CBSE Class 12 Chemistry

Sample paper 05 (2020-21)

Maximum Marks: 70

Time Allowed: 3 hours

General Instructions:

a. There are 33 questions in this question paper. All questions are compulsory.
b. 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.
c. Section B: Q. No. 17 to 25 are short answer questions and carry 2 marks each.
d. Section C: Q. No. 26 to 30 are short answer questions and carry 3 marks each.
e. Section D: Q. No. 31 to 33 are long answer questions carrying 5 marks each.
f. There is no overall choice. However, internal choices have been provided.
g. Use of calculators and log tables is not permitted.

Section A

1. **Read the passage given below and answer any four out of the following questions:**
Phosphorus forms two types of halides which are phosphorus Trichloride and phosphorus pentachloride. Phosphorus forms a number of oxoacids Orthophosphoric acid, Orthophosphorous acid, Pyrophosphoric acid, Hypophosphorous acid, Cyclotrimetaphosphoric acid and Polymetaphosphoric acid. Phosphorus trichloride is a colourless oily liquid and hydrolyses in the presence of moisture. Phosphorus pentachloride is prepared by the reaction of white phosphorus with excess of dry chlorine. The oxoacids in which phosphorus has a lower oxidation state. These acids in +3 oxidation state of phosphorus tend to disproportionate to higher and lower oxidation states. The acids which contain P–H bond have strong reducing properties. Thus, hypophosphorous acid is a good reducing agent as it contains two P–H bonds and reduces. These P–H bonds are not ionisable to give H+ and do not play any role in basicity. Only those H atoms which are attached with oxygen in P–OH form are ionisable and cause the basicity.
The following questions are multiple-choice questions. Choose the most appropriate

answer.

i. _____ is obtained by action of SO_2Cl_2 on phosphorus.

a. phosphorus trichloride

b. phosphorus pentachloride

c. both (a) and (b)

d. none of these

ii. Oxaacids of phosphorus contain at least

a. one P=O and one P–OH bond

b. one P=O and two P–OH bond

c. three P=O and one P–OH bond

d. four P=O and one P–OH bond

iii. Which of the following equation shows the reducing property of H_3PO_2

a. $4H_3PO_3 \longrightarrow 3H_3PO_4 + PH_3$

b. $2Ag + PCl_5 \longrightarrow 2AgCl + PCl_3$

c. $Sn + 2PCl_5 \longrightarrow SnCl + 2PCl_3$

d. $4AgNO_3 + 2H_2O + H_3PO_2 \longrightarrow 4Ag + 4HNO_3 + H_3PO_4$

iv. In solid-state PCl_5 exists as an ionic solid because

a. it contain $[PCl_4]^+ [PCl_6]^-$

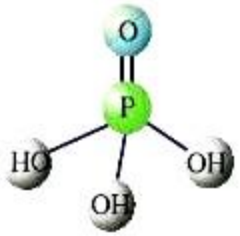
b. $[PCl_4]^+$ is cation

c. $[PCl_6]^-$ is anion

d. all of these

v. Which of the following structure is of orthophosphoric acid

a. 

b. 

c. 

d. none of these

2. **Read the passage and answer any four out of the following questions:**

Lyophilic colloids are stable. When stability factors are removed, a lyophilic sol can be coagulated. This is done by adding an electrolyte and by adding a suitable solvent. When solvents such as alcohol and acetone are added to hydrophilic sols, the dehydration of the dispersed phase occurs. Lyophilic sols are more stable due to the fact that lyophilic colloids are extensively solvated i.e., colloidal particles are covered by a sheath of the liquid in which they are dispersed. Fog, mist and rain, blood, soil and the formation of the delta are examples of colloids. There are liquid-liquid colloidal systems in which a mixture of two immiscible or partially miscible liquids is shaken, a coarse dispersion of one liquid in the other is obtained which is called emulsion. Emulsions can be broken into constituent liquids by heating, freezing, centrifuging, etc.

In these questions, 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 and reason is wrong statement
d. Assertion is wrong statement but reason is correct statement

i. **Assertion:** Charge and solvation of the colloidal particles are responsible for the stability of lyophilic colloid.
Reason: Lyophilic sol is more stable than lyophobic sol.

ii. **Assertion:** Lyophilic colloids have a unique property of protecting lyophobic colloids.
Reason: Lyophilic particles form a layer around lyophobic particles and thus protect the latter from electrolytes.

iii. **Assertion:** Clouds are gel having small droplets of water suspended in the air.
Reason: The rainfall occurs when two oppositely charged clouds meet.

iv. **Assertion:** Emulsions of oil in water are unstable.

Reason: The emulsifying agent forms an interfacial film between suspended particles and the medium.

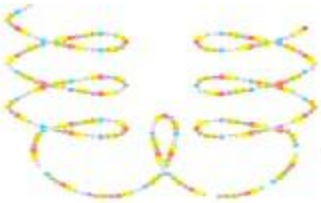
v. **Assertion:** The styptic action of alum and ferric chloride solution is due to the coagulation of blood.

Reason: Blood is a colloidal solution of an albuminoid substance.

