CBSE Class 12 Chemistry
Sample paper 01 (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 question**

   Ozone is an allotropic form of oxygen. It is too reactive to remain for long in the atmosphere at sea level. At a height of about 20 kilometers, it is formed from atmospheric oxygen in the presence of sunlight. This ozone layer protects the earth's surface from an excessive concentration of ultraviolet (UV) radiations. The formation of ozone from oxygen is an endothermic process. If concentrations of ozone greater than 10 per cent are required, a battery of ozonises can be used, and pure ozone can be condensed in a vessel surrounded by liquid oxygen. When ozone reacts with an excess of potassium iodide solution buffered with a borate buffer, iodine is liberated which can be titrated against a standard solution of sodium thiosulphate. Ozone layer is probably posed by the use of freons which are used in aerosol sprays and as refrigerants.

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

   i. When a slow dry stream of oxygen is passed through a silent electrical discharge, conversion of oxygen to ozone (10%) occurs. The product is known as

   - a. dioxygen
   - b. ozone
   - c. ozonised oxygen
   - d. none of these

ii. Pure ozone is a
   - a. pale blue gas
   - b. dark blue liquid
   - c. violet-black solid
   - d. all of these

iii. Ozone is thermodynamically unstable its decomposition into oxygen results in
   - a. liberation of heat
   - b. increases in entropy
   - c. both (a) and (b)
   - d. decreases in entropy

iv. Length of oxygen-oxygen bond in ozone
   - a. 128pm
   - b. 134pm
   - c. 430pm
   - d. 290pm

v. Ozone oxidise lead sulphide to
   - a. lead sulphate
   - b. only sulphate
   - c. only lead
   - d. sulphite

2. **Read the passage given below and answer any four out of the following questions:**
The accumulation of molecular species at the surface rather than in the bulk of a solid or liquid is termed adsorption. There are mainly two types of adsorption of gases on solids physisorption and chemisorption. If the accumulation of gas on the surface of a solid occurs on account of weak van der Waals forces, the adsorption is termed as physical adsorption or physisorption. When the gas molecules or atoms are held to the solid surface by chemical bonds, the adsorption is termed chemical adsorption or chemisorption. Physisorption usually lack specificity surface of an adsorbent does not show any preference for a particular gas as the van der Waals' forces are universal,

nature of absorbate gases adsorbed as van der Waals' forces are stronger near the critical temperatures, physical adsorption of a gas by a solid is generally reversible more of gas is adsorbed when pressure is increased as the volume of the gas decreases, enthalpy of adsorption physical adsorption is an exothermic process.

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

a. Assertion and reason both are correct statement and reason is correct explanation for assertion
b. Assertion and reason both are correct statement and reason is not correct explanation for assertion
c. Assertion is correct but reason is wrong statement
d. Assertion is wrong but reason is correct statement

i. **Assertion:** Chemisorption involves high energy of activation.
   Reason: Molecules of hydrogen dissociate to form hydrogen atom which is held on the surface by chemisorption.
ii. **Assertion:** Easily liquefiable gases are readily absorbed.
   Reason: 1g of methane absorb more sulphur dioxide than activated charcoal.
iii. **Assertion:** finely divided metals and porous substances having large surface areas are good adsorbents.
   Reason: The extent of adsorption increases with the increase of the surface area of the adsorbent.
iv. **Assertion:** Enthalpy of adsorption is quite low.
   Reason: The attraction between gas molecules and solid surface is only due to weak van der Waals' forces.
v. **Assertion:** physisorption is highly specific in nature.
   Reason: Low temperature is favourable for adsorption.

3. The following reaction takes place in the presence of:

a. None of these
b. H_2/Pd
c. NaOH/Pd
d. HCl/Pd

4. Which of the following is a fibrous protein?
    a. Glycoprotein
    b. Keratin
    c. Proteoses
    d. Prolamine

OR

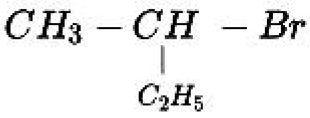
The combination of nitrogen – containing heterocyclic base with 1' position of sugar is known as

a. s – RNA
b. nucleotide
c. m – RNA
d. nucleoside

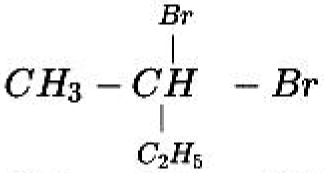
5. Solution of hydrogen in palladium is an example of
    a. Gas in gas
    b. Solid in solid
    c. Liquid in gas
    d. Gas in solid
6. To prepare alkanes containing odd number of carbon atoms, Wurtz reaction is not preferred because:
    a. a lot of reaction mixture goes wasted.
    b. a mixture of three different alkyl halides has to be used.
    c. a mixture of four different alkyl halides has to be used.
    d. a mixture of two different alkyl halides has to be used.

OR

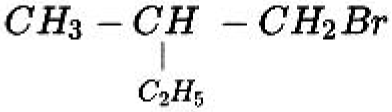
Which of the following compounds will give racemic mixture on nucleophilic substitution by OH⁻ ion?

a. 

$CH_3 - \underset{\displaystyle C_2H_5}{\underset{|}{CH}} - Br$

b. 

$CH_3 - \overset{Br}{\underset{C_2H_5}{CH}} - Br$

c. 

