# INDIAN SCHOOL AL WADI AL KABIR

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| **Class: XII** | **DEPARTMENT: SCIENCE (2020-21)**<br>**SUBJECT: CHEMISTRY** | **Date of completion:**<br>**III week of September, 2020** |
| **Worksheet No:08 with answers** | **TOPIC: ELECTROCHEMISTRY** | **Note:**<br>**A4 FILE FORMAT** |

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| **NAME OF THE STUDENT** | **CLASS & SEC:** | **ROLL NO.** |

## MULTIPLE CHOICE QUESTIONS

**1.** The SI units of conductivity is

a) $Sm^1$ b) $Sm^2$ c) $Sm^{-1}$ d) $Sm^{-2}$

**2.** How is conductivity related to concentration of solution?

a) Conductivity always decreases with decrease in concentration
b) Conductivity always increases with decrease in concentration
c) Conductivity first decreases with decrease in concentration and then increases.
d) None of these.

**3.** The difference between the electrode potentials of two electrodes when no current is drawn through the cell is called __________

a) Cell potential
b) Cell emf
c) Potential difference
d) Cell voltage

**4.** Electrode potential of SHE is …………

a) 100 V
b) 10 V
c) 1 V
d) 0 V

**5.** A negative $E^{\circ}$ means that the redox couple is a ……………. than the $H^+/H_2$ couple.

a) weaker reducing agent
b) stronger reducing agent
c) stronger oxidising agent
d) None of these

**6.** The quantity of charge required to obtain one mole of Barium from $BaCl_2$ is ……….

a) 1 F
b) 2 F
c) 3 F
d) 4 F

**7.** The cell constant of a conductivity cell …………….

a) changes with change of electrolyte.
b) changes with change of concentration of electrolyte.
c) changes with temperature of electrolyte.
d) remains constant for a cell.

**8.** Identify the wrong statement from the following

a) The electronic conductance of metals depends on the nature and structure of the metal.
b) The electronic conductance of metals decreases with increase of temperature
c) The conductivity of electrolytic solutions depends on size of the ions produced and their salvation.
d) The conductivity of electrolytic solutions decreases with the increase of temperature

**9.** Identify the electrode used in SHE.

a) Pt
b) Zn
c) Cu
d) Mg

**10.** In the cell, Mg | $Mg^{2+}$(0.130M) || $Ag^{+}$(0.0001M) | Ag

Calculate its $E_{(cell)}$ if $E^{o}_{(cell)}$ = 3.17 V.

a) 3.17 V
b) 3.38 V
c) 2.96 V
d) 2.38 V

## Read the given passage and answer the questions that follow:

Molar conductivity increases with decrease in concentration. This is because the total volume, *V*, of solution containing one mole of electrolyte also increases. It has been found that decrease in κ on dilution of a solution is more than compensated by increase in its volume. Physically, it means that at a given concentration, $\Lambda_m$ can be defined as the conductance of the electrolytic solution kept between the electrodes of a conductivity cell at unit distance but having area of cross section large enough to accommodate sufficient volume of solution that contains one mole of the electrolyte.

**11.** Define conductivity of a solution.

**12.** Conductivity always decreases with decrease in concentration. Why?

**13.** What do you mean by limiting molar conductivity?

**14.** State Kohlrausch law of independent migration of ions.

**15.** What is the relationship between degree of dissociation, molar conductivity and limiting molar conductivity?

## Question – Answer Type:

**16.** How does molar conductivity vary with concentration of solution? **1**

**17.** What are the products obtained when molten NaCl undergoes electrolysis? **1**

**18.** Represent the cell in which the following reaction takes place: **1**

$$Zn(s) + 2Ag^{+}(aq) \longrightarrow Zn^{2+}(aq) + 2Ag(s)$$

**19.** Write any two factors affecting the electronic conductance of metals. **1**

**20.** Give the equation connecting cell constant and conductivity. **1**

**21.** Explain the setup of standard hydrogen electrode. **2**

**22.** Give reasons: **2**

(i) On the basis of $E^{o}$ values, $O_2$ gas should be liberated at anode but it is $Cl_2$ gas which is liberated in the electrolysis of aqueous NaCl.

(ii) Conductivity of $CH_3COOH$ decreases on dilution.

