Chapter-2 Electrochemistry

1 In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices. (Q.18 to Q.20)
(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(c) Assertion is correct statement but reason is wrong statement.
(d) Assertion is wrong statement but reason is correct statement.
Assertion: E_{Cell} should have a positive value for the cell to function.
Reason: $E_{cathode} < E_{anode}$ 1

2 In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices. (Q.18 to Q.20)
(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(c) Assertion is correct statement but reason is wrong statement.
(d) Assertion is wrong statement but reason is correct statement.
Assertion: Λ_m for weak electrolytes shows a sharp increase when the electrolytic solution is diluted.
Reason: For weak electrolytes degree of dissociation increases with dilution of solution. 1

3 In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices. (Q.18 to Q.20)
(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(c) Assertion is correct statement but reason is wrong statement.
(d) Assertion is wrong statement but reason is correct statement.
Assertion: For measuring resistance of an ionic solution an AC source is used.
Reason: Concentration of ionic solution will change if DC source is used. 1

4 Calculate the time in hours for collecting 24g of Mg from $MgCl_2$ using 10 amp current? (Mg = 2 hr)
(a) 2 hrs (b) 4 hrs
(c) 5 hrs (d) 5.36 hour 1

5 $(a)\ \frac{\Delta G}{\Delta S}$ $(b)\ \frac{\Delta G}{\Delta H}$ Efficiency of fuel cell is equal
$(c)\ \frac{\Delta S}{\Delta G}$ $(d)\ \frac{\Delta H}{\Delta G}$ 1

6 Which cell will measure standard electrode potential of copper electrode? [NCERT Exemplar Problem]

(a) $Pt(s)|H_2\ (g,0.1\ bar)|H^+\ (aq.,1\ M)||Cu^{2+}(aq.,1M)|Cu$

(b) $Pt(s)|H_2\ (g,\ 1\ bar)|H^+\ (aq.,1\ M)||Cu^{2+}\ (aq.,2\ M)|Cu$ 1

(c) $Pt(s)|H_2\ (g,\ 1\ bar)|H^+\ (aq.,1\ M)||Cu^{2}+\ (aq.,1\ M)|Cu$

(d) $Pt(s)|H_2\ (g,\ 1\ bar)|H^+\ (aq.,0.1\ M)||Cu^{2+}\ (aq.,1\ M)|Cu$

7 The equilibrium constant of the following reaction at 298 K is 1×10^8 for

$$2Fe^{3+}(aq) + 2I^-(aq) \rightleftharpoons 2Fe^{2+}(aq) + I_2$$

$E^\circ_{I_2|I^-} = +0.54\ V \quad E^\circ_{Fe^{3+}|Fe} = ?$ 1

(a) + 1.006 V (b) + 0.77 V

(c) – 0.77 V (d) – 0.625 V

8 What will happen during the electrolysis of aqueous solution of $CuSO_4$ by using platinum electrodes? [NCERT Exemplar Problem]
(a) Copper will deposit at cathode.
(b) Copper will deposit at anode. 1

(c) Oxygen will be released at anode.
(d) Copper will dissolve at anode.

9 What will happen during the electrolysis of aqueous solution of $CuSO_4$ in the presence of Cu electrodes? 1
(a) Copper will deposit at cathode.
(b) Copper will dissolve at anode.
(c) Oxygen will be released at anode.
(d) Copper will deposit at anode.

10 For the given cell, $Mg|Mg^{2+}||\ Cu^{2+}|Cu$ 1
(a) Mg is cathode
(b) Cu is cathode
(c) The cell reaction is
$Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$
(d) Cu is the oxidising agent

11 Set up Nernst equation for the standard dry cell. Using this equation, show that the voltage of dry cell has to decrease with use. 2

12 (a) Following reactions occur at cathode during the electrolysis of aqueous silver chloride solution:

$$Ag^+(aq) + e^- \longrightarrow Ag(s);\ E^\circ = +0.80\ V$$
$$H^+(aq) + e^- \longrightarrow \frac{1}{2}H_2(g);\ E^\circ = 0.00\ V$$

On the basis of their standard reduction electrode potential (E°) values, which reaction is feasible at the cathode and why? 2

(b) Define limiting molar conductivity. Why conductivity of an electrolyte solution decreases with the decrease in concentration?