$CH_3 - \underset{C_2H_5}{CH} - CH_2Br$

a. (b), (c)

b. (a), (c)

c. (a), (b), (c)

d. (a)

7. Direct nitration of aniline yields a significant amount of meta derivative. To obtain more p – nitro derivative, one or more of the below can be done________.

a. reacting with acetic anhydride

b. by increasing temperature

c. controlling the nitration reaction

d. All of these

OR

Arrange the following compounds in order of increasing boiling point: $CH_3NHCH_2CH_3$; $CH_3OCH_2CH_3$; $(CH_3)_3N$; and $CH_3CH_2CH_2OH$.

a. Low to high; $CH_3OCH_2CH_3$.; $(CH_3)_3N$; $CH_3NHCH_2CH_3$; $CH_3CH_2CH_2OH$.

b. Low to high: $CH_3NHCH_2CH_3$; $CH_3CH_2CH_2OH$.; $(CH_3)_3N$; $CH_3OCH_2CH_3$.

c. Low to high: $(CH_3)_3N$; $CH_3OCH_2CH_3$; $CH_3NHCH_2CH_3$; $CH_3CH_2CH_2OH$.

d. Low to high: $CH_3CH_2CH_2OH$; $CH_3NHCH_2CH_3$; $(CH_3)_3N$; $CH_3OCH_2CH_3$.

8. Which of the following is a homoleptic complex?

a. $[Cr(NH_3)_3Cl_3]$

b. $[CoCl_2(en)_2]^+$

c. $[Co(NH_3)_4Cl_2]^+$

d. $[Cu(NH_3)_4]^{+2}$

OR

Match the complex ions given in Column I with the colours given in Column II and assign the correct code :

Column I (Complex ion)	Column II (Colour)
(a) $[Co(NH_3)_6]^{3+}$	(i) Violet
(b) $[Ti(H_2O)_6]^{3+}$	(ii) Green
(c) $[Ni(H_2O)_6]^{2+}$	(iii) Pale blue
(d) $(Ni\ (H_2O)_4(en)]^{2+}$ (aq)	(iv) Yellowish orange
	(v) Blue

a. (a)-(i), (b)-(ii), (c)-(iv), (d)-(v)
b. (a)-(iii), (b)-(ii), (c)-(iv), (d)-(i)
c. (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)
d. (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

9. The oxidation number of Fe in $K_4[Fe(CN)_6]$ is:
   a. 0
   b. +1
   c. +3
   d. +2
10. Grignard reagent should be prepared under anhydrous conditions because:
    a. the carbon – Mg bond is covalent but highly polar
    b. the Mg – Halogen bond is essentially ionic
    c. it can react with any source of protons to give hydrocarbons
    d. All of these
11. The correct order of the packing efficiency in different types of unit cells is:
    a. fcc < bcc > simple cubic
    b. fcc > bcc > simple cubic
    c. bcc < fcc > simple cubic
    d. fcc < bcc < simple cubic
12. **Assertion:** $[Cr(H_2O)_6]Cl_2$ and $[Fe(H_2O)_6]Cl_2$ are reducing in nature.

    Reason: Unpaired electrons are present in their d-orbitals.

a. Assertion and reason both are true, reason is correct explanation of assertion.
b. Assertion and reason both are true but reason is not the correct explanation of assertion.
c. Assertion is true, reason is false.
d. Assertion is false, reason is true.

13. **Assertion:** Purine base present in DNA are adenine and guanine.

Reason: The base thymine is present in RNA whereas base uracil is present in DNA.

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:** When a solution is separated from the pure solvent by a semipermeable membrane, the solvent molecules pass through it from the pure solvent side to the solution side.

Reason: Diffusion of solvent occurs from a region of high concentration solution to a region of low concentration solution.

a. Assertion and reason both are correct statements and reason is correct explanation for assertion.
b. Assertion and reason both are correct statements but the reason is not the correct explanation for the assertion.
c. The assertion is a correct statement but the reason is the wrong statement.
d. Assertion and reason both are incorrect statements.

OR

Assertion: Cooking time in pressure cookers is reduced.

Reason: Boiling point inside the pressure cooker is raised.

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:** Ethanol is a weaker acid than phenol.

    Reason: Sodium ethoxide can not be prepared by the reaction of ethanol with aqueous NaOH.

    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:** KCN reacts with methyl chloride to give methyl isocyanide.

    Reason: CN^- is an ambident nucleophile.

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

Section B

17. Explain why the boiling points of isomeric haloalkanes decrease with increase in branching.

OR

Complete the following reactions:

i. $CH_3CH_2OH + PCl_5 \rightarrow$
ii. $CH_3CH_2CH_2OH \xrightarrow{red\ P/Br_2}$
iii. $CH_3OH + HCl \xrightarrow{ZnCl_2}$

18. Mention a large scale use of the phenomenon called reverse osmosis?

19. Write the IUPAC name of $[Co(NH_3)_3ONO]Cl_2$

OR

Write the IUPAC names and hybridisation of the following complexes:

i. $[Ni(CN)_4]^{2-}$

ii. $[Fe(H_2O)_6]^{2+}$ (Given : Atomic number Ni = 28, Fe = 26)

20. Give the units of specific reaction rate constant for a zero order reaction.

21. In a first order reaction, the concentration of the reactant is reduced from 0.6 mol L^{-1} to 0.2 mol L^{-1} in 5 min. Calculate the rate constant of the reaction.

