Sample Question Paper - 25
Chemistry (043)
Class- XII, Session: 2021-22
TERM II

Time allowed : 2 hours **Maximum marks : 35**

General Instructions :

Read the following instructions carefully.

1. *There are 12 questions in this question paper with internal choice.*
2. *SECTION A - Q. No. 1 to 3 are very short answer questions carrying 2 marks each.*
3. *SECTION B - Q. No. 4 to 11 are short answer questions carrying 3 marks each.*
4. *SECTION C - Q. No. 12 is case based question carrying 5 marks.*
5. *All questions are compulsory.*
6. *Use of log tables and calculators is not allowed.*

Section - A

1. Give IUPAC name of (any 2): **[2]**

(a) Succinic acid

(b) Oxalic acid

(c) Glutaric acid

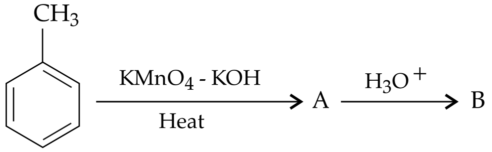
2. In a galvanic cell, the following cell reaction occurs: **[2]**

$Zn(s) + 2Ag^+(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$; $E°cell = +1.56V$

(a) Is the direction of flow of electrons from zinc to silver or silver to zinc?

(b) How will concentration of Zn^{2+} ions and Ag^+ ions be affected when the cell functions?

3. Identify A and B and explain the given chemical reaction. **[2]**



Section - B

4. **(a)** What are colloids? **[1+2]**

(b) Explain lyophobic and lyophilic colloids.

5. **(a)** Explain the trend of ionization enthalpy in first row of transition metals. **[1+2]**

(b) Why Lanthanoids cannot be separated easily?

6. **(a)** A study of reaction A + B → P, gave the following data of chemical kinetics at 298 K. **[2+1]**

Experiment	[A]	[B]	r_f
1	1.0	0.15	4.20×10^{-6}
2	2.0	0.15	8.40×10^{-6}
3	1.0	0.20	5.60×10^{-6}

Calculate the following:

(i) Order of the reaction

(ii) Rate constant of the reaction

(b) Explain why H_2 and O_2 do not react at room temperature.

7. **(a)** Explain the intermolecular association in primary, secondary and tertiary amines. **[2+1]**

(b) Write an isomer of C_3H_9N which gives foul smell of isocyanide when treated with chloroform and ethanolic NaOH.

OR

Give reasons:

(a) Aniline does not undergo Friedel-Crafts reaction.

(b) $(CH_3)_2$ NH is more basic than $(CH_3)_3$ N in an aqueous solution.

(c) Primary amines have higher boiling point than tertiary amines. **[1×3=3]**

8. The magnetic moment of few transition metal ions are given below: **[1×3=3]**

Metal ion	Magnetic moment (BM)
Sc^{3+}	0.00
Cr^{2+}	4.90
Ni^{2+}	2.84
Ti^{3+}	1.73

(Atomic no. Sc = 21, Ti = 22, Cr = 24, Ni = 28)

Which of the given metal ions:

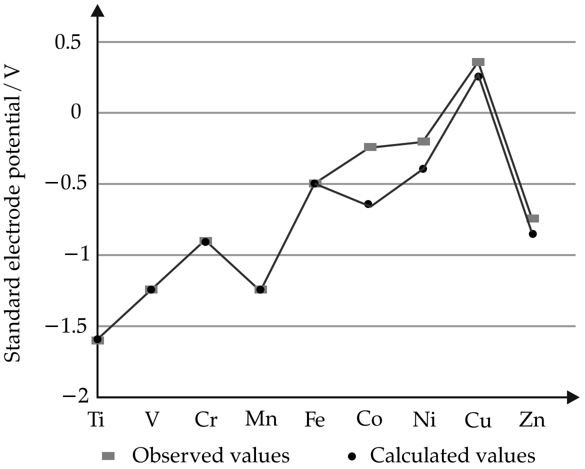
(a) has the maximum number of unpaired electrons?

(b) gives colourless aqueous solution?

(c) exhibits the most stable +3 oxidation state?

OR

Observed and calculated values for the standard electrode potentials of elements from Ti to Zn in the first reactivity series are depicted in figure (1): **[1×3=3]**



Explain the following observations:

(a) The general trend towards less negative E° values across the series.

(b) The unique behaviour of Copper.

(c) More negative E° values of Mn and Zn.