**23.** Equilibrium constant ($K_c$) for the given cell reaction is 10. Calculate $E^{o}_{cell}$. **2**

$$A(s) + B^{2+}(aq) \rightleftharpoons A^{2+}(aq) + B(s)$$

**24.** Solutions of two electrolytes 'A' and 'B' are diluted. The limiting molar conductivity of 'B' increases to a smaller extent while that of 'A' increases to a much larger extent comparatively. Which of the two is a strong electrolyte? Justify your answer. **2**

**25.** 0.1 M KCl solution offered a resistance of 100 ohms in a conductivity cell at 298 K. If the cell constant of the cell is 1.29 $cm^{-1}$, calculate the molar conductivity of KCl solution. **2**

**26.** Calculate $\Delta G^\circ$ and log $K_c$ for the following reaction at 298 K : **3**

$$2Cr(s) + 3Fe^{2+}(aq) \longrightarrow 2Cr^{3+}(aq) + 3Fe(s)$$

Given : $E^\circ_{cell} = 0.30$ V

**27.** The conductivity of 0.001 mol $L^{-1}$ solution of $CH_3COOH$ is $3.905 \times 10^{-5}$ S $cm^{-1}$. Calculate its molar conductivity and degree of dissociation ($\alpha$). **3**

Given : $\lambda^\circ (H^+) = 349.6$ S $cm^2$ $mol^{-1}$ and $\lambda^\circ (CH_3COO^-) = 40.9$ S $cm^2$ $mol^{-1}$.

**28.** Calculate the emf of the following cell at 298 K : **3**

$$Mg(s)|Mg^{2+}(0.1\ M)||Cu^{2+}(1.0 \times 10^{-3}\ M)|Cu(s)$$

[Given = $E^\circ_{cell} = 2.71$ V]

**29.** The conductivity of 0·001 mol $L^{-1}$ solution of $CH_3COOH$ is $4{\cdot}95 \times 10^{-5}$ S $cm^{-1}$. Calculate its molar conductivity and degree of dissociation ($\alpha$). **3**

[Given : $\lambda^0_{H^+}$ = 349·6 S $cm^2$ $mol^{-1}$ and

$\lambda^0_{CH_3COO^-}$ = 40·9 S $cm^2$ $mol^{-1}$]

**30.** The e.m.f. of the following cell at 298 K is 0.1745 V **3**

Fe (s) / $Fe^{2+}$ (0.1 M) // $H^+$ (x M)/ $H_2$ (g) (1 bar)/ Pt (s)

Given : $E^0_{Fe^{2+}/Fe} = -0.44V$

Calculate the pH of the solution at the electrode where hydrogen is being produced.

# ANSWERS

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| **1.** | c |
| **2.** | a |
| **3.** | b |
| **4.** | d |
| **5.** | b |
| **6.** | b |
| **7.** | d |
| **8.** | d |
| **9.** | a |
| **10.** | c |
| **11.** | The conductivity of a solution at any given concentration is the conductance of one unit volume of solution kept between two platinum electrodes with unit area of cross section and at a distance of unit length. |
| **12.** | The number of ions per unit volume that carry the current in a solution decreases on dilution. |
| **13.** | Molar conductivity at infinite dilution is called limiting molar conductivity. |
| **14.** | Limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte. |
| **15.** | $\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$ |
| **16.** | Molar conductivity increases with decrease in concentration |
| **17.** | Sodium metal and $Cl_2$ gas. |
| **18.** | $Zn(s) \mid Zn^{2+}(aq) \parallel Ag^{+}(aq) \mid Ag(s)$ |
| **19.** | (i) the nature and structure of the metal<br>(ii) the number of valence electrons per atom<br>(iii) temperature (it decreases with increase of temperature). |
| **20.** | $G^* = \frac{l}{A} = R\ \kappa$ |
| **21.** | The standard hydrogen electrode consists of a platinum electrode coated with platinum black. The electrode is dipped in an acidic solution and pure hydrogen gas is bubbled through it. The concentration of both the reduced and oxidised forms of hydrogen is maintained at unity. It is assigned a zero potential. |

