Code No. 043

Roll No. ☐☐☐☐☐☐☐

- Please check that this question paper contains **6** printed pages.
- Code number given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
- Please check that this question paper contains **33** questions.
- **Please write down the Serial Number of the question before attempting it.**
- 15 minutes time has been allotted to read this question paper. The question paper will be distributed at 10.15 a.m. From 10.15 a.m. to 10.30 a.m., the students will read the question paper only and will not write any answer on the answer-book during this period.

CHEMISTRY–XII
Sample Paper (Solved)

Time allowed: 3 hours *Maximum Marks: 70*

General Instructions:

Read the following instructions carefully:

(i) *There are 33 questions in this question paper. All questions are compulsory.*
(ii) ***Section A** : Q. No. **1 to 16** are Objective Type Questions. Q. No. 1 and 2 are passage based questions carrying 4 marks each while Q. No. **3 to 16** carry **1 mark** each.*
(iii) ***Section B :** Q. No. **17 to 25** are Short Answer Type I questions and carry **2 marks** each.*
(iv) ***Section C :** Q. No. **26 to 30** are Short Answer Type II questions and carry **3 marks** each.*
(v) ***Section D:** Q. No. **31 to 33** are Long Answer Questions carrying **5 marks** each.*
(vi) *There is no overall choice. However, internal choices have been provided.*
(vii) *Use of calculators and log tables is not permitted.*

SECTION A (Objective Type)

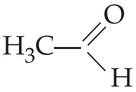
1. Read the passage given below and answer the following questions: **(1×4=4)**

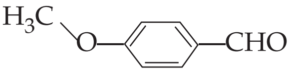
Aldehydes and ketones are amphoteric. Thus they can react both as acids and bases. Under acidic conditions, the carbon of the protonated carbonyl group is much more electrophilic, reacting even with weak nucleophile. Carbonyl compounds give nucleophilic addition reaction. In this reaction the nucleophilic attack precedes the electrophilic attack.

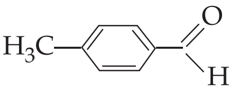
(*i*) Which of these statements is correct?

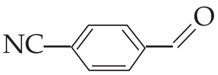
(*a*) Carbonyl compound is amphoteric in character.
(*b*) Acid catalyst makes the carbonyl carbon more electrophilic.
(*c*) Basic catalyst makes the nucleophile more nucleophilic.
(*d*) All of these.

(*ii*) Which one of the carbonyl compounds is more reactive towards NaCN/H$^+$?

(*a*) 

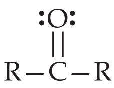
(*b*) 

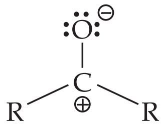
(*c*) 

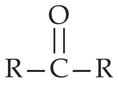
(*d*) 

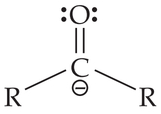
Or

Which is major contributing structure in depicting C—O dipoles of a carbonyl group?

(*a*) 
$R-\overset{\overset{:O:}{||}}{C}-R$

(*b*) 

(*c*) 
$R-\overset{\overset{O}{||}}{C}-R$

(*d*) 

(*iii*) Carbonyl compounds gives nucleophilic addition with

(*a*) Carbon nucleophile
(*b*) Oxygen nucleophile
(*c*) Nitrogen nucleophile
(*d*) All of these

(*iv*) The rate determining step of addition reaction is:

(*a*) Addition of nucleophile
(*b*) Addition of electrophile
(*c*) By formation of alkoxide
(*d*) Both (*a*) and (*b*)

2. Read the passage given below and answer the following questions: **(1×4=4)**

Coagulation is generally brought about by the addition of electrolytes. When an electrolyte is added to a colloidal solution, the particles of the sol take up the ions which are oppositely charged and thus get neutralised. The neutralising ion is known as flocculation ion. The neutral particles then start accumulating to form particles of larger size which settle down. When the concentration of the electrolyte added in low, the process is called flocculation. At higher concentration, coagulation takes place and the process cannot be reversed by shaking.

In these questions a statement followed by a statement of reason is given. Choose the correct answer out of the following choices.

(*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.

(*i*) ***Assertion:*** Colloidal AgI is prepared by adding KI in slight excess to $AgNO_3$ solution, the sol particles migrate towards cathode under electric field.
Reason: Colloidal particles adsorb ions and thus becomes electrically neutral.

(*ii*) ***Assertion:*** Smaller the flocculation value of an electrolyte, greater is its coagulating power.
Reason: Greater the valency of the oppositely charged ions of the electrolytes, more will be its coagulating power.