22. How are the following conversions carried out?
    i. Propene to propan-2-ol
    ii. Phenol to salicylaldehyde

23. Explain the following observations:
    i. The transition elements have great tendency for complex formation.
    ii. There is a gradual decrease in the atomic sizes of transition elements in a series with increasing atomic numbers.

24. How may methyl bromide be preferentially converted to methyl cyanide and methyl isocyanide?

25. Excess of lithium makes LiCl crystal pink. Explain.

Section C

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

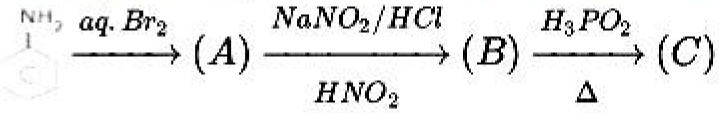
OR

Explain why NH_3 is basic while BiH_3 is only feebly basic.

27. Complete the following reaction equations:
    i. $C_6H_5NH_2 + CH_3COCl \longrightarrow$
    ii. $C_2H_5NH_2 + C_6H_5SO_2Cl \longrightarrow$
    iii. $C_2H_5NH_2 + HNO_2 \longrightarrow$

OR

Identify the compounds A, B and C in the following equation:



28. Why are liquids and gases categorised as fluids?

29. How do you explain the amphoteric behavior of amino acids?

30. Give the structures and IUPAC names of the products expected from the following reactions:
   a. Catalytic reduction of butanol.
   b. Hydration of propene in the presence of dilute sulphuric acid.
   c. Reaction of propanone with methyl magnesium bromide followed by hydrolysis.

Section D

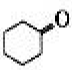
31. a. Explain the following:
      i. Transition elements tend to be unreactive with increasing atomic number in the series.
      ii. d-block elements exhibit more oxidation state than f-block elements.
   b. A green chromium compound (A) on fusion with alkali gives yellow compound (B) which on acidification gives an orange coloured compound (C) 'C' on treatment with NH_4Cl given an orange coloured product (D) which on heating decomposes to give back (A). Identify A, B, C and D. Write equation for the reactions.

OR

What may be the possible oxidation state of the transition element with the following d electron configurations in the ground state of their atoms as $3d^3$, $3d^5$, $3d^8$ and $3d^4$?

32. a. Write the main product formed when propanal reacts with the following reagents:
      i. 2 moles of CH_3OH in presence of dry HCl
      ii. Dilute NaOH
      iii. H_2N-NH_2 followed by heating with KOH in ethylene glycol
   b. Arrange the following compounds in increasing order of their property as indicated :
      i. F - CH_2COOH, O_2N - CH_2COOH, CH_3COOH, HCOOH - acidic character
      ii. Acetone, Acetaldehyde, Benzaldehyde, Acetophenone - reactivity towards addition of HCN

OR

i. Write the product(s) in the following reactions:
   a.  + HCN $\longrightarrow$?

b.  + NaOH $\xrightarrow[\Delta]{CaO}$?

c. CH_3-CH=CH-CN $\xrightarrow[(b)\ H_2O]{(a)\ DIBAL-H}$?

ii. Give simple chemical tests to distinguish between the following pairs of compounds:

a. Butanal and butan-2-one

b. Benzoic acid and phenol

33. a. (i) Represent the galvanic cell in which the reaction $Zn(s) + 2Ag^+(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$ takes place.

(ii) Which electrode is negatively charged?

(iii) Write reactions taking place at each electrode.

b. Calculate the number of coulombs required for the oxidation of 1 mole of water to oxygen as per equation.

$2H_2O \rightarrow 4H^+ + O^2 + 4e^-$

(Given 1 F = 96500 C mol^{-1})

OR

Write the Nernst equation and the e.m.f. of the following cells at 298 K.

i. $Mg(s)|Mg^{2+}(0.001M)||Cu^{2+}(0.001M)|Cu(s)$

ii. $Fe(s)|Fe^{2+}(0.001M)||H^+(1M)|H_2(g)(1bar)|pt(s)$

iii. $Sn(s)|Sn^{2+}(0.050M)||H^+(0.020M)|H_2(g)(1bar)|pt(s)$

iv. $Pt(s)|Br_2(1)|Br^-(0.010M)|H^+(0.030M)|H2(g)(1bar)|pt(s)$

Given:

$E^0(Mg^{2+}/Mg) = -2.37V$

$E^0(Cu^{2+}Cu) = +0.34V$

$E^0(Fe^{2+}/Fe) = -0.44V$

$E^0(Sn^{2+}/Sn) = -0.14V$ $E^0(Br_2/Br^-) = +1.08V$

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Solution

Section A

1.
   i. (c) ozonised oxygen
   ii. (d) all of these
   iii. (c) both (a) and (b)
   iv. (a) 128pm
   v. (a) lead sulphate
2.
   i. (b) Assertion and reason both are correct statements and reason is not correct explanation for assertion.
   ii. (c) Assertion is correct statement but reason is wrong statement.
   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.
   v. (d) Assertion is wrong statement but reason is correct statement.
3. (b) H_2/Pd

   Explanation: -NO_2 group is reduced to -NH_2 using H_2/Pd.
4. (b) Keratin

   Explanation: When the polypeptide chains run parallel and are held together by hydrogen and disulphide bonds, then fibre– like structure is formed. Such proteins called fibrous proteins are generally insoluble in water. A common example is keratin (present in hair, wool, silk).

