed through $AuCl_3$ for 50 minutes? (Au = 196.97)

(A) 2.04 g (B) 6.12 g

(C) 12.25 g (D) 4.08 g

26. An electrochemical reaction takes place between an Ag(s) anode and a Pt cathode in 500 mL of 0.05 M aqueous KCl. The solubility product of AgCl is $1.8 \times 10^{-10}$ and $F = 96500\ C mol^{-1}$. How much time is required for precipitation of AgCl to begin in the cell with a current of 2 μA?

(A) 347.4 s (B) 43.43 s

(C) 86.85 s (D) 173.7 s

27. 1.8 faraday of electricity is passed through a 1.8 M $AlCl_3$ solution. The amount of aluminium deposited at the cathode will be—

(A) 0.6 g-eqv (B) 1.8 g-eqv

(C) 5.4 g-eqv (D) 3.6 g-eqv

28. According to Faraday's second law, when the same quantity of electricity is passed through different electrolytes, the mass of substance deposited is proportional to which of the following?

(A) chemical equivalent

(B) atomic mass

(C) inverse of the electrochemical equivalent

(D) valency

29. Faraday's law is applicable—

(A) in the extraction of metals

(B) in the purification of metals

(C) in electroplating

(D) in all of these

30. Which conditions apply for the determination of standard electrode potential?

(A) 0°C temperature, 1 N concentration and 2 atm pressure

(B) 25°C temperature, 0.1 M concentration and 1 atm pressure

(C) 25°C temperature, 1 M concentration and 1 atm pressure

(D) 0°C temperature, 1 M concentration and 1 atm pressure

31. What happens in an electrochemical cell when the external potential ($E_{ext}$) is equal to the cell potential ($E_{cell}$)?

(A) Electrons flow from the cathode to the anode

(B) The cell produces double the electricity

(C) The cell behaves like an electrolytic cell

(D) No current flows in the cell

32. Calculate the electromotive force (EMF) of the following cell—
$Fe \mid Fe^{2+}(0.2\ M) \parallel Sn^{2+}(0.5\ M) \mid Sn$
$E^0_{Fe/Fe^{2+}} = 0.44\ V$, $E^0_{Sn/Sn^{2+}} = 0.14\ V$

(A) 0.312 V (B) 0.580 V

(C) 0.300 V (D) 0.288 V

33. For the galvanic cell
$Zn(s) \mid ZnSO_4(aq) \parallel CuSO_4(aq) \mid Cu(s)$, when the concentration of $Cu^{2+}$ ions is 100 times that of $Zn^{2+}$ ions, which is the correct expression for $\Delta G$ in $J mol^{-1}$? ($E^0_{cell} = 1.1\ V$)

(A) $-2.2F - 4.606RT$ (B) $-2.2F - 2.303RT$

(C) $-2.2F + 4.606RT$ (D) $4.606RT - 1.1F$

34. What will be the reduction potential (in V) of a hydrogen electrode dipped in a solution of pH = 2.5 at 25°C?

(A) −0.148 (B) +0.148

(C) −0.296 (D) −0.074

35. The potential of a $Zn$ electrode varies as follows—
$E_{Zn^{2+}/Zn} = E^0_{Zn^{2+}/Zn} - \frac{0.059}{2} \log \frac{1}{[Zn^{2+}]}$
The graph of $E_{Zn^{2+}/Zn}$ versus $\log[Zn^{2+}]$ will be—
(A) a straight line parallel to the x-axis
(B) a straight line with negative slope (slope = −0.0295)
(C) a straight line with positive slope (slope = 0.0295)
(D) an upward curve (exponential)

36. Which of the following reactions takes place at the anode?
(A) $Ag^+ + e^- \longrightarrow Ag$
(B) $2H^+ + 2e^- \longrightarrow H_2$
(C) $Cu^{2+} + 2e^- \longrightarrow Cu$
(D) $Fe^{2+} \longrightarrow Fe^{3+} + e^-$

37. For the cell reaction $Cu(s) + 2Ag^+(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$, $E^0_{cell} = +0.46\,V$. If the concentration of $Ag^+$ ions in the solution is halved, the value of $E^0_{cell}$ will—
(A) become half
(B) decrease
(C) remain unchanged
(D) increase

38. If $E^0_{Cu^{2+}/Cu} = 0.34\,V$ and $E^0_{Fe^{2+}/Fe} = -0.44\,V$, which of the following is correct?
(A) $Fe^{2+}$ will be reduced by $Cu$
(B) $Cu^{2+}$ will be reduced by $Fe$
(C) $Fe$ will be oxidised by $Cu$
(D) $Cu$ will be oxidised by $Fe^{2+}$