3. Gabriel synthesis is used for the preparation of:
   a. Quaternary salt
   b. Primary amines
   c. Tertiary amine
   d. Secondary amine
4. Nucleic acids are the polymers of
   a. sugars
   b. bases
   c. nucleosides
   d. nucleotides

OR

The following structure of protein is called



   a. quaternary structure
   b. Secondary structure
   c. Tertiary structure
   d. primary structure
5. Which of the following is a colligative property?
   a. Osmotic pressure
   b. Dipole moment
   c. Change in free energy
   d. Heat of vapourization
6. Decreasing order of reactivity of hydrogen halide acids in the conversion of ROH $\rightarrow$ RX

is:

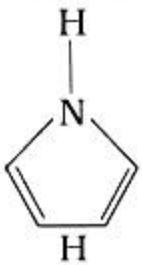
a. HF > HBr > HI > HCI
b. HI > HBr > HCl > HF
c. HF > HCI> HBr > HI
d. HCI > HBr > HI > HF

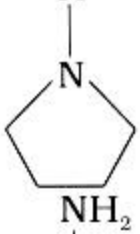
OR

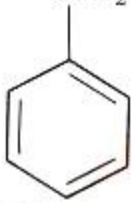
Methyl bromide is converted into ethane by heating it in ether medium with:

a. Na
b. Cu
c. Al
d. Zn

7. Among the following amines, the strongest Brönsted base is _____.

a. 

b. 

c. 

d. NH_3

OR

Acid anhydrides on reaction with primary amines give _____.

a. secondary amine
b. amide

c. imide

d. imine

8. Which of the following is paramagnetic?

   a. $K_3[Fe(CN)_6]$

   b. $K_4[Fe(CN)_6]$

   c. $Ni(CO)_4$

   d. $[Co(NH_3)_6]Cl_3$

OR

Which of the following compound would exhibit coordination isomerism?

   a. $[Cr(H_2O)]Cl_3$

   b. $[Cr(NH_3)_6][Co(CN)_6]$

   c. [Cr(en)2]NO_2

   d. $[Ni(NH_3)_6][BF_4]_2$

9. Mohr's salt is a better volumetric agent then ferrous sulphate because:

   a. Its reaction are less violent

   b. It is less readily oxidized in the solid state

   c. All the chemical reactions given by ferrous sulphate are given by Mohr's salt

   d. It does not effloresce like ferrous sulphate

10. Which reagent will you use for the following reaction?

    $CH_3CH_2CH_2CH_3 \rightarrow CH_3CH_2CH_2CH_2Cl + CH_3CH_2CHClCH_3$

    a. Cl_2 gas in the presence of iron in dark

    b. $NaCl + H_2SO_4$

    c. Cl_2 gas in dark

    d. Cl_2/UV light

11. A substance forms face centered cubic crystals. Its density is 1.984 g/cm^3 and the length of the edge of the unit cell is 630 pm. Calculate the molar mass in g/mol?

    a. 18.66

    b. 149.35

    c. 74.65

d. 29.85

12. **Assertion:** The $[Ni(en)_3]Cl_2$ (en = ethylenediamine) has lower stability than $[Ni(NH_3)_6]Cl_2$.

    Reason: In $[Ni(en)_3]Cl_2$ the geometry of Ni is trigonal bipyramidal.

    a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
    b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
    c. Assertion is CORRECT but, reason is INCORRECT.
    d. Both assertion and reason are INORRECT.

13. **Assertion:** The newly formed RNA dictates the synthesis of protein at the ribosome.

    Reason: DNA has a double helical structure while RNA has single stranded structure.

    a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
    b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
    c. Assertion is CORRECT but, reason is INCORRECT.
    d. Assertion is INCORRECT but, reason is CORRECT.

14. **Assertion:** 0.1 M glucose solution has higher increment in the freezing point than 0.1 M urea solution.

    Reason: K_f for both has different values.

    a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
    b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
    c. Assertion is CORRECT but, reason is INCORRECT.
    d. Both assertion and reason are INCORRECT.

OR

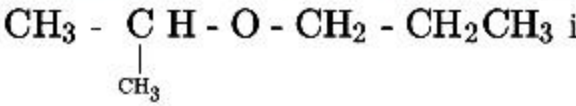
Assertion: The sum of mole fractions of all components of a solution is unity.

Reason: Mole fraction is independent of temperature.

a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
c. Assertion is CORRECT but, reason is INCORRECT.
d. Assertion is INCORRECT but, reason is CORRECT.

15. **Assertion:** IUPAC name of the compound



is 2- Ethoxy - 2 methyl propane

Reason: In IUPAC nomenclature, ether is regarded as a hydrocarbon derivative in which a hydrogen atom is replaced by -OR or -OAr group [where R = alkyl group and Ar = aryl group]

a. Assertion and reason both are correct and the reason is the correct explanation of assertion.
b. Assertion and reason both are wrong statements.
c. The assertion is a correct statement but the reason is the wrong statement.
d. The assertion is a wrong statement but the reason is the correct statement

16. **Assertion:** Addition of HCI to propene in presence of peroxide gives 1- chloropropane.
Reason: The reaction occurs by carbonium ion intermediate.

a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
c. Assertion is CORRECT but, reason is INCORRECT.
d. Assertion is INCORRECT but, reason is CORRECT.

Section B

17. Convert ethene to chloroethane.

OR

Convert chlorobenzene to benzyl alcohol.

18. Define the terms osmosis and osmotic pressure. What is the advantage of using osmotic pressure as compared to other colligative properties for the determination of molar masses of solutes in solutions?
19. Among $[Ag(NH_3)_2]Cl$, $[Ni(CN)_4]^{2-}$ and $[CuCl_4]^{2-}$ which

i. has square planar geometry?

ii. remains colourless in aqueous solutions and why?