(*iii*) ***Assertion:*** For coagulation of positively charged sols; $[Fe(CN)_6]^{4-}$ ions has higher coagulating power than that of PO_4^{3-}, SO_4^{2-}, Cl^-.
Reason: Because according to Hardy Schulze rule, higher is the valency of ions for the oppositely charged sol particles, better will be the precipitation.

(*iv*) ***Assertion:*** Silver iodide is similar to ice.
Reason: It helps in artificial rain.

Or

Assertion: Two oppositely charged solutions when mixed in equal proportions, they get partially or completely neutralised.
Reason: Electrolytes are removed from the solution and colloid becomes unstable and gets coagulated.

Following questions (No. 3-11) are Multiple Choice Questions carrying 1 mark each.

3. Conductivity of 0.00241 M acetic acid is 7.896×10^{-5} S cm^{-1} its $\Delta°_m$ is 390.5 S cm^2 mol^{-1}. What is its molar conductivity?

(*a*) 1.85×10^{-5} mol L^{-1}
(*b*) 2.86×10^{-3} mol L^{-1}
(*c*) 1.92×10^{-4} mol L^{-1}
(*d*) 3.52×10^{-2} mol L^{-1}

4. Glucose molecule reacts with X number of molecules of phenylhydrazine to yield osazone. The value of X is

(*a*) Three
(*b*) Two
(*c*) One
(*d*) Four

Or

Which statement is incorrect about peptide bond?

(*a*) C-N bond length in proteins is longer than usual bond length of C-N bond.
(*b*) Spectroscopic analysis shows planar structure of –CO–NH– group.
(*c*) C–N bond length in proteins in smaller than usual bond length of C–N bond.
(*d*) None of the above.

5. The edge length of face centred cubic unit cell is 508 pm. If the radius of the cation is 110 pm, the radius of the anion is

(*a*) 144 pm (*b*) 288 pm (*c*) 618 pm (*d*) 398 pm

6. A liquid is in equilibrium with its vapour at its boiling point on the average, the molecules in the two phases have equal:

(*a*) intermolecular forces (*b*) potential energy (*c*) total energy (*d*) kinetic energy

7. Which chromium compounds is widely used in tanning of leather?

(*a*) Cr_2O_3 (*b*) CrO_2Cl_2
(*c*) $CrCl_3$ (*d*) $K_2SO_4 \, . \, Cr_2(SO_4)_3, \, 24 \, H_2O$

8. Of the following transition metals, the maximum number of oxidation states is exhibited by

(*a*) Manganese (Z = 25) (*b*) Iron (Z = 26)
(*c*) Titanium (Z = 22) (*d*) Chromium (Z = 24)

Or

In which of the following ions, the colour is not due to d-d transition.

(*a*) $Ti(H_2O)_6^{3+}$ (*b*) CoF_6^{3-} (*c*) CrO_4^{2-} (*d*) $[Cu(NH_3)_4]^{2+}$

9. IUPAC name of $(Pt(NH)_3)_3$ $Br(NO_2)Cl]$ Cl is

(*a*) Triamminechloridobromidonitroplatinum (IV) chloride
(*b*) Triamminebromidonitrochloridoplatinum (IV) chloride
(*c*) Triamminebromidochloridonitroplatinum (IV) chloride
(*d*) Triamminenitrochloridobromidoplatinum (IV) chloride

Or

The total number of possible isomers for the complex compound $[Cu^{II}(NH_3)_4]$ $[Pt^{II} Cl_4]$ are

(*a*) 3 (*b*) 6 (*c*) 5 (*d*) 4

10. $C_4H_{11}N$ on reaction with HNO_2 forms a tertiary alcohol. Thus $C_4H_{11}N$ is

(*a*) Primary amine (*b*) Secondary amine
(*c*)Tertiary amine (*d*) Quaternary ammonium salt

Or

Basicity of $CH_3CH_2NH_2$ (I), CH_3 $CONH_2$ (II) and C_6H_5 (OH) (III) follows the order :

(*a*) I > II > III (*b*) I > III > II
(*c*) II > III > I (*d*) III > II > I

11. The ratio of Fe^{3+} and Fe^{2+} ions in $Fe_{0.9}$ $S_{1.0}$ is

(*a*) 0.28 (*b*) 0.5 (*c*) 2 (*d*) 4

In the following (Q. No. 12-16) a statement of assertion followed by a statement of reason is given Choose the correct answer out of the following choices:

(*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.

12. *Assertion:* Fructose reduces Fehling's solution and Tollens' reagent.
Reason: Fructose does not contain any aldehyde group.

