INDIAN SCHOOL AL WADI AL KABIR		
Class: XII	**Department: SCIENCE 2022-23**	**Date: 24.11.2022**
Worksheet No.: 3 **WITH ANSWERS**	**Topic: CHEMISTRY** ELECTROCHEMISTRY	**Note: A4 FILE FORMAT**
NAME OF THE STUDENT:	**CLASS & SEC:**	**ROLL NO.**

I. MULTIPLE CHOICE QUESTIONS (1 MARK)

1. If the half-cell reaction A + e−⟶ A−has a large negative reduction potential, it follows that
   (a) A is readily reduced
   (b) A is readily oxidised
   (c) A−is readily reduced
   (d) A−is readily oxidized

2. The cell reaction of this galvanic cell:
   $Cu(s) / Cu^{2+}(aq) // Hg^{2+}(aq) / Hg(l)$ is
   (a) $Hg + Cu^{2+} \longrightarrow Hg^{2+} + Cu$
   (b) $Hg + Cu^{2+} \longrightarrow Cu^{+} + Hg^{+}$
   (c) $Cu + Hg \longrightarrow CuHg$
   (d) $Cu + Hg^{2+} \longrightarrow Cu^{2+} + Hg$

3. The conductivity of a 0.1 N KCl solution at 23ºC is $0.012 ohm^{-1}cm^{-1}$ The resistance of cell containing the solution at the same temperature was found to be 55 ohms. The cell constant will be
   (a) $0.142 cm^{-1}$
   (b) $0.66 cm^{-1}$
   (c) $0.918 cm^{-1}$
   (d) $1.12 cm^{-1}$

4. If limiting molar conductivity of Ca^{2+} and Cl^{-} are 119.0 and 76.3 S cm^2 mol^{-1} then the value of limiting molar conductivity of $CaCl_2$ will be
   (a) 195.3 S cm^2 mol^{-1}
   (b) 271.6 S cm^2 mol^{-1}
   (c) 43.3 S cm^2 mol^{-1}
   (d) 314.3 S cm^2 mol^{-1}

5. A silver cup is plated with silver by passing 965 coulombs of electricity, the amount of silver deposited is (Atomic mass of Silver = 107.87 u)
   (a) 9.89 g
   (b) 107.87 g
   (c) 1.0787 g
   (d)1.002 g

6. The emf of the cell:
   Ni / Ni^{2+} (1.0 M) // Au^{3+} (1.0 M) / Au

(E° = -0.25 V for Ni^{2+}/Ni;
E° = 1.5 V for $Au^{3+/}$Au) is:
(a) 1.25 V
(b) -1.25 V
(c) 1.75 V
(d) 2.0 V

7. Which of the following expression is correct for 'Ka' in terms of Λ° and Λ, where 'C' is molarity.

(a) $K_a = \frac{C\Lambda_m^o}{\Lambda_m(\Lambda_m^o - \Lambda)}$

(b) $K_a = \frac{C\Lambda_m^2}{\Lambda_m^o(\Lambda_m^o - \Lambda_m)}$

(c) $K_a = \frac{C\Lambda_m^2}{\Lambda_m^o}$

(d) $K_a = \frac{C\Lambda_m^2}{(\Lambda_m^o - \Lambda_m)}$

8. The standard emf of a galvanic cell involving cell reaction with n = 2 is formed to be 0.295 V at 25° C. The equilibrium constant of the reaction would be
(a) 1.0×10^{10}
(b) 2.0×10^{11}
(c) 4.0×10^{12}
(d) 1.0×10^{2}
[Given F = 96500 (mol-1); R = 8.314 JK-1 mol-1]

9. $Ag^+(aq) + e^- \rightarrow Ag(s)$ E° = + 0.80 V
$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$ E° = – 0.44 V

What is the emf of $Fe(s) + 2Ag^+(aq) \rightarrow Fe^{2+}(aq) + 2Ag(s)$

(a) 1.16 V
(b) 1.24 V
(c) 2.04 V
(d) -1.16 V

10. Which of the following statements is not correct about an inert electrode in a cell?
(a) It does not participate in the cell reaction.
(b) It provides surface either for oxidation or for reduction reaction.
(c) It provides surface for conduction of electrons.
(d) It provides surface for redox reaction.