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| **22.** | (i) Due to over potential of $O_2$<br>(ii) The number of ions per unit volume decreases. |
| **23.** | $\log Kc = \frac{nE^0 cell}{0.059}$<br>$\log Kc = \frac{2xE^0 cell}{0.059}$<br>$\log 10 = \frac{2xE^0 cell}{0.059}$<br>$E^0_{cell} = \frac{0.059}{2} = 0.0295\ V$ |
| **24.** | Electrolyte B is a strong electrolyte.<br>Limiting molar conductivity increases only to a smaller extent for a strong electrolyte, as on dilution the interionic interactions are overcome.<br>Limiting molar conductivity increases to a larger extent for a weak electrolyte, as on dilution the degree of dissociation increases, therefore the number of ions in total volume of solution increases. |
| **25.** | $G^* = \kappa R$<br>$\kappa = \frac{1.29}{100} = 0.0129\ S\,cm^{-1}$<br>$\Lambda_m = \frac{1000\ \kappa}{C}$<br>$\Lambda_m = \frac{1000\ x\ 0.0129}{0.1}$<br>$\Lambda_m = 129\ S\,cm^2\,mol^{-1}$ |
| **26.** | Given $E^o_{Cell} = +\ 0.30V$ ; $F = 96500C\ mol^{-1}$<br>$n = 6$ (from the given reaction)<br>$\Delta_r G^O = -\ n\ x\ F\ x\ E^o_{Cell}$<br>$\Delta_r G^O = -\ 6\ x\ 96500\ C\ mol^{-1}\ x\ 0.30V$<br>$= -\ 173{,}700\ J\ /\ mol$ or $-\ 173.7\ kJ\ /\ mol$<br>$\log Kc = \frac{n\ E^o_{Cell}}{0.059}$<br>$\log Kc = \frac{6\ x\ 0.30}{0.059}$<br>$\log Kc = 30.5$ |

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| **27.** | $\Lambda_m = \frac{\kappa}{c}$ <br> $= \frac{3.905 \times 10^{-5}\ S\ cm^{-1}}{0.001 mol\ L^{-1}} \times \frac{1000 cm^3}{L}$ <br> $\mathbf{\Lambda_m = 39.05\ Scm^2mol^{-1}}$ <br> $\Lambda_o = \lambda^o(H^+) + \lambda^o(CH_3COO^-)$ <br> $= (349.6 + 40.9)\ Scm^2mol^{-1}$ <br> $\Lambda_o = 390.5\ Scm^2mol^{-1}$ <br> $\alpha = \frac{\Lambda_m}{\Lambda_o}$ <br> $= \frac{39.05\ Scm^2mol^{-1}}{390.5\ Scm^2mol^{-1}}$ <br> $\mathbf{\alpha = 0.1}$ |
| **28.** | $E_{cell} = E^o_{cell} - \frac{0.059}{n} \log \frac{[Mg2+]}{[Cu2+]}$ <br> $= 2.71\ V - \frac{0.059}{2} \log \frac{0.1}{0.001}$ <br> $= 2.71\ V - \frac{0.059}{2} \log 10^2$ <br> $= 2.651\ V$ |
| **29.** | $\Lambda^c{}_m = \kappa \times 1000/M$ <br> $= 4.95 \times 10^{-5} \times 1000/ 0.001$ <br> $= 49.5\ S\ cm^2/mol$ <br> $CH_3COOH \rightarrow CH_3COO^- + H^+$ <br> $\Lambda^0\ CH_3COOH = \lambda^0\ CH_3COO- + \lambda^0\ H^+$ <br> $= 40.9 + 349.6$ <br> $\Lambda^0\ CH_3COOH = 390.5\ S\ cm^2/mol$ <br> $\alpha = \frac{\Lambda_m}{\Lambda^0_m}$ <br> $= 49.5/ 390.5$ <br> $= 0.127$ |

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| **30.** | $Fe + 2H^+ \rightarrow H_2 + Fe^{2+}$<br>$E_{cell} = E^0_{cell} - \frac{2.303RT}{nF} \log \frac{Fe^{2+}}{[H^+]^2}$<br>$E^0_{cell} = E^0_{H^+/H_2} - E^0_{Fe^{2+}/Fe}$<br>$= 0-(-0.44) = 0.44V$<br>$0.1745 = 0.44 - \frac{0.0591}{2} \log \frac{[0.1]}{[x]^2}$<br>Log x = -5<br>Log[$H^+$] = -5<br>pH = 5 |

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