13. *Assertion:* Salts of ClO_3^- and ClO_4^- are well known but those of FO_3^- and FO_4^- are unknown.
Reason: F is more electronegative than O while Cl is less electronegative than O.

14. *Assertion:* One molar aqueous solution has always higher concentration than one molal solution.
Reason: One molar solution contains less solvent than one molal solution.

Or

Assertion: Vapour pressure of water is less than 1.013 bar at 373K.

Reason: Water boils at 373K as the vapour pressure at this temperature becomes equal to atmospheric pressure.

15. *Assertion:* Fehling solution oxidises acetaldehyde to acetic acid but not benzaldehyde to benzoic acid.

Reason: The C–H bond of CHO group in benzaldehyde is stronger than in acetaldehyde.

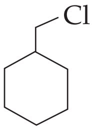
16. *Assertion:* Aromatic aldehydes can be distinguished from aliphatic aldehydes by Fehling solution.

Reason: Fehling solution is an alkaline solution of $CuSO^-_4$ containing Rochelle salt.

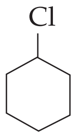
SECTION B

The following question, Q. No. 17-25 are Short Answer Type I and carry 2 marks each.

17. (*i*) In the following pairs of halogen compounds, which would undergo S_N1 reaction faster? Explain.



and



(*ii*) Amongst the isomeric dihalobenzenes which isomer has the highest melting point and why?

Or

Which will have a higher boiling point—1-chloroethane or 2-chloro-2-methylbutane? Give reason.

18. (*i*) Of 0.1 M solution of glucose and sodium chloride respectively, which one will have a higher boiling point and why?

(*ii*) Why is an increase in temperature observed on mixing chloroform with acetone?

19. Describe the type of hybridisation for the complex ion $[Fe(H_2O)_6]^{2+}$.

Or

(*i*) **Write the formula for the following coordinate compound:**

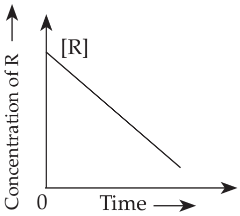
Amminebromidochloridonitrito – N-platinate(II)

(*ii*) Which isomer of $[CoCl_2(en)_2]^+$ does not show optical isomerism?

20. In the following reaction:

$$Q + R \longrightarrow \text{Products}$$

the time taken for 99% reaction of Q is twice the time taken for 90% reaction of Q. The concentration of R varies with time as shown in the figure. What is the overall order of the reaction? Give the units of the rate constant for the same. Write the rate expression for the above reaction.



Or

Rate constant for a first order reaction has been found to be $2.54 \times 10^{-3}\ s^{-1}$. Calculate its three fourth life.

21. After 24 hrs, only 0.125 gm out of the initial quantity of 1 gm of a radioactive isotope remains behind. What is its half life period?

22. (*i*) Amongst the isomeric alkanes of molecular formula C_5H_{12}, identify the one that on photochemical chlorination yields a single monochloride.

(*ii*) Draw the structure of 4-tertbutyl-3-iodoheptane.

23. Draw the structure of the following compounds:

(*i*) $H_2S_2O_7$ (*ii*) $XeOF_4$

24. Give a simple test to distinguish among $CH_3–CH=CHCl$, $CH_3CH_2CH_2Cl$ and $CH_2=CH–CH_2Cl$.

25. Name the crystal defect which reduces the density of an ionic solid. What type of ionic substances show this defect?

SECTION C

Q. No. 26-30 are Short Answer Type II carrying 3 marks each.

26. (*a*) Which element in the first series of transition elements does not show variable oxidation state and why?

(*b*) **Give plausible explanation for the following:**

(*i*) The first ionization enthalpy of first transition series does not vary much with increasing atomic number.

(*ii*) Compounds of transition metals are generally coloured.

Or

Describe the trends in the following cases:

(*i*) Atomic size of the elements in the 4*f* inner transition series.

(*ii*) Melting point of the elements in the 3*d* transition series.

(*iii*) Probable oxidation states of the elements in the 3*d* transition series.

27. Give the structures of A, B and C in the following reactions:

(*a*) $C_6H_5NO_2 \xrightarrow{Fe/HCl} A \xrightarrow{HNO_2\,;\,273K} B \xrightarrow{C_6H_5OH} C$

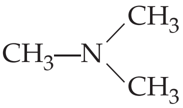
(*b*) $C_6H_5N_2Cl \xrightarrow{CuCN} A \xrightarrow{H_2O/H^+} B \xrightarrow{NH_3\,;\,\Delta} C$

Or

(*a*) A hydrocarbon C_5H_{12} gives only 1 mono-chlorination product. Identify the hydrocarbon.