9. Explain on the basis of Valence bond theory that $[Ni(CN)_4]^{2-}$ ion with square planar structure is diamagnetic and $[NiCl_4]^{2-}$ ion with tetrahedral geometry is paramagnetic. **[3]** AI

OR

(a) What type of isomerism is shown by the complex $[Co(NH_3)_5 (SCN)]^{2+}$? **[1×3=3]**

(b) Why is $[NiCl_4]^{2-}$ paramagnetic while $[Ni(CN)_4]^{2-}$ is diamagnetic ? (Atomic number of Ni = 28)

(c) Why are low spin tetrahedral complexes rarely observed ?

10. Compound 'A' was prepared by oxidation of compound 'B' with alkaline $KMnO_4$. Compound 'A' on reduction with lithium aluminium hydride gets converted back to compound 'B'. When compound 'A' is heated with compound 'B' in the presence of H_2SO_4 it produces fruity smell of compound 'C' to which family the compounds 'A', 'B' and 'C' belong to? **[3]**

11. **(a)** Write the structures of different isomeric amines corresponding to the molecular formula, $C_4H_{11}N$ and their IUPAC names. **[2+1]**

(b) What type of isomerism is exhibited by different types of amines in the above question?

OR

(a) Write the reactions involved in the following: **[2+1]** AI

- **(i)** Hoffmann bromamide degradation reaction
- **(ii)** Gabriel phthalimide synthesis

(b) Give reason:

$(CH_3)_2NH$ is more basic than $(CH_3)_3N$ in an aqueous solution. AI

Section - C

12. Read the passage given below and answer the questions that follow.

The cell constant is usually determined by measuring the resistance of the cell containing a solution whose conductivity is already known. For this purpose, we generally use KCl solutions whose conductivity is known accurately at various concentrations and at different temperatures. Consider the resistance of a conductivity cell filled with 0.1 M KCl solution is 200 W. If the resistance of the same cell when filled with 0.02 M KCl solution is 420 W. (Conductivity of 0.1 M KCl solution is 1.29 S m^{-1}.)

(a) What is the conductivity of 0.02M KCl solution?

(b) What will happen to the conductivity of cell with the dilution?

(c) What is the nature of cell constant of a conductivity cell?

(d) What are the factors on which conductivity depends?

OR

Why does the conductivity of solution of different electrolytes in the same solute at a given temperature differ? Also, write the SI unit for conductivity of a solution. **[1+1+1+2]**

❑❑❑

Solution

CHEMISTRY - 043

Class 12 - Chemistry

Section - A

1. **(a)** IUPAC name of succinic acid is Butane-1, 4-dioic acid. **[1]**

(b) IUPAC name of oxalic acid is Ethane-1, 2-dioic acid. **[1]**

(c) IUPAC name of glutaric acid is Pentane-1, 5-dioic acid. **[1]**

Commonly Made Error

- While naming the compounds, students don't mention the exact position of functional group in carbon chain.

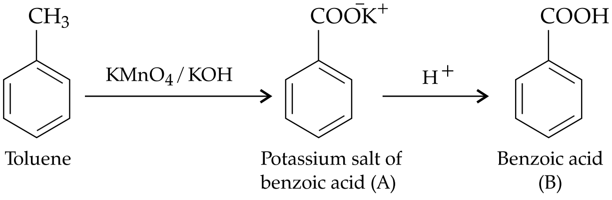
Answering Tip

- Students must practice the IUPAC name of different compounds applying proper nomenclature rules.

2. **(a)** Oxidation : $Zn(s) \rightarrow Zn^{+2}(aq) + 2e^-$
Reduction : $2Ag^+_{(eq)} + 2e^- \rightarrow Ag(s)$
Thus, electron flow from zinc to silver **[1]**

(b) Concentration of Zn^{2+} ions will increase and Ag^+ ions will decrease because zinc is being oxidised to zinc ion and silver ion is being reduced to silver. **[1]**

3. A is Potassium salt of benzoic acid and B is benzoic acid. **[2]**



Section - B

4. **(a)** A colloid is an intermediate mixture between a homogeneous mixture known as a solution and the heterogeneous suspension. There are different types of colloids based in the state and interaction between the dispersed phase and dispersion medium. The three main types of colloids are: **[1]**

- Sol – solid in liquid
- Gel – liquid in liquid
- Emulsion – liquid in liquid

(b) Based on the interaction between the dispersion medium and dispersed phase, sols are classified into two types:

- **Lyophilic colloids or lyophilic sols (solvent-loving):** In case of water as a dispersion medium, they are known as hydrophilic.
  They are easy to prepare just by mixing, shaking or heating substance with the dispersion medium.
- **Lyophobic colloids or lyophobic sols (solvent-hating):** When water is a dispersion medium, they are known as hydrophobic.
  They require special methods to prepare and an electrolyte for stabilization. **[2]**

5. **(a)** Ionization enthalpy is the energy required to remove the most loosely bound electron from the isolated gaseous atoms to produce a cation. Ionization enthalpy of transition elements tend to increase from left to right in the periodic table as there is an increase in nuclear charge which accompanies the filling in the inner *d* orbitals. However, there are some exceptions, for example, Titanium (Z = 22) has first ionization enthalpy of 656 kJ/mol whereas Vanadium (Z = 23) has first ionization enthalpy of 652 kJ/mol. **[2]**

(b) Due to lanthanoid contraction, the change in the atomic or ionic radii of these elements is very small. So, their chemical properties are similar. Hence, lanthanoids cannot be easily separated. **[1]**

6. (a) From the experimental data,

Rate law expression,

$$R = k[A]^m[B]^n$$

$$4.20 \times 10^{-6} = k[1.0]^m[0.15]^n \quad ...(i)$$

$$8.40 \times 10^{-6} = k[2.0]^m[0.15]^n \quad ...(ii)$$

$$5.60 \times 10^{-6} = k[1.0]^m[0.20]^n \quad ...(iii)$$

Dividing (ii) by (i), we get

$$\frac{8.40 \times 10^{-6}}{4.20 \times 10^{-6}} = \frac{k[2.0]^m[0.15]^n}{k[1.0]^m[0.15]^n}$$

$$\Rightarrow \quad 2 = 2^m$$

$$\Rightarrow \quad m = 1$$

Similarly, dividing (iii) by (i), we get

$$\frac{5.6 \times 10^{-6}}{4.2 \times 10^{-6}} = \frac{k(1.0)^m(0.20)^n}{k(1.0)^m(0.15)^n}$$

$$\Rightarrow \quad \frac{4}{3} = \left(\frac{4}{3}\right)^n$$

$$\Rightarrow \quad n = 1$$

(i) Order of the reaction,

$$m + n = 1 + 1 = 2$$

(ii) From equation (i) we get,

$$4.20 \times 10^{-6} = k(1)^1(0.15)^1$$

$$\Rightarrow \quad \frac{4.2 \times 10^{-6}}{0.15} = k$$

$$k = 8.07 \times 10^{-6} \text{ units}$$

(b) Due to high activation energy of the reaction between O_2 and H_2. **[1]**

7. (a) Primary and secondary amines are often engaged in the intermolecular association as a result of hydrogen bonding between the nitrogen of one and hydrogen of the other molecule.

The intermolecular association is more prominent in case of primary amines as compared to secondary due to the availability of two hydrogen atoms.

In tertiary amines, there is no intermolecular association due to the absence of free hydrogen atom for bonding. **[2]**

(b) Isomer of C_3H_9N is $\underset{\text{Propan-1-amine}}{CH_3CH_2CH_2NH_2}$,

gives foul smell of isocyanides (because primary amine gives carbylamine reaction.) **[1]**

$$\underset{\text{Propanamine}}{CH_3CH_2CH_2NH_2} + CHCl_3 \xrightarrow{\text{alc. KOH}}$$

$$\underset{\text{Propyl isocyanide}}{CH_3CH_2CH_2-N \overset{\rightarrow}{\equiv} C} + 3KCl + 3H_2O$$

OR

(a) Aniline is a Lewis base while $AlCl_3$ is lewis acid. They combine to form a salt. **1**

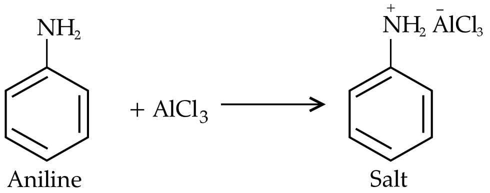
(b) Due to combined +I and solvation effects. **1**

(c) Due to presence of H-bonding in primary amines. **1**

[CBSE Marking Scheme, 2016]

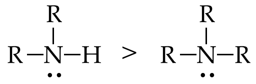
Detailed Answer:

(a) Friedel Crafts reaction is carried out in the presence of $AlCl_3$. But $AlCl_3$ is used as a catalyst and is acidic in nature whereas aniline is a strong base. Thus, aniline reacts with $AlCl_3$ to form a salt.