[Atomic number of Ag = 47, Ni = 28, Cu = 29]

OR

Using the valence bond approach, predict the shape and magnetic behaviour of $[CoCl_4]^{2-}$

Given, atomic number of Co = 27]

20. What will be the effect of temperature on rate constant?
21. Identify the reaction order for each of the following rate constant-
    1. $k = 2.3 \times 10^{-5} Lmol - 1s^{-1}$
    2. $k = 3.1 \times 10^{-4} s^{-1}$
22. What happens when propene is treated with chlorine at 773K?
23. Assign reasons for the following:
    i. Copper (I) ion is not known to exist in aqueous solutions.
    ii. Both O_2 and F_2 stabilise high oxidation states of transition metals but the ability of oxygen to do so exceeds that of fluorine.
24. Hydrolysis of optically active 2 - bromobutane forms optically inactive butan - 2 - ol.
25. Name the parameters that characterize a unit cell.

Section C

26. Account for the following:
    i. All the bonds in PCl_5 are not equivalent.
    ii. Sulphur in vapour state exhibits paramagnetism
    iii. Fluorine is the strongest oxidant amongst the halogens.
    iv. Among the noble gases, only xenon is known to form true chemical compounds.
    v. PbO_2 is stronger oxidizing agent than SnO_2

OR

Draw the structure of H_2SO_3 .

27. How will you convert:
    i. 3-Methylaniline into 3-nitrotoluene.
    ii. Aniline into 1, 3, 5-tribromobenzene?

OR

Predict, giving reasons the order of basicity of the following compounds:

i. gaseous phase

ii. in aqueous solution

$(CH_3)_3N$, $(CH_3)_2NH$, CH_3NH_3, NH_3

28. A metal (atomic mass = 50) has a body centred cubic lattice. The density of the metal is 5.91 g cm^{-3}. Find out the volume of the unit cell. $[N_A = 6.022 \times 10^{23}]$
29. Define the terms as related to proteins:
    i. Peptide linkage
    ii. Primary structure
    iii. Denaturation
30. An organic compound A(C_6H_6O) gives a characteristic colour with aq. $FeCl_3$ solution. (A) On reacting with CO_2 and NaOH at 400k under pressure gives (B) which on acidification gives a compound (C). The compound (C) reacts with acetyl chloride to give (D) which is a popular pain killer. Deduce the structure of A,B,C & D.

Section D

31. a. Write one difference between transition elements and p-block elements with reference to variability of oxidation states.
    b. Why do transition metals exhibit higher enthalpies of atomization?
    c. Name an element of lanthanoid series which is well known to shown +4 oxidation state. Is it a strong oxidising agent or reducing agent?
    d. What is lanthanoid contraction? Write its one consequence.
    e. Write the ionic equation showing the oxidation of Fe(II) salt by acidified dichromate solution.

OR

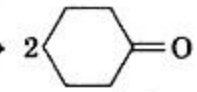
Describe the general trends in the following properties of the first series (3d) of the transition elements:

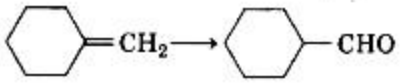
i. Number of oxidation states exhibited.

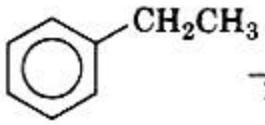
ii. Formation of oxo metal ions.

32. i. Complete the following reaction by giving the missing starting material, reagent or

product as required:

a. ..... $\xrightarrow[Zn\text{-}H_2O]{O_3}$ 2 

b. 

c.  $\xrightarrow[KOH,\ heat]{KMnO_4}$ .....

ii. Describe the following reactions:

a. Cannizzaro reaction

b. Cross aldol condensation

OR

Account for the following :

i. CH_3CHO is more reactive than CH_3COCH_3 towards reaction with HCN.

ii. There are two -NH_2 groups in semicarbazide ($H_2NNHCONH_2$). However, only one is involved in the formation of semicarbazone.

33. Explain with an example how weak and strong electrolytes can be distinguished.

OR

i. State Faraday's first law of electrolysis. How much charge in terms of Faraday's is required for the reduction of 1 mole of Cu^{2+} to Cu.

ii. Calculate emf of the following cell at 298 K.

$Mg(s)\left|Mg^{2+}(0.1M)\right\|Cu^{2+}(0.01)\left|Cu(s)\right.$

Given, E°_{cell} = +2.71 V,

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

CBSE Class 12 Chemistry

Sample paper 05 (2020-21)

Solution

Section A

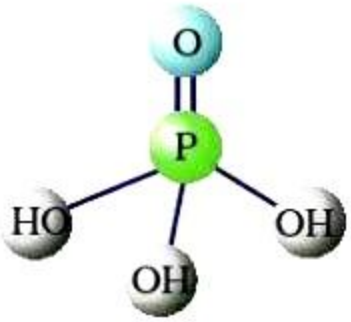
1. i. (b) phosphorus pentachloride

   ii. (d) all of these

   iii. (d) $4AgNO_3 + 2H_2O + H_3PO_2 \longrightarrow 4Ag + 4HNO_3 + H_3PO_4$

   iv. (a) one P=O and one P–OH bond

   v. (b)



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

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

   iii. (d) Assertion is wrong statement but Reason is correct statement

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

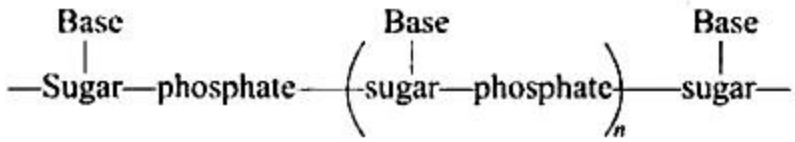
   v. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion

3. (b) Primary amines

   Explanation: In Gabriel Phthalimide reaction, the sodium or potassium salt of phthalimide is N-alkylated with a primary alkyl halide to give the corresponding *N*-alkylphthalimideis for producing primary amines. This is because of the reaction of sodium or potassium salt of phthalimide with alkyl halide impure SN_2 reaction.