(*b*) **Write the IUPAC names of the following:**

(*i*) $C_6H_5CH_2NH_2$

(*ii*) 

$CH_3—N(CH_3)_2$

28. (*a*) The edge length of unit cell of a metal having weight 75 g/mol is 5 A which crystallises in cubic lattice. If the density is 2 g/cm^3, find the radius of the metal atom.

(*b*) **Answer the following questions:**

(*i*) How does the electrical conductivity of metallic conductors vary with temperature? Give a brief reason.

(*ii*) A compound formed by elements A and B has a cubic structure in which A atoms are at the corners of the cube and B atoms are at the face centres. Derive the formula of the compound.

29. (*a*) A non reducing disaccharide 'A' on hydrolysis with dilute acid gives an equimolar mixture of D–(+)–glucose and D–(–)–fructose.

$$\begin{array}{ccccc} A + H_2O & \xrightarrow{HCl} & C_6H_{12}O_6 & + & C_6H_{12}O_6 \\ [\alpha]_D = +66.5^\circ & & +52.5^\circ & & -92.4^\circ \end{array}$$

Identify A. What is the mixture of D–(+)– glucose and D–(–)–fructose known as? Name the linkage that holds the two units in the disaccharide.

(*b*) α-amino acids have relatively higher melting points than the corresponding halo acids. Explain.

30. (*a*) Give the formula of a noble gas species which is isostructural with IBr_2^-.

(*b*) **Arrange the following in order of property indicated for each set :**

(*i*) F_2, Cl_2, Br_2, I_2 — increasing bond dissociation enthalpy

(*ii*) PH_3, AsH_3, BiH_3, SbH_3, NH_3 — increasing base strength

SECTION D

Q. No. 31 to 33 are Long Answer Type carrying 5 marks each.

31. (*a*) **Write balanced chemical equations for the following:**

(*i*) Complete hydrolysis of XeF_6.

(*ii*) Disproportionation reaction of orthophosphorus acid.

(*b*) Draw the structure of a noble gas species which is isostructural with BrO_3^-.

(*c*) Considering the parameters such as bond dissociation enthalpy, electron gain enthalpy and hydration enthalpy, compare the oxidising power of F_2 and Cl_2.

(*d*) Why is $K_{a_2} << K_{a_1}$ for H_2SO_4 in water?

Or

Explain the following:

(*a*) Hydrogen fluoride is a weaker acid than hydrogen chloride in aqueous solution.

(*b*) PCl_5 is ionic in nature in the solid state.

(*c*) SF_6 is inert towards hydrolysis.

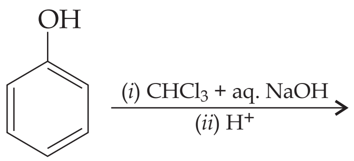
(*d*) H_3PO_3 is diprotic.

(*e*) Out of noble gases only Xenon is known to form established chemical compounds.

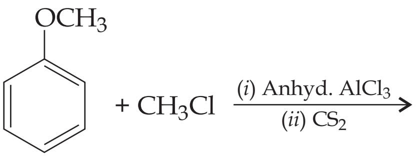
32. (*a*) Predict the major products obtained by heating hydrogen iodide with Methoxybenzene.

(*b*) **Identify the name of the reaction associated with the following half equations and write the main organic product formed:**

(*i*)



(*ii*)



(*c*) **Arrange the following compounds in the increasing order of their acid strength:**
3-Nitrophenol, Phenol, 2-Methylphenol

Or

(*a*) (*i*) Predict the major product of acid catalysed dehydration of 1-Methylcyclohexanol.

(*ii*) You are given benzene, conc. H_2SO_4, NaOH and dil. HCl. Write the preparation of phenol using these reagents.

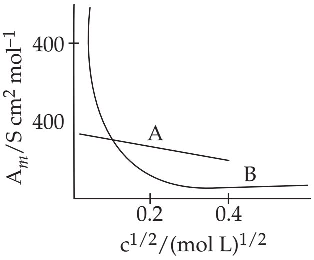
(*b*) **The following is not an appropriate reaction for the preparation of tert–butyl ethyl ether:**

$$C_2H_5ONa + (CH_3)_3C—Cl \longrightarrow (CH_3)_3C—OC_2H_5$$

(*i*) What would be the major product of the given reaction?