Due to the positive charge on the N—atom, electrophilic substitution in the benzene ring is deactivated. Hence, aniline does not undergo Friedel—Crafts reaction. **[1]**

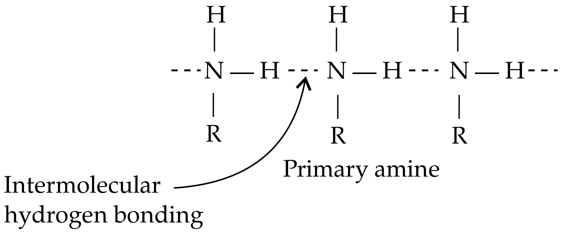
(b) $(CH_3)_2$ NH is more basic than $(CH_3)_3N$ in an aqueous solution. +I effect will increase due to alkyl group that results in increasing the donation of lone pair of electron. Amine accepts a proton and from cation which will be stabilised in water by solvation. But greater the size of ion, lower will be the solvation in aqueous solution. Higher the solvation by hydrogen bonding, higher will be the basic strength.



$$R-\overset{\overset{R}{|}}{\underset{\cdot\cdot}{N}}-H > R-\overset{\overset{R}{|}}{\underset{\cdot\cdot}{N}}-R$$

Therefore, with increase in methyl group, hydrogen bonding and stabilisation by solvation decreases. This net effect results in decreases of basic strength from secondary to tertiary amine. **[1]**

(c) In tertiary amines, there are no H-atoms whereas, in primary amines, two H-atoms are present. Due to the presence of H-atoms, primary amines undergo extensive intermolecular H-bonding.



As a result, extra energy is required to separate the molecules of primary amine. Therefore, primary amines have higher boiling point than tertiary amines. **[1]**

8. **(a)** Magnetic moment, $\mu = \sqrt{n(n+2)}$

Where, n = No. of unpaired electrons

Higher the magnetic moment, higher will be the number of unpaired electrons.

$\mu_{Cr^{+3}} = 4.9$ BM

Hence, Cr^{+3} has maximum number of unpaired electrons. **[1]**

(b) Colour in aqueous solution is due to partially filled $(n-1)d$-orbitals *i.e.,* presence of unparied electrons. So, except Sc^{+3} (μ = 0.00 BM) rest are coloured in aqueous solution. Because, μ = 0 BM shows, unavailability of unpaired electrons. **[1]**

(c) Sc^{3+} has stable +3 oxidation state because electronic configuration of $Sc^{+3}(3d^{\circ}45^{\circ})$ aquires stable noble gas configuration. Rest all have incomplete octet such as:

Cr^{+2} : [Ar] $3d^4 4s^0$ **[1]**

Ni^{+2} : [Ar] $3d^8 4s^0$

Ti^{+3} : [Ar] $3d^1 4s^0$

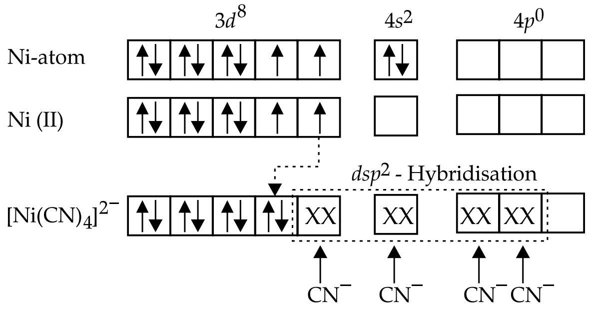
OR

(a) The general trend towards less negative E° values across the series is related to the general increase in the sum of the first and second ionization enthalpies. **[1]**

(b) Copper is the only d-block element which has positive reduction potential, thus require high enthalpy to convert Cu to Cu^{+2}. The high energy to transform Cu(s) to Cu^{2+} (aq) is not balanced by its hydration enthalpy. **[1]**

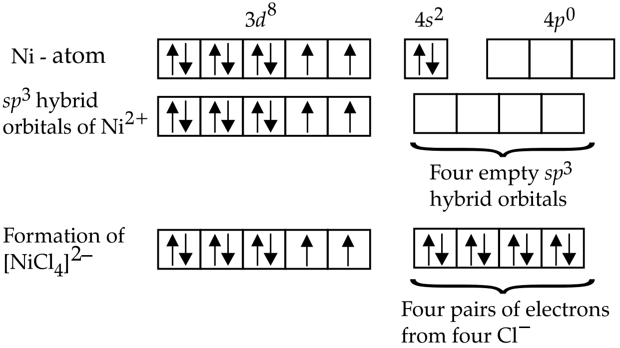
(c) The stability of the half-filled d sub-shell in Mn^{2+} and the completely filled d^{10} configuration in Zn^{2+} are related to their more negative E° values. **[1]**

9.