4. (d) nucleotides

   Explanation: Nucleic acids are polymers of nucleotides in which nucleic acids are linked together by a phosphodiester linkage also called a polynucleotide.



e.g., DNA, RNA, etc.

OR

(c) Tertiary structure

Explanation: This structure represents tertiary structure of proteins. The tertiary structure of proteins represents overall folding of the polypeptide chains i.e., further folding of the secondary structure.

5. (a) Osmotic pressure

   Explanation: Colligative property is dependent on no. of moles of solute. (π=cRT)

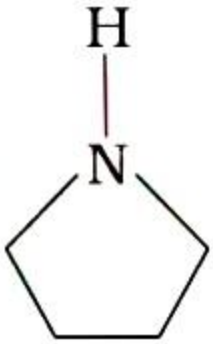
6. (b) HI > HBr > HCl > HF

   Explanation: As we move down the group 17, the size of atom increases as F<Cl<Br<I. Thus the bond strength of hydrogen halides reduces as HF>HCl>HBr>HI. So, it is easiest to break the H-I bond. Hence, the decreasing order of reactivity for the conversion of ROH to RX is HI>HBr>HCl>HF.

OR

(a) Na

Explanation: The Wurtz reaction, named after Charles-Adolphe Wurtz, is a coupling reaction in organic chemistry, organometallic chemistry and recently inorganic main group polymers, whereby two alkyl halides are reacted with sodium metal in dry ether solution to form a higher alkane: $2R–X + 2Na \rightarrow R–R + 2NaX$.

7. (b) 

Explanation: Aniline is a weaker base than NH_3 due to the delocalization of the lone pair of electrons on the N-atom into the benzene ring and less available for protonation. Pyrrole is not at all basic because the lone pair of electrons on N -atom is donated

towards aromatic sextet formation. Therefore, pyrrolidine has a strong tendency to accept a proton and hence the strongest base.

OR

(b) amide

Explanation: primary amine form amide

$C_2H_5NH_2 + (CH3CO)_2O \rightarrow \underset{\text{N - Ethylacetamide}}{CH_3CONHC_2H_5} + CH_3COOH$

8. (a) $K_3[Fe(CN)_6]$

   Explanation: In given complex, there are 3 K^+ ions and so the anion has overall -3 charge. In $[Fe(CN)_6]^{3-}$, there are $6CN^-$ ligands and an overall charge of -3 on the complex and hence Fe is in +3 oxidation state so its electronic configuration is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$. Since CN^- is a strong field ligand and it causes pairing of electrons. But there is one unpaired electron which makes this complex paramagnetic.

   OR

   (b) $[Cr(NH_3)_6][Co(CN)_6]$

   Explanation: Coordination isomerism arises from the interchange of ligands between cationic and anionic entities of different metal ions present in a complex. Here interchange of CN^- and NH_3 ligands is possible between Cr and Co to give $[Co(NH_3)_6][Cr(CN)_6]$. So this complex can exhibit coordination isomerism.

9. (b) It is less readily oxidized in the solid state

   Explanation: Mohr's salt is a better volumetric agent than ferrous sulphate because it is less readily oxidized in the solid state. Also, Mohr's salt is more stable than $FeSO_4$.

10. (d) Cl_2/UV light

    Explanation: Production of alkyl chlorides from alkanes can be carried out by chlorination under the presence of UV light. Chlorine molecule(Cl_2) under the influence of UV light forms free radicals, which react with alkanes to form a mixture of isomeric monohaloalkane and polyhaloalkanes.

11. (c) 74.65

    Explanation: $M = \frac{dN_A a^3}{Z}$

$= \frac{1.984 \times 6.02 \times 10^{23} \times 25.0 \times 10^{-23}}{4}$

= 74.65 g mol^{-1}

12. (d) Both assertion and reason are INORRECT.

    Explanation: Both assertion and reason are INORRECT.

13. (b) Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

    Explanation: Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

14. (d) Both assertion and reason are INCORRECT.

    Explanation: Both assertion and reason are INCORRECT.

OR

(b) Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

Explanation: Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

15. (d) The assertion is a wrong statement but the reason is the correct statement

    Explanation: IUPAC name of the compound is 2-propoxypropane

16. (d) Assertion is INCORRECT but, reason is CORRECT.

    Explanation: Assertion is INCORRECT but, reason is CORRECT.

