	INDIAN SCHOOL AL WADI AL KABIR	
Class: XII	**Department: SCIENCE 2023 – 24** **SUBJECT: CHEMISTRY**	**Date : 12:10:2023**
Worksheet No: 07 **WITH ANSWERS**	**CHAPTER / UNIT: ELECTROCHEMISTRY**	**Note:** **A4 FILE FORMAT**
NAME OF THE STUDENT	**CLASS & SEC:**	**ROLL NO.**

Multiple Choice Questions (1 M)

1. Kohlrausch gave the following relation for strong electrolytes:
   $\lambda = \lambda° - Ac^{1/2}$
   Which of the following equality holds?
   (a) $\lambda = \lambda°$ as $c \rightarrow A^{1/2}$
   (b) $\lambda = \lambda°$ as $c \rightarrow 0$
   (c) $\lambda = \lambda°$ as $c \rightarrow \infty$
   (d) $\lambda = \lambda°$ as $c \rightarrow 1$

2. If the standard electrode potential of an electrode is greater than zero, then we can infer that its
   (a) reduced form is more stable compared to H_2 gas.
   (b) oxidized form is more stable compared to H_2 gas.
   (c) reduced and oxidized forms are equally stable.
   (e) reduced form is less stable than H_2 gas

3. Without losing its concentration, $ZnCl_2$ solution cannot be kept in contact with
   (a) Au
   (b) Al
   (c) Pb
   (d) Ag

4. An electrochemical cell generally consists of a cathode and an anode. Which of the following statements is correct with respect to the cathode?
   (a) Oxidation occurs at the cathode
   (b) Electrons move into the cathode

(c) Usually denoted by a negative sign

(d) Is usually made up of insulating material

5. When equilibrium is reached inside the two half-cells of the electrochemical cells, what is the net voltage across the electrodes?
   (a) > 1
   (b) < 1
   (c) = 0
   (d) Not defined

6. Which of the following is not a generally used electrolyte in the salt bridges used to connect the two half-cells of an electrochemical cell?
   (a) NaCl
   (b) KNO_3
   (c) KCl
   (d) $ZnSO_4$

7. Which of the following statements is true regarding a primary cell?
   (a) The electrode reactions can be reversed
   (b) It can be recharged
   (c) An example of a primary cell is a mercury cell
   (d) An example of a primary cell is a nickel-cadmium storage cell

***Assertion Reason* type questions**

8. **Assertion(A)** : Electrolysis of aqueous NaCl gives Chlorine gas at anode instead of oxygen gas.
   Reason(R): Formation of oxygen gas at anode requires overpotential.

   Select the most appropriate answer from the options given below:
   (a) Both A and R are true and R is the correct explanation of A
   (b) Both A and R are true but R is not the correct explanation of A.
   (c) A is true but R is false.
   (d) A is false but R is true.

9. **Assertion (A):** The resistivity for a substance is its resistance when it is one meter long and its area of cross-section is one square meter.
   Reason (R): The SI units of resistivity is ohm meter (m)

   Select the most appropriate answer from the options given below:
   (a) Both A and R are true and R is the correct explanation of A
   (b) Both A and R are true but R is not the correct explanation of A.
   (c) A is true but R is false.
   (d) A is false but R is true

10. **Assertion (A):** Galvanized iron does not rust.
    Reason (R): Zinc has a more negative electrode potential than iron.

    Select the most appropriate answer from the options given below:
    (a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true

Very Short answer type (2 M)

11. Define fuel cell and write its two advantages. (2023)

12. Using E° values of X and Y given below, predict which is better for coating the surface of Iron to prevent corrosion and why? (2023)
Given $E°_{(X2+/X)} = -2.36$ V
$E°_{(Y2+/Y)} = -0.14$ V
$E°_{(Fe2+/Fe)} = -0.44$ V

13. Write the Nernst equation for the following cell reaction. (2022)
$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$
How will the E_{cell} be affected when concentration of
(a) Cu^{2+} ions is increased
(b) Zn^{2+} ions is increased

14. a. Write the cell representation for the following electrochemical cell. (2020)
$Mg(s) + Ag^{+}(aq) \rightarrow Ag(s) + Mg^{2+}(aq)$
b. How much charge in Faraday is required for the reduction of 1 mol of Ag^{+} to Ag? (2015)

15. Calculate the time to deposit 1.5 g of silver at cathode when a current of 1.5 A was passed through the solution of $AgNO_3$. (Molar mass of Ag = 108 g mol^{-1}, 1 F = 96500 C mol^{-1}).