13 (a) Following reactions occur at cathode during the electrolysis of aqueous copper (II) chloride solution: 2

$$Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s); \quad E^0 = +0.34\ V$$
$$H^+(aq) + e^- \longrightarrow \frac{1}{2}H_2(g); \quad E^0 = 0.00\ V$$

On the basis of their standard reduction electrode potential (E^2) values, which reaction is feasible at the cathode and why?

(b) State Kohlrausch law of independent migration of ions. Write its one application.

14 Following reactions occur at cathode during electrolysis of aqueous sodium chloride solution: 2

$$Na^+ + e^- \longrightarrow Na(s);\ E^\circ = -2.71\ V$$
$$H^+ + e^- \longrightarrow \frac{1}{2}H_2(g);\ E^\circ = 0.00\ V$$

On the basis of their standard electrode potential (E°) values, which reaction is feasible at the cathode and why?

15 The standard electrode potential (E°) for Daniel cell is +1.1 V. Calculate the ΔG° for the reaction: 2

$$Zn(s) + Cu^{2+}(aq) \longrightarrow Zn^{2+}(aq) + Cu(s) \quad (1\ F = 96500\ C)$$

16 Zinc rod is dipped in 0.1 M solution of ZnSO4. The salt is 95% dissociated at this dilution at 298 K. Calculate the electrode potential. Given $E^\circ_{Zn^{2+}/Zn} = -0.76$ V. 2

17 Determine the values of equilibrium constant (K_c) and ΔG° for the following reaction: 2
$Ni(s) + 2Ag^+(aq) \rightarrow Ni^{2+}(aq) + 2Ag(s)$, E° = 1.05 V (1 F = 96500 C mol^{-1})

18 Give an example of a fuel cell and write the cathode and anode reactions for it. 2

19 Write the overall reaction that occurs during use (discharging) of nickelcadmium cell. Is it a primary or a secondary cell. Mention its one merit over the lead storage cell. 2

20 Mention the reactions occurring at (i) anode, (ii) cathode, during working of a mercury cell. Why does the voltage of a mercury cell remain constant during its operation? 2

21 For the cell: Zn(s) | Zn^{2+}(2M) || Cu^{2+}(0.5 M) | Cu(s)
(a) Write equation for each half-reaction.
(b) Calculate the cell potential at 25 °C. 3
[Given: $E^\circ_{Zn^{2+}/Zn} = -0.76$ V; $E^\circ_{Cu^{2+}/Cu} = +0.34$V]

22 Consider the cell: Mg(s) | Mg^{2+} (0.13 M) || Ag^+ (1.0×10^{-4}) M | Ag(s)
Its emf is 2.96 V. Calculate E°cell. 3
(R = 8.314 JK^{-1} mol^{-1}, 1F = 96500 C mol^{-1})

23 A conductivity cell was filled with 0.1 M NaCl solution at 25 °C. Its resistance was found to be 176.6 ohms. The conductivity of the solution is 9.2×10^{-3} S cm^{-1}. The cross-sectional area of the electrode used was 4 cm^2. What must be distance between the electrodes and calculate molar conductivity. 3

24 How long will it take an electric current of 0.15 A to deposit all the copper from 500 mL of 0.15 M copper sulphate solution? 3

25 How many grams of sodium and chlorine can be obtained by electrolysis of molten NaCl with a current of 1 amp for 15 min. 3
[F = 96500 C, At mass of Na = 23, Cl = 35.5]

26 (a) What type of a battery is lead storage battery ? Write the anode and cathode reactions and the overall cell reaction occurring in the operation of a lead storage battery.
(b) Calculate the potential for half-cell containing 0.10 M $K_2Cr_2O_7$(aq), 0.20 M Cr^{3+}(aq) and 1.0×10^{-4} M H^+(aq) 5
The half-cell reaction is

$Cr_2O_7^{2-}(aq) + 14\ H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$ and the standard electrode potential is given as E° = 1.33 V.

27 (a) How many moles of mercury will be produced by electrolysing 1.0 M $Hg(NO_3)_2$ solution with a current of 2.00 A for 3 hours ? $[Hg(NO_3)_2 = 200.6\ g\ mol^{-1}]$

(b) A voltaic cell is set up at 25° C with the following half-cells Al^{3+} (0.001 M) and Ni^{2+} (0.50 M). Write an equation for the reaction that occurs when the cell generates an electric current and determine the cell potential. 5

(Given: $E^\circ_{Ni^{2+}/Ni} = -0.25$ V, $E^\circ_{Al^{3+}/Al} = -1.66$ V)