II. ASSERTION REASON TYPE QUESTIONS (I MARK)

For the following questions, two statements are given- one labelled *Assertion* (A) and theother

labelled *Reason* (R). Select the correct answer to these questions from the codes (i),(ii), (iii) and (iv) as given below

(i) Both A and R are true and R is the correct explanation of the assertion.
(ii) Both A and R are true but R is not the correct explanation of the assertion.
(iii)A is true but R is false.
(iv)A is false but R is true.

11. Assertion: 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: The SI units of resistivity is ohm metre (m).

12. Assertion: Galvanised iron does not rust.
Reason: Zinc has a more negative electrode potential than iron

13. Assertion: Electrolytic cell uses electrical energy to carry non-spontaneous chemical reactions.
Reason: Chemical energy of a spontaneous redox reaction can be converted into electrical energy.

III. 2 MARKS QUESTIONS

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Calculate ΔG° for the reaction

$$Zn\,(s) + Cu^{2+}\,(aq) \longrightarrow Zn^{2+}\,(aq) + Cu\,(s).$$

Given : E° for $Zn^{2+}/Zn = -0{\cdot}76$ V and

E° for $Cu^{2+}/Cu = +0{\cdot}34$ V

$R = 8{\cdot}314\ JK^{-1}\ mol^{-1}$

$F = 96500\ C\ mol^{-1}$.

15. Calculate the emf of the cell in which the following reaction takes place:
$Ni(s) + 2Ag^+_{(0.002\ M)} \rightarrow Ni^{2+}_{(0.160\ M)} + 2Ag(s)$.
Given that $E^0cell = 1.05$ V.
Log 4 = 0.6020

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(a) Out of the following pairs, predict with reason which pair will allow greater conduction of electricity :
(i) Silver wire at 30°C or silver wire at 60°C.
(ii) 0·1 M CH_3COOH solution or 1 M CH_3COOH solution.
(iii) KCl solution at 20°C or KCl solution at 50°C.

(b) Give two points of differences between electrochemical and electrolytic cells.

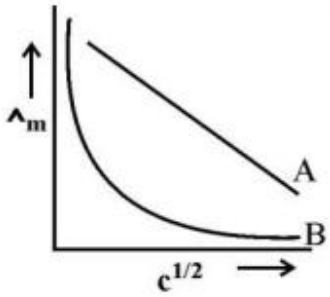
1V 3 MARKS QUESTIONS

17. How much charge is required for the following reductions?

(i) 1 mol of Al^{3+} to Al
(ii) 1 mol of Cu^{2+} to Cu
(iii) 1 mol of MnO_4^- to Mn^{2+}

18.

In the plot of molar conductivity ($\wedge_m$) 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 electrolytes A and B.

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

19. Write the cell reactions which occurs in lead storage battery when the battery is on charging mode.

V 5 MARKS QUESTIONS

20. (a) Give reason for the following:
(i) Rusting of iron is quicker in saline water than in ordinary water.
(ii) Aluminium metal cannot be produced by the electrolysis of aq solution of Aluminium salt.
(b) State two advantage of H_2-O_2 fuel cell over ordinary cell.

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E°_{cell} for the given redox reaction is 2.71 V

$$Mg_{(s)} + Cu^{2+}_{(0.01\ M)} \longrightarrow Mg^{2+}_{(0.001\ M)} + Cu_{(s)}$$

Calculate E_{cell} for the reaction. Write the direction of flow of current when an external opposite potential applied is

(i) less than 2.71 V and

(ii) greater than 2.71 V

22. (i) Calculate the potential of hydrogen electrode in contact with a solution whose Ph is 10.

(ii) State Faraday's laws of electrolysis. How much charge in terms of Faraday is required for reduction of 1 mol of $Cr_2O_7^{2-}$ to Cr^{3+}?

VI PASSAGE BASED /CASE STUDY BASED QUESTIONS

23. All chemical reactions involve interaction of atoms and molecules. A large number of atoms/molecules are present in a few grams of any chemical compound varying with their atomic/molecular masses. To handle such large number conveniently, the mole concept was introduced. All electrochemical cell reactions are also based on mole concept. For example, a 4.0 molar aqueous solution of NaCl is prepared and 500 mL of this solution is electrolysed. This leads to the evolution of chlorine gas at one of the electrodes. The amount of products formed can be calculated by using mole concept.