39. The relation between the standard electromotive force ($E^0$) of a cell and the equilibrium constant ($K$) is—
(A) $E^0 = \frac{nF}{RT} \ln K$
(B) $E^0 = \frac{RT}{nF} \ln K$
(C) $E^0 = -\frac{RT}{nF} \ln K$
(D) $E^0 = -nFRT \ln K$

40. Which of the following equations is correct?
(A) $E_{cell} = E^0_{cell} + \frac{RT}{nF} \ln \frac{[Product]}{[Reactant]}$
(B) $E_{cell} = E^0_{cell} - \frac{RT}{nF} \ln \frac{[Product]}{[Reactant]}$
(C) $E_{cell} = E^0_{cell} - \frac{nF}{RT} \ln \frac{[Product]}{[Reactant]}$
(D) $E_{cell} = E^0_{cell} - RT \ln \frac{[Reactant]}{[Product]}$

41. What is the emf of the following cell at 25°C?
$Pt, H_2(2\,atm) | H^+(1\,M) | H_2(0.2\,atm), Pt$
(A) 0.0000 V
(B) 0.0591 V
(C) 0.0296 V
(D) −0.0296 V

42. At 25°C, the dissociation constant of the complex ion $[Ag(NH_3)_2]^+$ into $Ag^+$ and $NH_3$ is $1.0 \times 10^{-13}$. Find the value of $E^0$ for $[Ag(NH_3)_2]^+ + e^- \rightarrow Ag + 2NH_3$.
[Given $Ag^+ + e^- \rightarrow Ag$; $E^0 = 0.799\,V$]
(A) −0.0307 V
(B) 0.0307 V
(C) 0.7990 V
(D) 1.5673 V

43. When an H-electrode is connected to a calomel electrode having an oxidation potential of −0.28 V, an emf of 0.45 V is obtained. At 25°C and 1 atm, what is the pH of the acid used?
(A) 7.61
(B) 1.44
(C) 2.88
(D) 12.35

44. What will be the EMF of the given cell reaction at 25°C?
$2Fe(s) + O_2(g) + 4H^+(aq) \rightarrow 2Fe^{2+}(aq) + 2H_2O(l)$
[where, $E^0 = 1.67\,V$, $[Fe^{2+}] = 10^{-2}\,M$, $P_{O_2} = 0.2\,atm$ and pH = 4]
(A) 1.482 V
(B) 1.295 V
(C) 1.670 V
(D) 1.858 V

45. In the light of the cell reaction $A^{n+}(aq) + B(s) \rightarrow A(s) + B^{n+}(aq)$, which is the Nernst equation?
(A) $E_{cell} = E^0_{cell} - \frac{RT}{F} \ln \frac{[B^{n+}]}{[A^{n+}]}$
(B) $E_{cell} = E^0_{cell} + \frac{2.303RT}{nF} \log \frac{[B^{n+}]}{[A^{n+}]}$
(C) $E_{cell} = E^0_{cell} - \frac{2.303RT}{nF} \log \frac{[B^{n+}]}{[A^{n+}]}$
(D) $E_{cell} = E^0_{cell} - \frac{2.303RT}{nF} \log \frac{[A^{n+}]}{[B^{n+}]}$

46. The cell reaction of an electrochemical cell is as follows:
$Cu(s) + 2Ag^+(C_1) \rightarrow Cu^{2+}(C_2) + 2Ag(s)$; at constant temperature, $\Delta G$ of the reaction depends on which of the following—
(A) $\ln\left(\frac{C_2}{C_1^2}\right)$
(B) $\ln\left(\frac{C_2}{C_1}\right)$
(C) $\ln(C_1 + C_2)$
(D) $\ln\left(\frac{C_1^2}{C_2}\right)$

47. Considering a temperature of 35°C, which is the Nernst equation for measuring the emf of a cell?
(A) $E = E^0 - \frac{0.0591}{n} \log Q$
(B) $E = E^0 - \frac{0.0265}{n} \log Q$
(C) $E = E^0 - \frac{0.0601}{n} \log Q$
(D) $E = E^0 - \frac{0.0611}{n} \log Q$

48. Which of the following is used as a secondary reference electrode?
(A) Zinc electrode
(B) Calomel electrode
(C) Copper electrode
(D) Standard hydrogen electrode

49. Which is the reaction taking place at the anode of an alkaline fuel cell (AFC)?
(A) $2H_2(g) + 4OH^-(aq) \rightarrow 4H_2O + 4e^-$
(B) $2H_2(g) \rightarrow 4H^+(aq) + 4e^-$
(C) $O_2(g) + 4H^+(aq) + 4e^- \rightarrow 2H_2O$
(D) $O_2(g) + 2H_2O + 4e^- \rightarrow 4OH^-(aq)$

50. In which battery is silver vanadium oxide ($Ag_2V_4O_{11}$) used as the cathode?
(A) Lithium-ion battery
(B) Lithium battery
(C) PEM fuel cell
(D) Lead storage cell