   OR

   (d) nucleoside

   Explanation: A unit formed by the attachment of a base to 1' position of sugar is known as nucleoside. In nucleosides, the sugar carbons are numbered as 1', 2', 3', etc. in order to distinguish these from the bases.
5. (d) Gas in solid

Explanation: Hydrogen (solute, gas) and solvent is palladium (solid).

6. (d) a mixture of two different alkyl halides has to be used.

   Explanation: Alkyl halides on treatment with sodium metal in dry ethereal (free from moisture) solution give higher alkanes. This reaction is known as the Wurtz reaction and is used for the preparation of higher alkanes containing even a number of carbon atoms. Many side products are formed when two different alkyl halides are used. So this method is not preferred to prepare alkanes having an odd number of C atoms.

   OR

   (d) (a)

   Explanation: A mixture containing two enantiomers in equal proportions but with zero optical activity because the opposite optical rotations of the two enantiomers cancel out each other rotation is called a racemic mixture. For a racemic mixture to occur after the nucleophilic substitution, the optically active reactant undergoes an S_N1 reaction. Options (a) is a chiral carbon atom and it will undergo an S_N1 substitution mechanism to give a racemic mixture. Option (b) is not an asymmetric carbon, and option (c) contains a secondary carbon asymmetric atom, which has less reactivity towards an S_N1 substitution mechanism.

7. (a) reacting with acetic anhydride

   Explanation: Direct nitration of aniline yield significant amount of meta derivative, this is because the use of HNO_3 during nitration of aniline causes the formation of anilinium ion($C_6H_5NH_3^+$). Anilinium ion is responsible for the formation of meta nitro aniline. To prevent this, the initial reaction of aniline with acetic anhydride acetylates -NH_2 group.

   $C_6H_5NH_2 + CH_3COOCOCH_3 \rightarrow C_6H_5NHCOCH_3$.

   Now, -$NHCOCH_3$ is an activating group, which on nitration followed by hydrolysis form para nitro aniline as a major product.

   OR

   (c) Low to high: $(CH_3)_3N$; $CH_3OCH_2CH_3$; $CH_3NHCH_2CH_3$; $CH_3CH_2CH_2OH$.

   Explanation: The increasing order of boiling point is as follows:

   Low to high: $(CH_3)_3N$; $CH_3OCH_2CH_3$; $CH_3NHCH_2CH_3$; $CH_3CH_2CH_2O$.

This is on the basis of intermolecular interactions.

8. (d) $[Cu(NH_3)_4]^{+2}$

   Explanation: Complexes in which the central metal is bound to only one kind of donor groups are called homoleptic complexes. $[Cu(NH_3)_6]^{+2}$ is a homoleptic complex because in this only ammonia group is the donor group bound to Cu^{+2}.

   OR

   (c) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

   Explanation: The complex ion form the corresponding colour are as follow:
   (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

9. (d) +2

   Explanation: The ligand CN^- has charge of –1. So the overall charge carried by 6 CN^- ligands is -6. Each potassium ion K^+ carries a charge of +1. So 4 potassium ions carry an overall charge of +4. This implies that the overall charge on the coordination sphere is -4 to balance the +4 charge of the potassium ions. Let the oxidation number of Fe be x. Then
   $x + (-6) = -4$
   $x = -4 - (-6)$
   $x = -4 + 6$
   $x = +2$
   So, the oxidation number of Fe is +2.

10. (d) All of these

    Explanation: In the Grignard reagent, the carbon-magnesium bond is covalent but highly polar, with carbon pulling electrons from electropositive magnesium; the magnesium halogen bond is essentially ionic.
    Grignard reagents are highly reactive and react with any source of a proton to give hydrocarbons. Even water, alcohols, amines are sufficiently acidic to convert them to corresponding hydrocarbons.

    $$RMgX + H_2O \rightarrow RH + Mg(OH)X$$

    It is therefore necessary to avoid even traces of moisture from a Grignard reagent.

11. (b) fcc > bcc > simple cubic

    Explanation: Packing efficiency (is the percentage of total space filled by the particle) in different types of unit cells can be tabulated as

Unit Cell	Packing Efficiency
fcc	74%
bcc	68%
Simple Cubic	52.4%

Hence, correct order is fcc (74%) > bcc (68%) > simple cubic (52.4%)

12. (b) Assertion and reason both are true but reason is not the correct explanation of assertion.

    Explanation: In the complexes, Co exists as Co^{2+} and Fe as Fe^{2+}. Both of the complexes become stable by oxidation of metal ion to Co^{3+} and Fe^{3+}
13. (c) Assertion is CORRECT but, reason is INCORRECT.

    Explanation: Assertion is CORRECT but, reason is INCORRECT.
14. (c) The assertion is a correct statement but the reason is the wrong statement.

    Explanation: Solvent molecules pass through the semipermeable membrane from a region of low concentration solution to the region of high concentration solution.