The following questions are multiple choice questions. Choose the most appropriate answer:

(i) The total number of moles of chlorine gas evolved is
(a) 0.5
(b) 2
(c) 1
(d) 1.9

(ii) The total charge (coulomb) required for complete electrolysis is
(a) 186000
(b) 24125
(c) 48296
(d) 193000

(iii) In the electrolytes, the number of moles of electrons involved are
(a) 2
(b) 1
(c) 3
(d) 4

(iv) In electrolysis of aqueous NaCl solution when Pt electrode is taken, then which gas is liberated at cathode?
(a) H_2 gas
(b) Cl_2 gas
(c) O_2 gas
(d) None of these

Q. No.	ANSWERS
1.	(b)
2.	(d)
3.	(b)
4.	(b)
5.	(c)
6.	(c)
7.	(b)
8.	(a)
9.	(b)
10.	(d)
11.	(ii)
12.	(i)
13.	(ii)
14.	$E^0cell = E^o_C - E^o_A$ $= 0.34 - (-0.76)$ $= 1.10V$ $\Delta G^o = -nFE^o$ $= -2 \times 1.10 \times 96500$ $= -212300$ J/mol or -212.3 kJ/mol
15.	By using Nernst equation $E^-_{Cell} - \frac{0.059}{2}\log\frac{[Ni^{2+}]}{[Ag^+]^2}$ $= 1.05 - \frac{0.059}{2}\log\frac{[0.160]}{[0.002]^2}$ $= 1.05 - 0.02955\log\frac{0.160}{0.000004}$ = 1.05 - 0.02955 (4 + 0.6021) = 0.914 V

16.

(a) (i) Silver wire at 30°C because as temperature decreases, resistance decreases so conduction increases.

(ii) 0.1 M CH_3COOH, because on dilution degree of ionization increases hence conduction increases.

(iii) KCl solution at 50°C, because at high temperature mobility of ions increases and hence conductance increases

(b)

Electrochemical	Electrolytic
(1) Anode -ve Cathode +ve	Anode +ve Cathode -ve
(2) Convert chemical Energy to electrical energy	Convert electrical Energy to chemical energy

17.

$Al^{3+} + 3e^- \rightarrow Al$

The reduction will require 3 Faraday of electricity or $3 \times 96500 = 2.895 \times 10^5$C.

$Cu^{2+} + 2e^- \rightarrow Cu$

The reduction will require 2 Faraday of electricity or $2 \times 96500 = 1.93 \times 10^5$C.

$MnO_4^- + 5e^- \rightarrow Mn^{2+}$

The reduction will require 5 Faraday of electricity or $5 \times 96500 = 4.825 \times 10^5$C.

18.

i)A- strong electrolyte , B-Weak electrolyte

ii)Λ^0_m for weak electrolytes cannot be obtained by extrapolation while Λ^0_m for strong electrolytes can be obtained as intercept.

19.

$$2PbSO_4(s) + 2H_2O \rightarrow Pb(s) + PbO_2(s) + 4H^+ + SO_4^{2-}$$

20.

(a)

(i) The $Na^{\oplus}$ and $Cl^{\ominus}$ present in saline water increase the conductance of the solution in contact with the metal surface.This accelerates the formation of Fe^{2+} ions and hence that of rust, $Fe_2O_3 \cdot xH_2O$

(ii) Aluminium cannot be produced by the electrolysis of an aluminium salt dissolved in water because of the high reactivity of aluminium with the protons of water and the subsequent formation of hydrogen.

(b) The advantage of water fuel cell over ordinary cell is, (i) It has high-efficiency and eco-friendly. (ii) The H_2O produced can be used by astronauts for drinking purposes.

21.	$= E^{o}_{cell} - \frac{0.059}{2} \log \frac{10^{-3}}{10^{-2}}$ $= 2.71 + 0.0295$ $E_{cell} = 2.7395\ V$ i)Cu to Mg / Cathode to anode / Same direction ii)Mg to Cu / Anode to cathode / Opposite direction
22.	(i) Ecell=E^0−0.0591log[H2]/[H+] pH=10 pH=−log[H+] $[H^+] = 10^{-10}M$ E=0 Ecell=E^0−0.0591log[H2]/[H+] E cell=E0−0.0591log10^{-10}=−0.591V (ii) (i) Faraday's law states that the number of moles of substance produced at an electrode during electrolysis is directly proportional to the number of moles of electrons transferred at that electrode. (ii) Faraday's second law of electrolysis states that if the same amount of electricity is passed through different electrolytes, the masses of ions deposited at the electrodes are directly proportional to their chemical equivalents. $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$ 6x96500 = 579000C
23.	(i) c (ii) d (iii) a (iv) a

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