Section B

17. Treat ethene with water in presence of conc. H_2SO_4 to give ethanol

$$\underset{ethene}{CH_2 = CH_2} \xrightarrow[H_2SO_4]{H_2O} \underset{ethanol}{CH_3CH_2OH}$$

Treat ethanol with $SOCl_2$ in presence of pyridine to give chloroethane

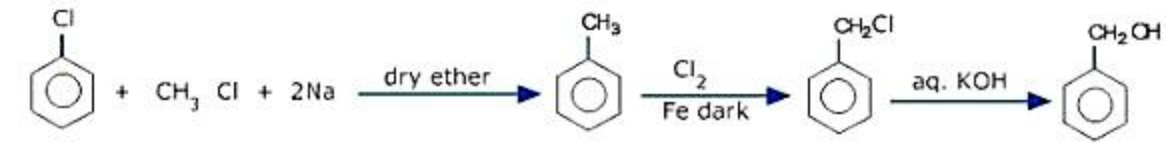
$$\underset{ethanol}{CH_3CH_2OH} \xrightarrow[pyridine]{SOCl_2} \underset{chloroethane}{CH_3CH_2Cl}$$

OR

Step 1: Wurtz fittig reaction-Treat chlorobenzene with methyl chloride and sodium in dry ether to give methyl benzene

Step 2: Methyl benzene when treated with Cl_2, Fe in dark gives benzyl chloride

Step 3: Benzyl chloride on reacting with aq. KOH gives benzyl alcohol



Chlorobenzene

benzyl alcohol

18. **Osmosis**: The movement of solvent molecules from a less concentrated solution to a more concentrated solution through a semipermeable membrane is called osmosis.

    Osmotic Pressure: Osmotic pressure is the extra pressure that is applied to the solution just to prevent the flow of solvent into the solution through a semipermeable membrane. The osmotic pressure method has an advantage over other colligative properties because

    i. Pressure measurement is around room temperature and the molarity of the solution is used instead of molality.

    ii. Its magnitude is large as compared to other colligative properties even for very dilute solutions.

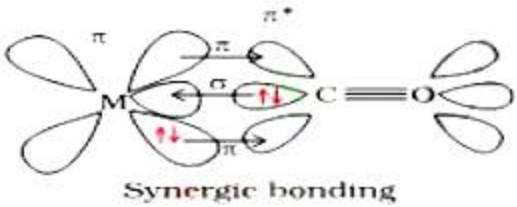
19. i. $Ag(CN)4]^{2-}$ has square planar geometry.

    ii. $[Ag(NH_3)_2]Cl$ remains colourless in aqueous solution because Ag+ has no unpaired electron, therefore, it cannot undergo d-d transition. $[Ni(CN)_4]^{2-}$ also remains colourless as it does not have unpaired electrons.

OR

Electronic configuration of Co: $[Ar]4s^23d^7$

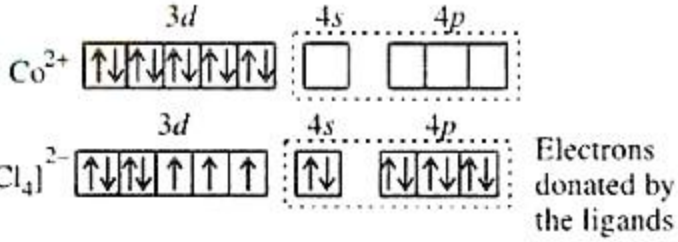
Electronic configuration of Co^{2+}: $[Ar]4s^03d^7$



Synergic bonding

Cl^- Cl^- does not cause pairing of electrons because it is weak field ligand.

Hence,



20. Rate constant of a reaction is nearly doubled with rise in temperature by 10°. The exact

dependence of the rate constant on temperature is given by Arrhenius equation, k = A $e^{-E_a/RT}$, where A is the Arrhenius factor or the frequency factor. It is also called pre-exponential factor. It is a constant specific to a particular reaction. R is gas constant and E_a is activation energy measured in joules/mole (J mol^{-1}).

21. a. Since the units of rate constant are L mol^{-1} s^{-1}, the reaction is of second order.

    b. Since the units of rate constant are s^{-1}, the reaction is of first order.

22. $$\underset{\text{Propene}}{CH_3-CH=CH_2} + Cl \xrightarrow{773K} \underset{\text{Allyl chloride}}{ClCH_2-CH=CH_2} + HCl$$

23. i. In aqueous solution Cu^+ undergoes disproportionation to form a more stable Cu^{2+} ion.

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

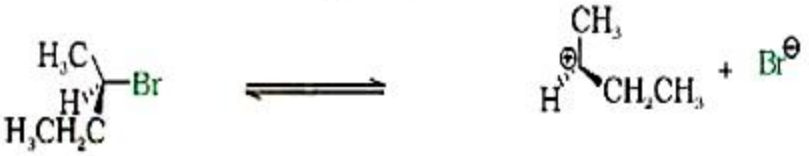
    The higher stability of Cu^{2+} in aqueous solution may be attributed to its greater negative $\Delta_{hyd}H°$ than that of Cu^+. It compensates for the second ionization enthalpy of Cu involved in the formation of Cu^{2+} ions.

    ii. Both O_2 and F_2 stabilize high oxidation states but the ability of oxygen to stabilise these higher oxidation states exceeds that of fluorine due to ability of oxygen to form multiple bonds with the metal atoms. e.g. Mn forms the highest fluoride as MnF_4 whereas, the highest oxide is Mn_2O_7. This is due to the tendency of oxygen to form multiple bonds.

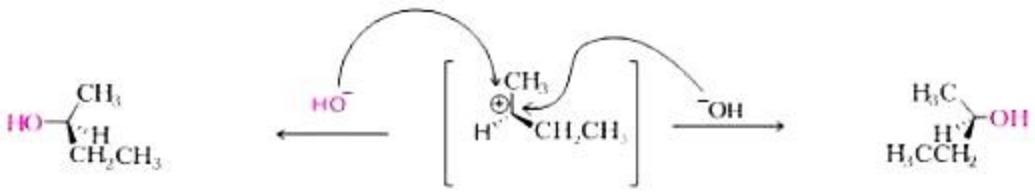
24. $$CH_3\underset{\underset{Br}{|}}{CH}-CH_2CH_3$$

    2 - Bromo butane

    The compound undergoes hydrolysis by S_N1 mechanism via the formation of carbocation which is planar.