    OR

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

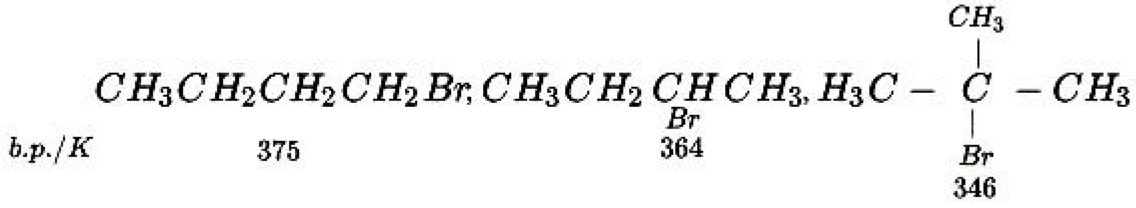
    Explanation: Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
15. (c) The assertion is a correct statement but the reason is the wrong statement.

    Explanation: Phenol is a stronger acid than ethanol as phenoxide ion is stabilized by resonance whereas no such stabilization occurs in ethoxide ion. Sodium ethoxide can be prepared by the reaction of ethanol with sodium.
    Since ethanol is poor acid (even from water also) so it can not react with a strong base like NaOH. While on treatment with strong electropositive metals like Na it liberates H_2 gas and Sodium ethoxide.
16. (a) The assertion is wrong but the reason is the correct statement.

    Explanation: Haloalkanes react with AgCN to form alkyl isocyanides as the main product while KCN forms alkyl cyanides as the chief product.

Section B

17. The boiling points of isomeric haloakanes decrease with branching due to decrease in surface areas with branching. As branching increases, the points of contacts with the other molecules decrease resulting in lesser vander waal forces of attraction. For e.g. the boiling points of isomers of C_4H_9 Br follow the order.



$$\underset{375}{CH_3CH_2CH_2CH_2Br}, \underset{364}{CH_3CH_2\underset{Br}{CH}CH_3}, H_3C-\underset{\underset{346}{Br}}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-CH_3$$

b.p./K 375 364 346

OR

i. $CH_3CH_2OH + PCl_5 \rightarrow CH_3CH_2Cl + POCl_3 + HCl$

ii. $CH_3CH_2CH_2OH \xrightarrow{red\ P/Br_2} CH_3CH_2CH_2Br$

iii. $CH_3OH + HCl \xrightarrow{ZnCl_2} CH_3Cl + H_2O$

18. Reverse osmosis is used in the desalination of water to get drinking water from sea water. Here the salts in sea water which makes the water hard and unfit for drinking purpose is removed along with impurities.

19. Hexaammine nitritocobalt III chloride

OR

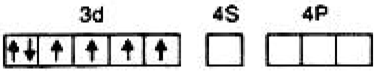
i. **IUPAC name** of the given complex $[Ni(CN)_4]^{2-}$ is tetracyanonickelate (II) ion.

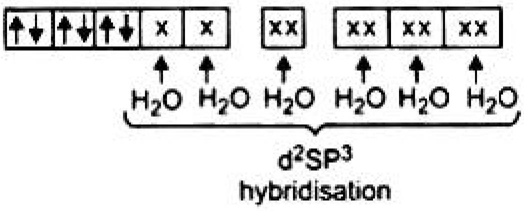
Hybridisation - Ni (28) E.C; $[Ar]3d^8\ 4s^2$ thus, dsp^2 hybridised orbital

ii. **IUPAC name** of the given complex $[Fe(H_2O)_6]^{2+}$ is Hexaaquairon(II).

Hybridisation - Fe (26) E.C: $[Ar]\ 4s^23d^6$

E.C. of $Fe^{2+} = 4s^03d^6$, d^2sp^3





20. Unit of k for zero order reaction is mol L^{-1} s^{-1}.

21. Rate constant,

$$k = \frac{2.303}{t}\log\frac{[R]_0}{[R]}$$

Given, [R]0 = 0.6 mol L^{-1}

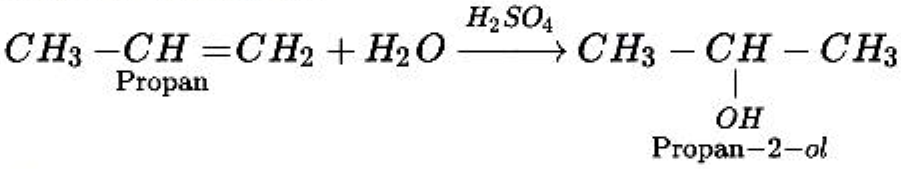
[R] = 0.2 mol L^{-1}, t = 5min

$$k = \frac{2.303}{5}\log\frac{0.6}{0.2}$$

$$k = \frac{2.303}{5}\log 3 \text{ (log 3 = 0.4771)}$$

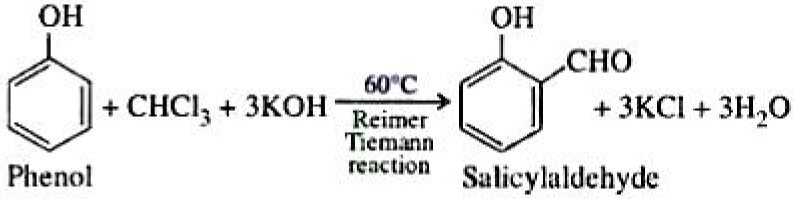
$$k = \frac{2.303}{5} \times 0.4771 = 0.2197 \text{min}^{-1}$$

22. i. Propene to propan-2-



$$\underset{\text{Propan}}{CH_3 - CH = CH_2} + H_2O \xrightarrow{H_2SO_4} \underset{\text{Propan}-2-ol}{CH_3 - \underset{OH}{\underset{|}{C}H} - CH_3}$$

ii. Phenol to salicylaldehyde



23. i. Due to the comparatively smaller size of the metal ions, high ionic charges and the availability of vacant d-orbitals for bond formation, transition metals form a large number of complex compounds.

ii. In general, atoms in a given series of transition metals show a progressive decrease in radius with increasing atomic number. This is because as new electron enters in a d-orbital, the nuclear charge increases progressively by unity. Due to the poor shielding effect of a d-electrons, the effective nuclear charge increases and radius decreases. Both these effects counter each other, therefore change in atomic size is negligible.