(*ii*) Write a suitable reaction for the preparation of tert–butyl ethyl ether, specifying the names of reagents used. Justify your answer in both cases.

33. (*a*) **The given curve is obtained when molar conductivity (Λ_m) is plotted against the square root of concentration, $c^{1/2}$ for two electrolytes A and B.**



(*i*) How do you account for the increase in the molar conductivity of the electrolyte A on dilution?

(*ii*) As seen from the graph, the value of limiting molar conductivity ($\Lambda°_m$) for electrolyte B cannot be obtained graphically. How can this value be obtained?

(*b*) A galvanic cell consists of a metallic zinc plate immersed in 0.1 M $Zn(NO_3)_2$ solution and metallic plate of lead in 0.02M $Pb(NO_3)_2$ solution. Calculate the emf of the cell. Write the chemical equation for the electrode reactions and represent the cell.
(Given: $E°_{Zn^{2+}/Zn} = -0.76V$; $E°_{Pb^{2+}/Pb} = -0.13V$)

Or

(*a*) State the relationship amongst cell constant of a cell, resistance of the solution in the cell and conductivity of the solution. How is molar conductivity of a solution related to conductivity of its solution?

(*b*) A voltaic cell is set up at 25°C with the following half cell;
Al/Al^{3+} (0.001 M) and Ni/Ni^{2+} (0.50 M)
Calculate the cell voltage. [$E°_{Ni^{2+}/Ni} = -0.25V$, $E°_{Al^{3+}/Al} = -1.66V$]

Answer Sheet

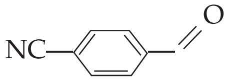
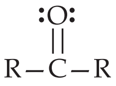
SAMPLE PAPER

Code No. **043**

Roll No.

CHEMISTRY

SECTION A

1\. (*i*) (*d*) All of these (*ii*) (*d*)  *Or* (*a*) 

$R-\overset{\ddot{O}:}{\overset{\|}{C}}-R$

(*iii*) (*d*) All of these (*iv*) (*a*) Addition of nucleophile

2\. (*i*) (*c*) Assertion is correct statement but reason is wrong statement.

(*ii*) (*a*) Assertion and reason both are correct statements and reason is correct explanation for assertion.

(*iii*) (*a*) Assertion and reason both are correct statements and reason is correct explanation for assertion.

(*iv*) (*a*) Assertion and reason both are correct statements and reason is correct explanation for assertion.

Or

(*b*) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

3\. (*a*) 1.85×10^{-5} mol L^{-1}

4\. (*a*) Three

Or

(*a*) C-N bond length in proteins is longer than usual bond length of C-N bond.

5\. (*a*) 144 pm

6\. (*c*) total energy

7\. (*d*) $K_2SO_4 . Cr_2(SO_4)_3, 24\ H_2O$

8\. (*a*) Manganese (Z = 25)

Or

(*c*) CrO_4^{2-}

9\. (*c*) Triamminebromidochloridonitroplatinum (IV) chloride

Or

(*d*) 4

10\. (*a*) Primary amine

Or

(*b*) I > III > II

11\. (*a*) 0.28

12\. (*b*) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

13\. (*b*) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

14. (*a*) Assertion and reason both are correct statements and reason is correct explanation for assertion.

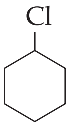
Or

(*d*) Assertion is wrong statement but reason is correct statement.

15. (*a*) Assertion and reason both are correct statements and reason is correct explanation for assertion.

16. (*b*) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

SECTION B

17. (*i*) 

In this halogen compound, secondary carbocation is formed which is more stable and more reactive than primary carbocation.

(*ii*) The para isomer has the highest melting point because due to symmetry its molecules are better aligned in crystal lattice.

Or

Due to high molecular mass, van der Waals forces of attraction in 2-chloro-2-methylbutane are stronger than in 1-chloroethane, therefore, 2-chloro-2-methylbutane has higher boiling point than 1-chloroethane.

18. (*i*) 0.1 M NaCl solution will have a higher boiling point as NaCl dissociates into ions in solution.

$$\text{NaCl} \rightleftharpoons \text{Na}^+ + \text{Cl}^-$$

(*ii*) The chloroform and acetone molecules posses dipole-dipole interactions but on mixing they form hydrogen bonds which are stronger thus resulting in release of energy. This gives rise to an increase in temperature.

19. Fe exists as Fe^{2+}. There are 4 unpaired electrons. Water is a weak ligand. Thus the hybridisation involved is sp^3d^2. It is an octahedral outer d-orbital complex.

Or

(*i*) $[Pt(NH_3)BrCl(NO_2)]^-$

(*ii*) Trans isomer does not show optical isomerism.