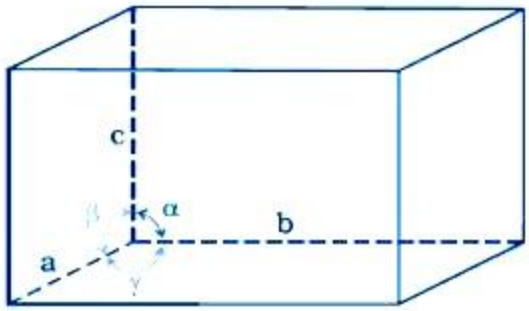
    The attack of nucleophile can result in product which is a mixture of compounds both with same configuration and inverted configuration.



(+)-Butan-2-ol (−)Butan-2-ol

Therefore it results in the formation of racemic mixture which is optically inactive.

25. A unit cell is characterized by
    a. Its dimensions along the three edges a, b and c. These edges may or may not be mutually perpendicular.
    b. Angles between the edges,α (between b and c), β (between a and b) and γ (between a and b). Thus, a unit cell is characterized by six parameters a, b, c, α , β *and* γ.



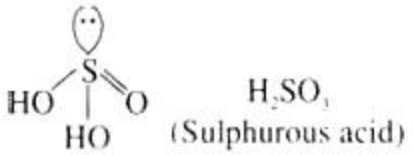
parameters of a unit cell

Section C

26. i. As a result of sp^3d hybridization, there are two axial bonds and three equatorial bonds in PCl_5 molecule. As the axial bond pairs suffer more repulsive interactions from the equatorial bond pairs, therefore, the axial bonds are slightly elongated and slightly weaker than equatorial bonds.
    ii. In vapour state, sulphur partly exists as S_2 molecule and S_2 molecule has two unpaired electrons in antibonding π orbital and hence exhibits paramagnetism.
    iii. Xenon has the lowest ionization energy among the noble gases except radon which is however radioactive.
    iv. Due to inner pair effect the lower oxidation state gets more stabilized in the increase in atomic number in the same group of p-block elements. Hence PbO_2 is stronger oxidizing agent than SnO_2.

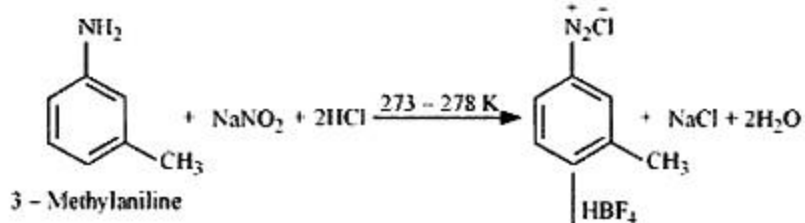
OR

The structure of H_2SO_3 is given below:

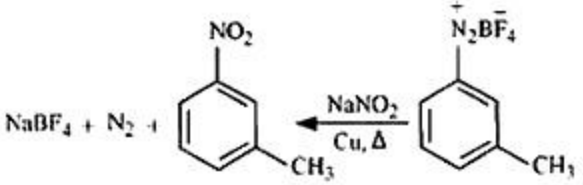


H_2SO_3
(Sulphurous acid)

27. i.



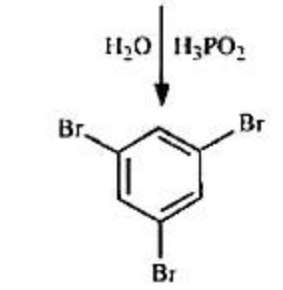
3 – Methylaniline



3 – Nitrotoluene

Aniline

ii.



1, 3, 5 – Tribromobenzene

OR

i. the order of basicity of amines in gaseous phase is as follows: 3° > 2° > 1°> NH_3

Therefore the order will be

$(CH_3)_3N > (CH_3)_2NH > CH_3NH_3 > NH_3$

ii. In aqueous solution the order will be as follows:

$(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$

Reason:

i. In gaseous phase, basic character of amine increases with increase in the number of electrons releasing alkyl groups due to + I effect so the trend of the basic character is:

$3° > 2° > 1°$

ii. In aqueous phase substituted ammonium cations get stabilised by both electron releasing effect of the alkyl group and solvation with a water molecule. Greater the size of ion, lesser will be the solvation and lesser will be the stability of ion, so on combining +I effect and salvation effect, in aqueous phase trend changes to $2° > 3° > 1°$.

28. Here, M = 50 g mol^{-1}

Z = 2

d = $5.91\, g\, cm^{-3}$

$V = a^3$

$d = \frac{Z \times M}{N_A \times a^3}$

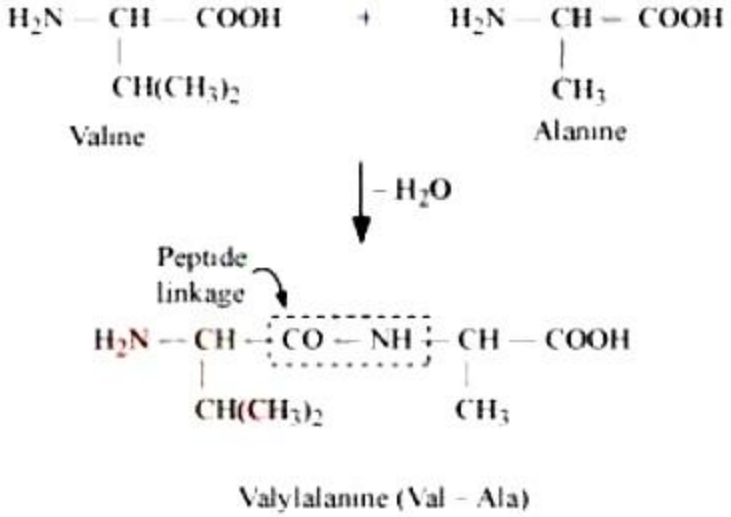
$a^3 = \frac{Z \times M}{N_A \times d}$

$= \frac{2 \times 50}{5.91 \times 6.023 \times 10^{23}}$

$a^3 = 2.80 \times 10^{-23}\, cm^3$

29. i. Peptide linkage:

The amide formed between -COOH group of one molecule of an amino acid and $-NH_2$ group of another molecule of the amino acid by the elimination of a water molecule is called a peptide linkage.



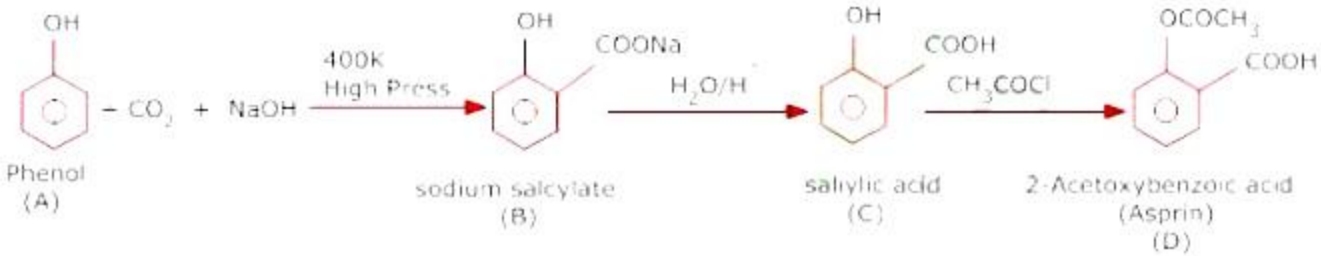
Valylalanine (Val – Ala)

ii. Primary structure: The primary structure of protein refers to the specific sequence in which various amino acids are present in it, i.e., the sequence of linkages between amino acids in a polypeptide chain. The sequence in which amino acids are arranged is different in each protein. A change in the sequence creates a different protein.

iii. Denaturation: In a biological system, a protein is found to have a unique 3-

dimensional structure and a unique biological activity. In such a situation, the protein is called native protein. However, when the native protein is subjected to physical changes such as change in temperature or chemical changes such as change in pH, its H-bonds are disturbed. This disturbance unfolds the globules and uncoils the helix. As a result, the protein loses its biological activity. This loss of biological activity by the protein is called denaturation. During denaturation, the secondary and the tertiary structures of the protein get destroyed, but the primary structure remains unaltered. One of the examples of denaturation of proteins is the coagulation of egg white when an egg is boiled.

30.



Section D

31. a. Transition elements show variable oxidation states that differ by 1 unit. p-block elements show variable oxidation states that differ by 2 units.
Heavier transition elements are stable in higher oxidation state whereas p-block elements are stable in lower oxidation state.

b. Transition metals exhibit higher enthalpies of atomization because of strong interatomic interactions and strong metallic bonding between atoms.

c. Element: Cerium or Terbium.
It is a strong oxidizing agent.

d. The steady decrease in atomic radii with an increase in the atomic number due to the poor shielding effect of 4f orbital electrons is known as lanthanoid contraction.
Consequence: 5d series have almost same size as 4d series.

e. Ionic equation:

$Cr_2O_7^{2-} + 14\ H^+ + 6\ Fe^{2+} \rightarrow 2\ Cr^{3+} + 6\ Fe^{3+} + 7\ H_2O$

OR

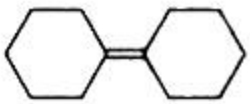
i. In 3d-series all the elements show +2 oxidation state except Sc(Sc = +3). Oxidation states first increases from Sc to Mn due to increase in number of unpaired electrons and then decreases because pairing take place. Fe and Ni show zero oxidation state in

metal carbonyls.

ii. All the metals except scandium form MO oxides which are ionic. The highest oxidation number in the oxides, coincide with the group number and is attained in Sc_2O_3 to Mn_2O_7. Beyond group 7, no higher oxides of iron above Fe_2O_3 are known.

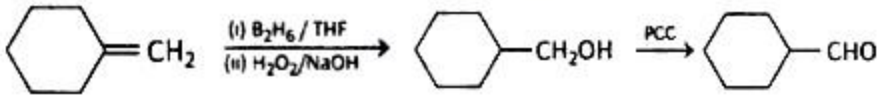
Besides the oxides, the oxocations stabilise V^V as VO_2^+, V^{IV}, as VO^{2+} and Ti as TiO^{2+}. As the oxidation number of a metal increases, ionic character decreases. In case of Mn, MnO_7 is a covalent green oil. Even CrO_3 and V_2O_5 have low melting points. In their higher oxides, the acidic character is predominant. Thus, Mn_2O_7 gives H_2MnO_4 and CrO_3 gives H_2CrO_4 and $H_2Cr_2O_7$. V_2O_5 is however, amphoteric though mainly acidic and it gives VO_4^{3-} as well as VO_2^+ salt.

32. i. a.