Short answer type (3 M)

16. (a) The standard Gibbs energy ($\Delta_rG°$) for the following cell reaction is -300 $kJmol^{-1}$. (2022)
$Zn(s) + 2Ag^{+}(aq) \rightarrow 2Ag(s) + Zn^{2+}(aq)$
Calculate $E°_{cell}$ for the reaction. (Given 1F = 96500 $Cmol^{-1}$)
(b) A dry cell becomes dead after a long time even if it has not been used. Give reason.

17. Calculate the EMF of the following cell at 25°C: (2023)

$Zn(s) \mid Zn^{2+}(0.1\ M) \parallel H^{+}(0.01\ M) \mid H_2(g)\ (1\ bar), Pt(s)$
[Given: $E°_{(Zn2+/Zn)} = -0.76$ V, $E°_{(H+/H2)} = 0.00$V, log 10=1

18. Conductivity of 2×10^{-3} M Methanoic acid is 8×10^{-5} Scm^{-1}. Calculate its molar conductivity and degree of dissociation if $\lambda°_m$ for Methanoic acid is 404 Scm^2mol^{-1}. (2020)

19. (a) The resistance of 0.01 M NaCl solution at 25 °C is 200 Ω. The cell constant of conductivity cell is unity. Calculate the molar conductance.
(b) What type of battery is mercury cell? Why is it more advantageous than dry cell**?**

20. (a) What type of battery is lead storage battery? Write the overall reaction occurring in lead storage battery.
(b) Corrosion is essentially an electrochemical phenomenon. Explain the reactions occurring during

corrosion of iron kept in an open atmosphere.

Passage based questions (4 M)

21.
The study of the conductivity of electrolyte solutions is important for the development of electrochemical devices, for the characterization of the dissociation equilibrium of weak electrolytes, and for the fundamental understanding of charge transport by ions. The conductivity of the electrolyte is measured for electrolyte solution with concentrations in the range of 10^{-3} to 10^{-1} mol L^{-1}, as a solution in this range of concentrations can be easily prepared. The molar conductivity (Λm) of strong electrolyte solutions is given by the equation.

$$\Lambda_m = \Lambda^\circ_m - A\sqrt{C}$$

Where $\Lambda^\circ m$ is the molar conductivity at infinite dilution and C is the concentration of the solution. A is an empirical proportionality constant to be obtained from the experiment.

(a) State Kohlrausch law of independent migration of ions.

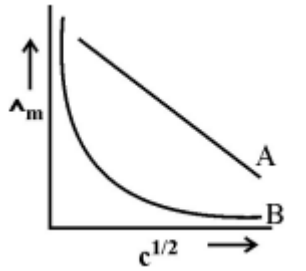
(b) Why does the conductivity of a solution decrease with dilution?

(c) If the molar conductivities at infinite dilution for NaI, CH_3COONa and $(CH_3COO)_2Mg$ are 12.69, 9.10 and 18.78 S cm^2 mol^{-1} respectively at 25°C, then calculate the molar conductivity of MgI_2 at infinite dilution.

Long answer type (5 M)

22. (a) A steady current of 2 amperes was passed through two electrolytic cells X and Y connected in series containing electrolytes $FeSO_4$ and $ZnSO_4$ until 2.8 g of Fe deposited at the cathode of cell X. How long did the current flow?
Calculate the mass of Zn deposited at the cathode of cell Y.
(Molar mass of Fe=56g/mol ,Zn=65.3g/mol ,1 F=96500C/mol)

(b) In the plot of molar conductivity (Λ_m) vs square root of concentration $(C)^{1/2}$ following curves are obtained for two electrolytes A and B .



Answer the following
(i) Predict the nature of the electrolytes A and B.

(ii) What happens on extrapolation of λ_m to concentration approaching zero for electrolytes A and B?

ANSWERS

Q. No	Answers/Hints	Marks
1	(b) $\lambda = \lambda°$ as $c \rightarrow 0$	1
2	(a) reduced form is more stable compared to H_2 gas.	1
3	(b) Al	1
4	(b) Electrons move into the cathode	1
5	(c) = 0	1
6	(d) $ZnSO_4$	1
7	(c) An example of a primary cell is a mercury cell	1
8	(a) Both A and R are true and R is the correct explanation of A	1
9	(b) Both A and R are true but R is not the correct explanation of A.	1
10	(a) Both A and R are true and R is the correct explanation of A	1
11	Galvanic cells that are designed to convert the energy of combustion of fuels like hydrogen, methane, methanol, etc. directly into electrical energy are called fuel cells. Uses The cell was used for providing electrical power in the Apollo space programme. Fuel cells produce electricity with an efficiency of about 70 % Environment friendly	2
12	A is better for coating the surface of iron to prevent corrosion. When corrosion takes place, iron is oxidized. Therefore to prevent it, coating Fe with element A is better. Element A with lower E°value will oxidise first	2
13	$Ecell = E°cell - 0.059/2 \log [Zn^{2+}]/[Cu^{2+}]$ (a) E_{cell} increases (b) E_{cell} decreases	1 ½ ½
14	a. $Mg(s) \mid Mg^{2+}(aq) \parallel Ag^{+}(aq) \mid Ag(s)$ b. $Ag^{+} + e^{-} \rightarrow Ag$ 1F	1 1
15	$Ag^{+} + e- \rightarrow Ag$ 1F = 108 x = 1.5 $Q = 1.5 \times 96500/108$ = 1340.27 C $Q = I \times t$ t = 1340.27/1.5 = 893 5 s	 1 1
16	(a) $\Delta_r G° = -nFE°_{cell}$	2