24. Reaction with KCN produces methyl cyanide and with AgCN produces methyl isocyanide preferentially.

$$CH_3\underset{\substack{\textit{Methyl}\\ \textit{bromide}}}{Br} + KCN \rightarrow CH_3\underset{\substack{\textit{Methyl}\\ \textit{cyanide}}}{C \equiv N} + KBr$$

$$CH_3\underset{\substack{\textit{Methyl}\\ \textit{bromide}}}{Br} + AgCN \rightarrow CH_3N \underset{\substack{\rightarrow\\ \textit{Methyl}\\ \textit{isocyanide}}}{=} C + AgBr$$

25. When crystals of LiCl are heated in an atmosphere of Li vapour the Lithium atoms are deposited on the surface of crystal. The Cl^- ions diffuse to the surface of crystal & combine with Li atoms to from LiCl which happens by loss of electrons by Li atoms to form Li^+ ions. These released elements diffuse into the crystal & electrons get excited after absorbing light from visible region & emit pink colour.

Section C

26. Fluorine is a much stronger oxidizing agent than chlorine. The oxidizing power depends on three factors.
    1. Bond dissociation energy
    2. Electron gain enthalpy
    3. Hydration enthalpy

    The electron gain enthalpy of chlorine is more negative than that of fluorine. However, the bond dissociation energy of fluorine is much lesser than that of chlorine. Also, because of its small size, the hydration energy of fluorine is much higher than that of chlorine. Therefore, the latter two factors more than compensate for the less negative electron gain enthalpy of fluorine. Thus, fluorine is a much stronger oxidizing agent than chlorine.

    OR

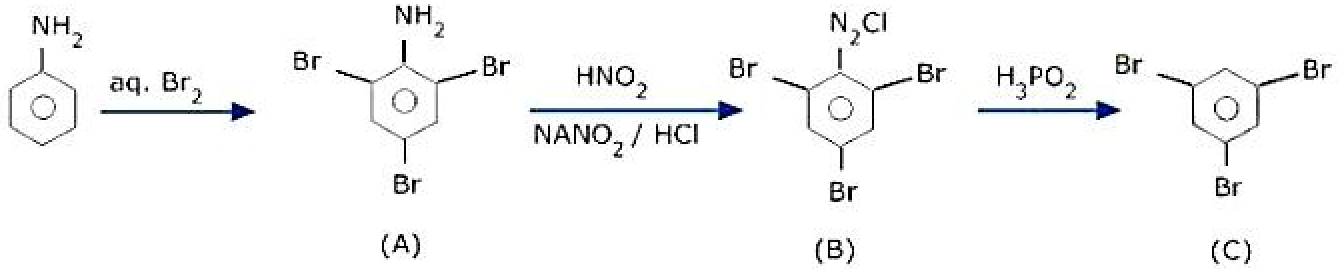
    NH_3 is distinctly basic while BiH_3 is feebly basic. Nitrogen has a small size due to which the lone pair of electrons is concentrated in a small region. This means that the charge density per unit volume is high. On moving down a group, the size of the central atom increases and the charge gets distributed over a large area decreasing the electron density. Hence, the electron donating capacity of group 15 element hydrides decreases on moving down the group.

27. i. $C_6H_5NH_2 + CH_3COCl \longrightarrow \underset{\text{Acetanilide}}{C_6H_5NHCOCH_3} + HCl$

ii. $C_2H_5NH_2 + C_6H_5SO_2Cl \longrightarrow C_6H_5SO_2NHC_2H_5 + HCl$

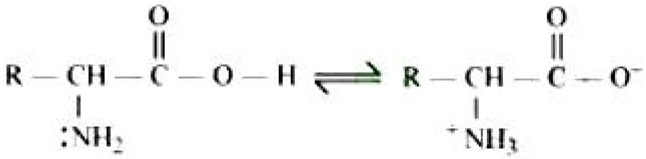
iii. $C_2H_5NH_2 + HNO_2 \longrightarrow C_2H_5OH + N_2 + HCl$

OR



28. The state of various substances to categorize as solid, liquid or gaseous depends on the nature of the constituent particles and the interactions and bonding between them. Liquids and gases are categorized as fluids because The liquid and gases have a property to flow i.e the molecules can move past and tumble over one another freely. The fluidity in both these states is due to the fact these two substances are free to move about unlike solids who are rigidly placed in their position and can only oscillate about their mean position.