Ni^{+2} has d^8 configuration. In presence of 4 CN^- ions, it can either have square planar or tetrahedral geometry. Since, CN^- is strong ligand, it causes pairing of unpaired $3d$ electron.

Hence, Ni in $[Ni(CN_4)]^{2-}$ undergoes dsp^2 hybridization. Since, all electrons are paired, it is diamagnetic.



While in case of $[Ni(Cl_4)]^{-2}$, Cl^- is weak ligand. In presence of weak ligand, it doesn't lead to pairing of unpaired $3d$ electrons. Since, there are 2 unpaired electrons left in $3d$ which are not paired, $[Ni(Cl_4)]^{-2}$ is paramagnetic. Hence, it undergoes sp^3 hybridization. **[3]**

OR

(a) Linkage isomerism. **[1]**

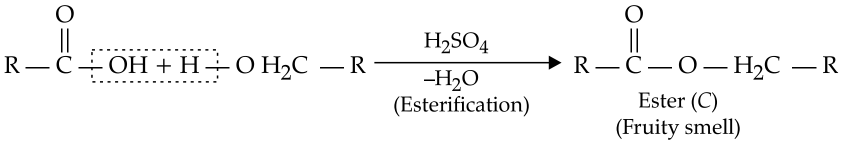
(b) In $[NiCl_4]^{2-}$, due to the presence of Cl^- (a weak field ligand) no pairing occurs whereas, in $[Ni(CN)_4]^{2-}$, CN^- is a strong field ligand and pairing takes place. **[1]**

(c) Because of very low CFSE which is not able to pair up the electrons. **[1]**

10. 'A' is carboxylic acid (R – COOH), 'B' is an alcohol (R – CH_2OH) and 'C' is an ester (RCH_2 – COOR).

$$R - CH_2OH \xrightarrow{\text{Oxidation } (KMnO_4)} R - COOH$$ **[1]**

$$\text{Alcohol } (B) \xleftarrow{LiAlH_4\text{, reduction}} \text{Carboxylic acid } (A)$$ **[1]**



$$R - \overset{\overset{\displaystyle O}{\|}}{C} - OH + H - O\,H_2C - R \xrightarrow[-H_2O]{H_2SO_4} R - \overset{\overset{\displaystyle O}{\|}}{C} - O - H_2C - R$$ **[1]**

(Esterification)

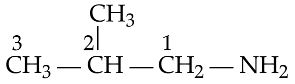
Ester (C)
(Fruity smell)

11. **(a)** The isomers of $C_4H_{11}N$ are:

(i) $\overset{4}{CH_3}-\overset{3}{CH_2}-\overset{2}{CH_2}-\overset{1}{CH_2}-NH_2$

Butan-1-amine
(Primary amine)

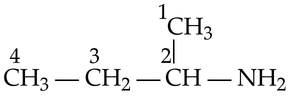
(ii)



$\overset{3}{CH_3}-\overset{\overset{CH_3}{2|}}{CH}-\overset{1}{CH_2}-NH_2$

2-Methylpropan-1-amine
(Primary amine)

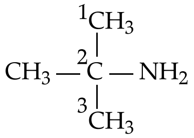
(iii)



$\overset{4}{CH_3}-\overset{3}{CH_2}-\overset{\overset{^1CH_3}{2|}}{CH}-NH_2$

Butan-2-amine
(Primary amine)

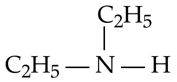
(iv)



$CH_3-\underset{\underset{^3CH_3}{|}}{\overset{\overset{^1CH_3}{|}}{^2C}}-NH_2$

2-Methylpropan-2-amine
(Primary amine)

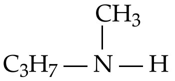
(v)



$C_2H_5-\overset{\overset{C_2H_5}{|}}{N}-H$

N-Ethylethanamine
(Secondary amine)

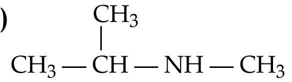
(vi)



$C_3H_7-\overset{\overset{CH_3}{|}}{N}-H$

N-Methypropan-1-amine
(Secondary amine)