	$-300 \times 10^3 = -2 \times 96500 \times E°_{cell}$ $E°_{cell} = 1.55$ V (b) Dry cell become dead after long time, even if it has not been used dry cell contains an acidic salt NH_4Cl which corrodes the zinc container. Thus, the cell becomes dead after a long time even when it is not in use.	1
17	$E_{cell} = E°_{cell} - 0.059/n \log [Zn^{2+}]/[H^+]^2$ $= 0.76 - 0.059/2 \log 10^{-1}/10^{-4}$ $= 0.76 - 0.0885$ $= 0.6715$ V	3
18	Molar conductivity $\Lambda_m = \frac{k \times 1000}{C}$ $= 40$ Scm^{2}mol^{-1} Degree of dissociation $\frac{\Lambda_m}{\Lambda_m^\circ} = \frac{40}{404} = 0.099$	2 1
19	(a) Cell constant = k × R k = 1/200 S λ_m = k ×1000/0.01 = 500 Scm^{2}mol^{-1} (b) Mercury cell is a primary cell and cannot be recharged. Its voltage remains constant over long period of time.	1 1 1
20	(a) Lead storage battery is a secondary battery. **Overall reaction:** $Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l)$ (b) At a particular spot of an object made of iron, oxidation takes place and that spot behaves as anode. Anode: $2\ Fe\ (s) \longrightarrow 2\ Fe^{2+} + 4\ e^-$ Electrons released at anodic spot move through the metal and go to another spot on the metal and reduce oxygen in the presence of H^+ Cathode: $O_2(g) + 4\ H^+(aq) + 4\ e^- \longrightarrow 2\ H_2O\ (l)$ The overall reaction being: $2Fe(s) + O_2(g) + 4H^+(aq) \longrightarrow 2Fe^{2+}(aq) + 2\ H_2O\ (l)$ The ferrous ions are further oxidised by atmospheric oxygen to ferric ions which come out as rust in the form of hydrated ferric oxide (Fe_2O_3 . x H_2O).	½ ½ ½ ½ 1
21	(a) The law states that limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte. $\Lambda_m^\circ = \nu_+ \lambda_+^\circ + \nu_- \lambda_-^\circ$ Explain the terms	1

	(b) Conductivity depends on the no of ions per unit volume. The number of ions per unit volume that carry the current in a solution decreases on dilution. Hence conductivity decreases. (c) $\lambda^{\circ}_{m(NaI)} = \lambda^{\circ}_{m(Na^+)} + \lambda^{\circ}_{m(I^-)}$ .....(i) $\lambda^{\circ}_{m(CH_3COONa)} = \lambda^{\circ}_{m(CH_3COO^-)} + \lambda^{\circ}_{m(Na^+)}$ .....(ii) $\lambda^{\circ}_{m(CH_3COO)_2Mg} = 2.\lambda^{\circ}_{m(CH_3COO^-)} + \lambda^{\circ}_{m(Mg^{2+})}$ .....(iii) $\lambda^{\circ}_{m(MgI_2)} = \lambda^{\circ}_{m(Mg^{2+})} + 2\lambda^{\circ}_{mI^-}$ .....(iv) We can get equation (iv) from equation 1, 2 and 3. Equation (iii) + 2(eq. (i)) – 2(eq. ii) $\lambda^{\circ}_{m(MgI_2)} = 18.78 + 2(12.69) - 2(9.10) = 25.96$	1 2
22	(a) $Fe^{2+} + 2e^- \rightarrow Fe$ 2F = 56 Q = 2.8 Q = 9650 C Q= I t t = 9650/2 = 4825 s $Zn^{2+} + 2e^- \rightarrow Zn$ 2F = 65.3 9650 = x x = 3.265 g (b) It can be found from the graph that for a strong electrolyte A, as the concentration approaches the zero value, the molar conductance approaches a limiting value called molar conductance at infinite dilution. The curve for a weak electrolyte B is a rectangular hyperbola and does not intercept the y-axis. Even though the concept of molar conductance at infinite dilution exists for a weak electrolyte, graphically the value cannot be evaluated.	3 2

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