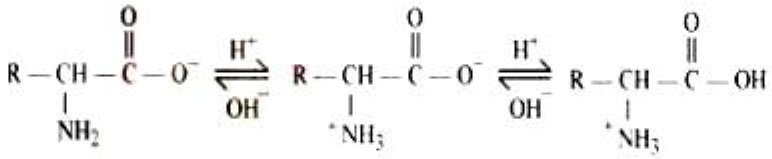
29. In aqueous solution, the carboxyl group of an amino acid can lose a proton and the amino group can accept a proton to give a dipolar ion known as zwitter ion.



$$R-\underset{\underset{:NH_2}{|}}{CH}-\overset{\overset{O}{||}}{C}-O-H \rightleftharpoons R-\underset{\underset{^{+}NH_3}{|}}{CH}-\overset{\overset{O}{||}}{C}-O^-$$

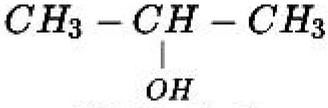
Zwitter ion

Therefore, in zwitter ionic form, the amino acid can act both as an acid and as a base.



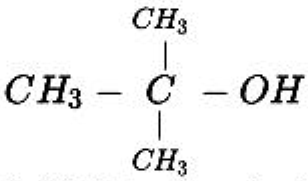
$$R-\underset{\underset{NH_2}{|}}{CH}-\overset{\overset{O}{||}}{C}-O^- \underset{OH^-}{\overset{H^+}{\rightleftharpoons}} R-\underset{\underset{^{+}NH_3}{|}}{CH}-\overset{\overset{O}{||}}{C}-O^- \underset{OH^-}{\overset{H^+}{\rightleftharpoons}} R-\underset{\underset{^{+}NH_3}{|}}{CH}-\overset{\overset{O}{||}}{C}-OH$$

30. a. $CH_3-CH_2-CH_2CH_2-OH$
Butan - 1 - ol

b. 

$CH_3-\underset{\underset{OH}{|}}{CH}-CH_3$

Propan - 2 - ol

c. 

$$CH_3-\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-OH$$

$2-Methylpropan-2-ol$

Section D

31. a. i. Transition metal form layer of oxides on their surface due to which they become unreactive. Secondly, reactivity decreases with increase in atomic number due to decrease in size and increase in ionization energy.

ii. In d-block elements, electrons of s-orbital and d-orbitals both take part in bond formation. In f-block elements due to poor shielding effect of f-electrons effective nuclear charge increases therefore, lesser number of oxidation states are shown.

b. $$\underset{'A'}{2Cr_2O_3} + 8\,NaOH + 3O_2 \rightarrow \underset{Yellow\,'B'}{4Na_2CrO_4} + 4H_2O$$

$$\underset{'B'}{2Na_2CrO_4} + H_2SO_4 \rightarrow \underset{Orange\text{ 'C'}}{Na_2Cr_2O_7} + Na_2SO_4 + H_2O$$

$$2NH_4Cl + Na_2Cr_2O_7 \rightarrow \underset{(Orange\text{ 'D'})}{(NH_4)_2Cr_2O_7} + 2NaCl$$

$$\underset{Ammonium\ dichromate}{(NH_4)_2Cr_2O_7} \xrightarrow{heat} N_2 + \underset{Green}{Cr_2O_3} + 4H_2O$$

So, Compound A = Cr_2O_3, compound B= Na_2CrO_4, compound C = $Na_2Cr_2O_7$, compound D= $(NH_4)_2Cr_2O_7$

OR

	Electronic configuration in ground state	**Stable oxidation states**
(i)	$3d^3$ (Vanadium)	+2, +3, +4 and +5
(ii)	$3d^5$ (Chromium)	+2,+3, +4,+5 and +6
(iii)	$3d^5$ (Manganese)	+2, +3,+4, +5 ,+6 and +7
(iv)	$3d^8$ (Cobalt)	+2, +3 and +4
(v)	$3d^4$	There is no $3d^4$ configuration in ground state.

Out of all the possible oxidation state of the transition elements there are some oxidation state which are most common among these elements. Common
oxidation states are:

i. $3d^3$ (Vanadium) is +5
ii. $3d^5$ (Chromium) is +3 , +6
iii. $3d^5$ (Manganese) is +2 , +7
iv. $3d^8$ (Cobalt) is +2 , +3

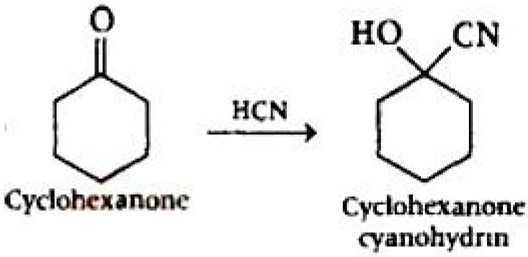
32. a. i. $CH_3CH_2CH(OCH_3)_2$
ii. $CH_3CH_2CH(OH)CH(CH_3)CHO$
iii. $CH_3CH_2CH_3$

b. i. Increasing order of acidic character:
$CH_3COOH < HCOOH < FCH_2COOH < O_2N\text{-}CH_2COOH$
ii. Increasing order of reactivity towards addition of HCN:
Acetophenone < Benzaldehyde < acetone < acetaldehyde