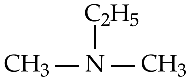
(vii)



$CH_3-\overset{\overset{CH_3}{|}}{CH}-NH-CH_3$

N-Methypropan-1-amine
(Secondary amine)

(viii)



$CH_3-\overset{\overset{C_2H_5}{|}}{N}-CH_3$

N,N-Dimethylethanamine
(Tertiary amine) **[2]**

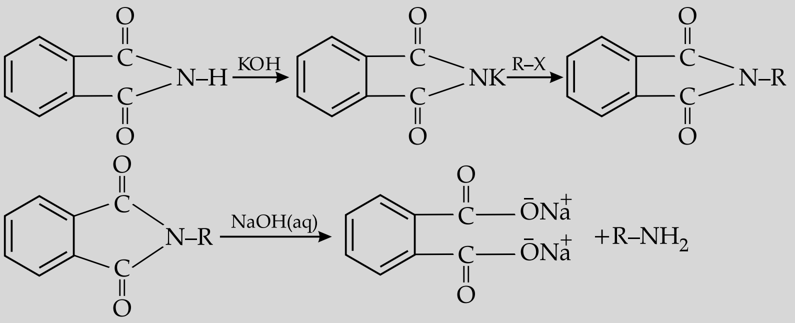
(b) Isomerism exhibited by different amines:

- **Chain isomers:** (i) and (ii); (iii) and (iv); (i) and (iv)
- **Position isomers:** (ii) and (iii); (ii) and (iv)
- **Metamers:** (v) and (vi); (vii) and (viii)
- **Functional isomers:** All the three types of amines are the functional isomers of each other. **[1]**

OR

(a) **(i)** $Ar/R\text{-}CONH_2 + Br_2 + 4NaOH \rightarrow Ar/R\text{-}NH_2 + 2NaBr + Na_2CO_3 + 2H_2O$ **[1]**

(ii)



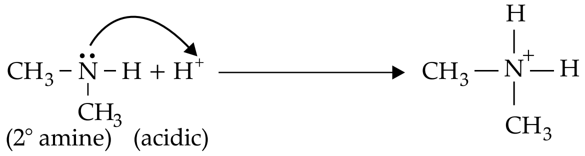
[1]

(b) Because of the combined factors of inductive effect and solvation or hydration effect. **[1]**

[CBSE Marking Scheme, 2018]

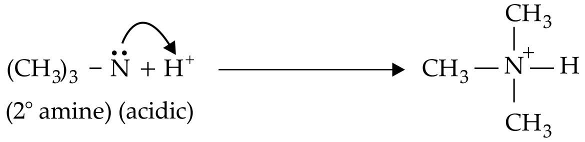
Detailed Answer:

(b)



$CH_3-\underset{\underset{CH_3}{|}}{\ddot{N}}-H + H^+ \longrightarrow CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{H}{|}}{N^+}}-H$

(2° amine) (acidic)



$(CH_3)_3-\ddot{N} + H^+ \longrightarrow CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{N^+}}-H$

(2° amine) (acidic)

2° amine salt form is more stable than 3° amine due to inductive effect and higher degree of hydration. Therefore, higher the stability of salt, greater will be the reactivity of corresponding compound.

Section - C

12. **(a)** Conductivity of 0.02 mol L^{-1} KCl Solution

$= \text{Cell constant/resistance } i.e., k = \frac{G^*}{R}$

$= \frac{258}{420}$

$= 0.614 \text{ Sm}^{-1}$ **[1]**

(b) The conductivity decreases with dilution because on dilution number of ions per unit volume that are charge carriers decreases. **[1]**

(c) The cell constant of a conductivity cell remains constant for a cell as it only depends on distance between the electrodes and their cross-section area. **[1]**

(d) The factors on which conductivity of a solution depends are:

(i) Nature of the material

(ii) Temperature

(iii) The number of valence electrons per atom or size of the ion produced and their solution (electrolytes). **[2]**

OR

The conductivity of solutions of different electrolytes in the same solvent and at a given temperature differs due to size and charge of the ions in which they dissociate, concentration of ions, ease with which the ions move under a potential gradient. **[2]**

The SI unit for conductivity of a solution is Sm^{-1} as conductance is reciprocal of resistance where,

$$\kappa = G\frac{l}{A}$$

$$\text{unit of } \kappa = \frac{\text{Sm}}{\text{m}^2}$$

$$\kappa = \text{Sm}^{-1}$$ **[2]**

■■■