20. Order w.r.t. Q = 1, w.r.t. R = 0 ∴ **Overall order = 1**

Dimenstion of K (unit) is $\sec^{-1}$

∴ **Rate expression = $K[Q]^1[R]^0$**

Or

$$t_{3/4} = \frac{2.303}{K}\log\frac{(R)_0}{\frac{(R)_0}{4}} = 1$$

$$= \frac{2.303}{K}\log 4 = \frac{2.303}{2.54\times10^{-3}} \times 2\log 2 \quad (\log 2 = 0.3010)$$

$$= \frac{2.303\times 2\times 0.3010\times 10^3}{2.54} = \mathbf{5.458 \times 10^2 \text{ seconds}}$$

21. **Given:** $a = 1$ g, $a - x = 0.125$ g, $t = 24$ hours

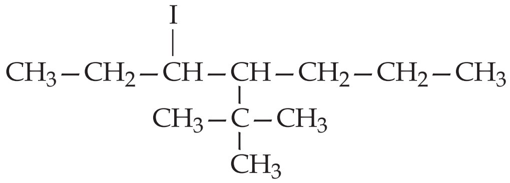
Using formula,

$$k = \frac{2.303}{t}\log\frac{a}{a-x} \quad\Rightarrow\quad k = \frac{2.303}{t}\log\frac{1}{0.125} = 0.0866\ \text{hr}^{-1}$$

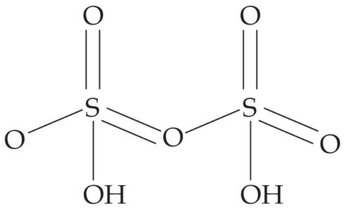
$$t_{1/2} = \frac{0.693}{k} \quad\Rightarrow\quad t_{1/2} = \frac{0.693}{0.0866} = \mathbf{8\ hours}$$

22. (*i*) Neopentane or 2, 2-Dimethylpropane.

(*ii*)

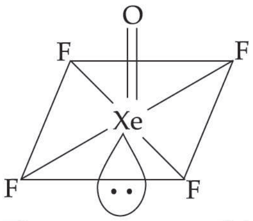


23. **(*i*) $H_2S_2O_7$ *(Pyrosulphuric acid)*** or oleum



(oleum)

(*ii*) $XeOF_4$



Shape: Square pyramidal

24. $CH_2 = CH–CH_2Cl$ is an allylic chloride (The Cl is very reactive). This reacts rapidly with $AgNO_3$ in the cold to give a white ppt. of AgCl.

$CH_3CH_2CH_2Cl$ (Propylchloride) gives white ppt. when warmed with $AgNO_3$ as it is comparatively less reactive.

$CH_3—CH=CHCl$ (1-chloroprop-1-ene) is inert and does not form white ppt. with $AgNO_3$.

25. **Schottky defect.** Equal number of cation and anion leave the lattice point.

As density = mass/volume hence it decreases.

SECTION C

26. **(*a*)** Zn does not show variable oxidation state because it has fully filled d orbital. It only shows +2 oxidation state.

(*b*) **(*i*)** Atomic size remains practically same due to shielding effect of $(n-1)d$ electrons and hence effective nuclear charge does not change much.

(*ii*) Because of unpaired electrons present in the *d* orbitals which can undergo $d-d$ transition by absorbing light in the visible region.

Or

(*i*) Atomic size decreases in 4*f* transition series due to poor shielding of *f* electrons. Increase in effective nuclear charge holds the outer most electrons strongly.

(*ii*) Melting point of 3*d* transition elements first increases till Cr and then decreases. Strength of metallic bonds depends upon the number of unpaired electrons. After Mn the pairing of *d* electrons takes place and hence strength of metallic bond decreases.

(*iii*) Probable oxidation states of the elements in the 3*d* transition series varies from +2 to +7. The number of greatest number of oxidation states occur in the middle of the series. Mn shows all the oxidation states from +2 to +7 because of comparable energies of 4*s* and 3*d.*

27. **(*a*)** **'A'** — $C_6H_5NH_2$ (Aniline)

'B' — $C_6H_5N_2^+Cl^-$ (Benzene diazonium chloride)

'C' — $C_6H_5—N_2—C_6H_4—OH$ (P-Hydroxy azobenzene)

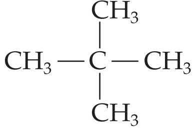
(*b*) **'A'** — C_6H_5CN (Benzonitrile)

'B' — C_6H_5COOH (Benzoic acid)