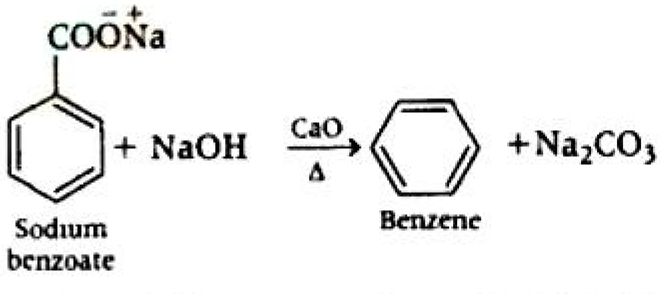
OR

i. Cyclohexanone when reacts with hydrogen cyanide (HCN) it form cyclohexanone cyanohydrin

a.



b. The sodium benzoate reacts with soda lime to give benzene

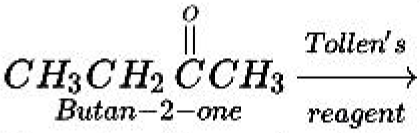


c. But-2-en-1 nitrile on reaction with DIBAL-H followed by water give

$$\underset{But-2-en-1-nitrile}{CH_3CH=CH-CN}\xrightarrow[(ii)\ H_2O]{(i)\ DIBAL-H}\underset{But-2-en-1-ol}{CH_3CH=CH-CHO}$$

ii. a. Butanal being an aldehyde reduces Tollen's reagent to shiny silver mirror but butan-2-one being a ketone does not reduces Tollen's reagent.

$$\underset{Butanal}{CH_3CH_2CH_2CHO}+\underset{Tollen's\ reagent}{2[Ag(NH_3)_2]^+}+3\bar{O}H\xrightarrow{\Delta}$$
$$CH_3CH_2CH_2COO^-+\underset{\substack{Silver\\ mirror}}{2Ag\downarrow}+4NH_3+2H_2O$$



$$\underset{Butan-2-one}{CH_3CH_2\overset{\overset{O}{||}}{C}CH_3}\xrightarrow[reagent]{Tollen's}\text{No silver mirror}$$

b. Phenol and benzoic acid can be distinguished by ferric chloride test. Phenol reacts with neutral $FeCl_3$ to form ferric phenoxide complex giving violet colouration.

$$\underset{Phenol}{6C_6H_5OH}+FeCl_3\rightarrow\underset{\substack{Iron\ phenol\ complex\\ (Voilet\ colour)}}{[Fe(OC_6H_5)_6]^{3-}}+6H^++3Cl^-$$

But benzoic acid reacts with neutral $FeCl_3$ to give a buff coloured precipitate of ferric benzoate.

$$\underset{Benzoic\ acid}{3C_6H_5COOH}+FeCl_3\rightarrow\underset{\substack{Ferric\ benzoate\\ (Buff\ coloured\ ppt)}}{(C_6H_5COO)_3\,Fe}+3HCl$$

33. a. (i) $Zn(s)\mid Zn^{2+}(aq)\parallel Ag^+(aq)\mid Ag(s)$

(ii) Anode is negatively charged.

(iii) **At anode:** $Zn(s)\rightarrow Zn^{2+}(aq)+2e^-$

At cathode: $2Ag^+(aq)+2e^-\rightarrow 2Ag(s)$

b. $2H_2O\rightarrow 4H^++O_2+4e^-$

2 moles of H_2O required 4×96500 C

c. 1 mole of H_2O will need $=\frac{4\times 96500}{2}=193000$ C

OR

i. For the given reaction, the Nernst equation can be given as:

$$E_{cell}=E^0_{cell}-\frac{0.0591}{n}\log\frac{[Mg^{2+}]}{[Cu^{2+}]}$$
$$=\{0.34-(-2.36)\}-\frac{0.0591}{2}\log\frac{.001}{.0001}$$
$$=2.7-\frac{0.0591}{2}\log 10$$

= 2.7 - 0.02955 = 2.67 V (approximately)

ii. For the given reaction, the Nernst equation can be given as:

$$E_{cell} = E^0_{cell} - \frac{0.0591}{n}\log\frac{[Fe^{2+}]}{[H^+]^2}$$

$$= \{0-(-0.44)\} - \frac{0.0591}{2}\log\frac{0.001}{1^2}$$

= 0.44 - 0.02955(-3)

= 0.52865 V = 0.53 V (approximately)

iii. For the given reaction, the Nernst equation can be given as:

$$E_{cell} = E^0_{cell} - \frac{0.0591}{n}\log\frac{[Sn^{2+}]}{[H^+]}$$

$$= \{0-(-0.14)\} - \frac{0.0591}{2}\log\frac{0.050}{(0.020)^2}$$

= 0.14 - 0.0295 × log125

= 0.14 - 0.062

= 0.078 V

= 0.08 V (approximately)

iv. For the given reaction, the Nernst equation can be given as:

$$E_{cell} = E^0_{cell} - \frac{0.0591}{n}\log\frac{1}{[Br^-][H^+]^2}$$

$$= (0-1.09) - \frac{0.0591}{2}\log\frac{1}{(0.010)^2(0.030)^2}$$

$$= -1.09 - 0.02955 \times \log\frac{1}{0.00000009}$$

$$= -1.09 - 0.02955 \times \log\frac{1}{9\times10^{-8}}$$

$$= -1.09 - 0.02955 \times \log(1.11 \times 10^7)$$

= -1.09 - 0.02955(0.0453 + 7)

= -1.09 - 0.208

= -1.298 V