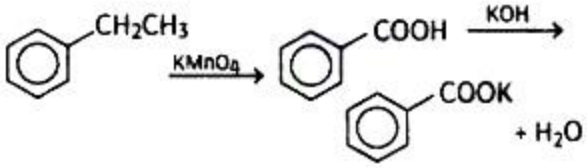


Cyclohexylidine cyclohexane

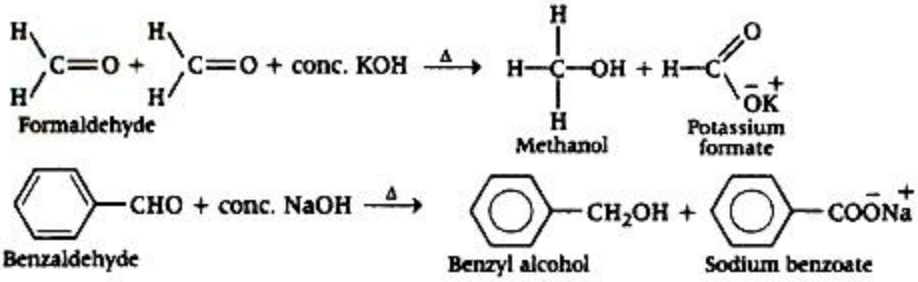
b. B_2H_6/THF polarised by H_2O_2/NaOH and PCC.



c.



ii. a. **Cannizzaro reaction:** Aldehydes which do not have α-H atoms undergo self oxidation and reduction reaction on treatment with conc. alkali, this reaction is known as Cannizzaro reaction. In this reaction, one molecule of aldehyde is reduced to alcohol while another molecule is oxidised to the salt of carboxylic acid.



b. **Cross aldol condensation:** When aldol condensation is carried out between two

different aldehydes or ketones or between an aldehyde or a ketone and at least one of them contain α-H, it is called cross aldol condensation. If both of them contain a-hydrogen atoms, it gives a mixture of four products.

$$CH_3CHO + CH_3CH_2CHO \xrightarrow[(ii)\Delta]{(i)NaOH} \underset{But-2-enal}{CH_3CH=CHCHO} + CH_3CH_2CH$$

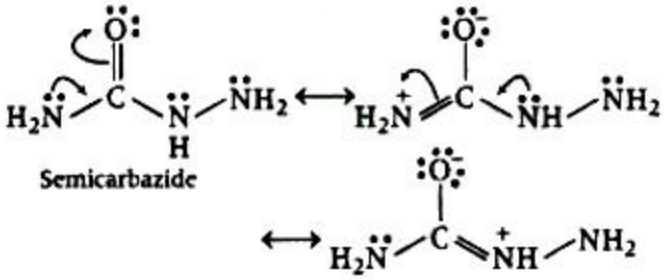
$$= \underset{2-methylpent-2-enal}{\overset{CH_3}{\overset{|}{C}}} - CHO + CH_3 - CH$$

$$= \underset{2-methylbut-2-enal}{\overset{CH_3}{\overset{|}{C}}} - CHO + CH_3CH_2 \underset{Pent-2-enal}{-CH=CHCHO}$$

OR

i. This is because of the fact that due to smaller +I-effect of one alkyl group (- CH_3) in CH_3CHO as compared to larger +I-effect of two alkyl (- $CH_3)_2$ groups in CH_3COCH_3 the, magnitude of positive charge on the carbonyl carbon is more in CH_3CHO than in CH_3COCH_3. Also, the steric effect is more pronounced in case of CH_3COCH_3.

ii. Although semicarbazide has two -NH_2 groups but one of them which is directly attached to C=O group is involved in resonance as shown below:



Therefore, the electron density on -NH_2 group involved in the resonance decreases. As a result, it cannot act as a nucleophile. In contrast, the lone pair of electrons on the other -NH_2 group is not involved in resonance, thus, it can act as a nucleophile and can attack carbonyl carbon atoms of aldehydes and ketones to produce semicarbazones.

33. Strong electrolysis: Those electrolytes which dissociate into ions completely into aqueous solution are called strong electrolytes. for example:
KCl, NaOH, H_2SO_4

Weak electrolytes: Those electrolytes which do not dissociate into ions completely into aqueous solution are weak electrolytes. for example: CH_3COOH, NH_4Cl

OR

i. **Faraday's first law of electrolysis** The amount of substance deposited during electrolysis is directly proportional to the quantity of electricity passed.

$m \propto Q$, $m \propto It$, m = ZIt

where Z is electrochemical equivalent, I is current in ampere, t is a time in seconds and Q is charge in coulomb.

Electrochemical equivalent (Z) It is the amount of substance deposited in grams when 1 ampere current is passed for 1 second, i.e. when 1coulomb of charge is passed. Its Unit is g C^{-1}.

Charge required for the reduction of 1 mole of cu^{2+} to cu = 2F

ii. $Cu^{2+} + Mg \longrightarrow Mg^{2+} + Cu$

Given, $E^{\circ}_{Ccll} = +2.71V$

By using the Nernst equation,

$$E_{cell} = E^{\circ}_{cell} - \frac{0.059}{n} \log \frac{[Mg^{2+}]}{[Cu^{2+}]}$$

Here, n = 2 and E°_{cell} = +2.71 V

$$\therefore E_{cell} = 2.71 - \frac{0.059}{2} \log \frac{(0.1)}{(0.01)}$$

$$= 2.71 - \frac{0.059}{2} \log 10$$

= 2.71 - 0.0295 [$\because$ log 10 = 1]

= 2.68 V