'C' — $C_6H_5CONH_2$ (Benzamide)

Or

(*a*) Since there is only one monochloroderivative, the compound contains 12 equivalent hydrogen in four equivalent CH_3. The compound is 2, 2–dimethyl propane



$$CH_3—\underset{CH_3}{\overset{CH_3}{C}}—CH_3$$

(*b*) **(*i*)** 1-Phenylmethanamine **(*ii*)** N, N-Dimethylmethanamine

28. **(*a*)** **Given:** $\rho = 2\ \text{g cm}^{-3}$, $a = 5 \times 10^{-8}$ cm, $M = 75\ \text{g mol}^{-1}$

$$\text{Density } \rho = \frac{z \times M}{a^3 \times N_A} \quad \Rightarrow \quad z = \frac{\rho \times a^3 \times N_A}{M}$$

$$z = \frac{2\text{g / cm}^3 \times (5 \times 10^{-8}\text{cm})^3 \times 6.022 \times 10^{23}\text{mol}^{-1}}{75\text{ g mol}^{-1}} = \mathbf{2\ (bcc\ structure)}$$

$$\therefore \quad r = \frac{\sqrt{3}}{4}a = \frac{1.732 \times 5}{4} = \mathbf{2.165\ Å}$$

(*b*) **(*i*)** It decreases with rise in temperature because kernels begin to vibrate and create hindrance in the flow of electrons.

(*ii*) No. of A atoms per unit cell = 8 (at corners) × $\frac{1}{8}$ = 1

No. of B atoms per unit cell = 6(at face centres) × $\frac{1}{2}$ = 3

∴ **Formula of the compound: AB_3**

29. **(*a*)** A — Sucrose ($C_{12}H_{22}O_{11}$)

The mixture of D–(+)– glucose and D–(–)–fructose is known as **invert sugar**.

The linkage which holds the two monosaccharide units through oxygen atom is called **glycosidic linkage**.

(*b*) The amino acids exist as a dipolar ion known as a zwitter ion. Due to this dipolar salt like character they have strong dipole dipole attractions. But halo acids do not exhibit such dipolar behaviour. Thus the melting points of amino acids are higher than the corresponding haloacids which do not exist as zwitter ions.

30. **(*a*)** XeF_2

(*b*) **(*i*)** $I_2 < F_2 < Br_2 < Cl_2$

(*ii*) $BiH_3 < SbH_3 < AsH_3 < PH_3 < NH_3$

SECTION D

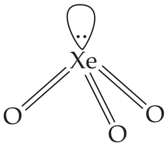
31. **(*a*)** **(*i*)**

$$\underset{}{XeF_6\,(s)} + 3H_2O\,(l) \longrightarrow \underset{\text{Xenon trioxide}}{XeO_3\,(s)} + 6HF\,(aq)$$

(*ii*)

$$4H_3PO_3 \xrightarrow{\text{Heat}} \underset{\text{Phosphine}}{PH_3} + \underset{\text{Phosphoric acid}}{3H_3PO_4}$$

(*b*) XeO_3 is isostructural with BrO^-_3. (Pyramidal structure)



XeO_3
Pyramidal

(*c*) The bond dissociation enthalpy of F—F bond is lower than that of Cl—Cl bond and hydration enthalpy of F^- ion is much higher than that of Cl^- ion.

These two factors more than compensate the less negative electron gain enthalpy of F_2. Thus, F_2 is a stronger oxidizing agent than Cl_2.

(*d*) H_2SO_4 ionises in two stages and hence has two dissociation constants.

$$K_{a_2} << K_{a_1}$$

This is because the negatively charged HSO_4 ion has much less tendency to donate a proton to H_2O as compared to neutral H_2SO_4. It is much easier for a neutral H_2SO_4 to release H^+.

Or

(*a*) Due to stronger H—F bond than HCl bond, HF ionises less readily than HCl in aqueous solution to give H^+ ions. Therefore, HF is a weaker acid than HCl.

(*b*) In solid state, PCl_5 consists of ions $[PCl_4]^+[PCl_6]^-$, therefore it is ionic in nature. On melting these ions become free to move and hence conduct electricity in the molten state.

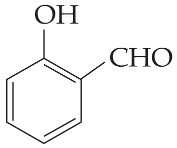
(*c*) In SF_6, S is sterically protected by six F atoms and hence does not allow H_2O molecules to attack the S molecule. Also, F does not have d-orbitals to accept the electrons donated by H_2O molecules.

(*d*) In the structure of H_3PO_3, it contains only two ionisable H-atoms which are present as –OH groups, thus it behaves as a dibasic acid.

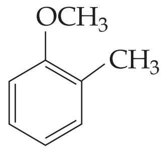
(*e*) Except radon which is radioactive, Xenon has least ionisation energy among noble gases and hence it readily forms chemical compounds particularly with O_2 and F_2.

32. (*a*) Phenol and Iodomethane; $C_6H_5OCH_3 + HI \longrightarrow C_6H_5OH + CH_3I$

(*b*) (*i*) **Reimer-Tiemann reaction** (*ii*) **Friedel-Craft reaction**

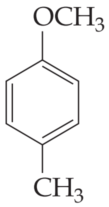


o-Hydroxybenzaldehyde



2-Methyl Anisole

+



4-Methyl Anisole

(*c*) 2-Methylphenol < Phenol < 3-Nitrophenol.

Or

(*a*) (*i*) 1-Methylcyclohexene

(*ii*) $\underset{\text{Benzene}}{C_6H_6} \xrightarrow{\text{conc. } H_2SO_4,\ \Delta} \underset{\text{Benzene Sulphonic acid}}{C_6H_5SO_3H} \xrightarrow{\text{NaOH, fuse, 575 K}} \underset{\text{Sodium phenoxide}}{C_6H_5ONa} \xrightarrow{\text{dil. HCl}} \underset{\text{Phenol}}{C_6H_5OH}$

(*b*) (*i*) Since the alkyl halide is a 3° halide and C_2H_5ONa is a strong base, therefore elimination occurs preferably. The product obtained is 2-Methylprop-1-ene:

$CH_3-C(CH_3)=CH_2$

(*ii*) To prepare tert-Butyl ethyl ether, the alkyl halide should be 1°, *i.e.*, chloroethane and the nucleophile should be sodium tert-butoxide because the 3° nucleophile is able to attack 1° alkyl halide.

$$(CH_3)_3C-O^-\,Na^+ + CH_3CH_2-Cl \longrightarrow (CH_3)_3C-OCH_2CH_3 + NaCl$$

33. (*i*) (*a*) As seen from the graph, electrolyte A is a strong electrolyte which is completely ionised in solution. With dilution, the ions are far apart from each other and hence the molar conductivity increases.

(*b*) To determine the value of limiting molar conductivity for electrolyte B, indirect method based upon Kohlrausch law of independent migration of ions is used.

(*ii*) ***Anode reaction:*** $Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$

Cathode reaction: $Pb^{2+}(aq) + 2e^- \rightarrow Pb(s)$

Cell representation: $Zn(s)/Zn^{2+}(aq)//Pb^{2+}(aq)/Pb(s)$

According to Nernst equation,

$$E_{cell} = E^o_{cell} - \frac{0.059}{n}\log\frac{[Zn^{2+}]}{[Pb^{2+}]}$$

$$= [-0.13 - (-0.76)] - \frac{0.059}{2}\log\left[\frac{0.1}{0.02}\right] = 0.63 - 0.02955 \times \log 5$$

$$= 0.63 - 0.02955 \times 0.6990 = 0.63 - 0.0206 = \mathbf{0.6094\ V}$$

Or

(*i*) We know that, reciprocal of resistance in the conductance of the cell,

$$G = \frac{1}{R}$$

Conductivity of the cell is given as

$$K = G \times \text{Cell constant} \qquad \ldots(i)$$

Substituting the value of conductance in the above equation,

$$K = \frac{1}{R} \times \text{Cell constant}$$

Molar conductivity is the product of conductivity and volume of the solution containing one mole of electrolyte.

$$\Lambda_m = K \times V$$

Therefore, upon dilution, the conductivity of the electrolyte decreases but the volume of the solution containing one mole of electrolyte increases. This increase in the volume is more pronounced than the decrease in the conductivity, thus molar conductivity increases. Therefore, we can conclude that the molar conductivity increases as the conductivity decreases with increase in volume of the solution.

(*ii*) Using Nernst equation

$$E = E^{o} - \frac{0.0591}{n} \log \frac{1}{[A]}$$

$$E_{Ni^{2+}/Ni} = -0.25 - \frac{0.0591}{2} \log \frac{1}{0.50} = -0.259 \text{ V}$$

$$E_{Al^{3+}/Al} = -1.66 - \frac{0.0591}{3} \log \frac{1}{0.001} = -1.719 \text{ V}$$

$$\therefore \quad \mathbf{E_{cell}} = 0.259 \text{ V} - (-1.719 \text{ V}) = \mathbf{1.46\ V}$$

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