CBSE Class 12 - Chemistry

Sample Paper 10 (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 following passage and answer any four out of the following questions:**
   Transition metal oxides are generally formed by the reaction of metals with oxygen at high temperatures. The highest oxidation number in the oxides coincides with the group number. In vanadium, there is a gradual change from the basic V_2O_3 to less basic V_2O_4 and to amphoteric V_2O_5. V_2O_4 dissolves in acids to give VO^{2+} salts. Potassium dichromate is a very important chemical used in the leather industry and as an oxidant for the preparation of many azo compounds. Dichromates are generally prepared from chromate. Sodium dichromate is more soluble than potassium dichromate. The latter is, therefore, prepared by treating the solution of sodium dichromate with potassium chloride. Sodium and potassium dichromates are strong oxidising agents; sodium salt has a greater solubility in water and is extensively used as an oxidising agent in organic chemistry. Potassium dichromate is used as a primary standard in volumetric analysis.
   The following questions are multiple-choice questions. Choose the most appropriate answer.

i. All transition metal reacts with oxygen to form MO oxide except
   a. scandium
   b. vanadium
   c. cupper
   d. zinc

ii. As the oxidation number of a metal increases, ionic character
   a. increases
   b. decreases
   c. remain the same
   d. none of these

iii. The shape of chromate ion is
   a. tetrahedral
   b. pyramidal
   c. square planer
   d. triangular

iv. Dichromates are generally prepared from chromate, which in turn are obtained by the fusion of
   a. $FeCr_2O$
   b. $FeCr_2O_4$
   c. Na_2CrO_4
   d. $Na_2Cr_2O_7$

v. The oxo cations stabilise V^{IV}
   a. VO
   b. VO^{4+}
   c. VO^{2+}
   d. all of these

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

Valence Bond Theory (VBT) According to this theory, the metal atom or ion under the influence of ligands can use its (n-1)d, ns, np or ns, np, nd orbitals for hybridisation to yield a set of equivalent orbitals of definite geometry such as octahedral, tetrahedral, square planar. the geometry of a complex is predicted from the knowledge of its magnetic behaviour on the basis of the valence bond theory. The magnetic moment of

coordination compounds can be measured by the magnetic susceptibility experiments. The results can be used to obtain information about the number of unpaired electrons and hence structures adopted by metal complexes. VB theory suffers from the shortcomings It involves a number of assumptions, It does not give a quantitative interpretation of magnetic data, It does not explain the colour exhibited by coordination compounds, It does not give a quantitative interpretation of the thermodynamic or kinetic stabilities of coordination compounds.

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 but reason is wrong statement
d. Assertion is wrong statement but reason is correct statement

i. **Assertion:** $[Mn(CN)6\ ]^{3-}$ has a magnetic moment of two unpaired electrons.

Reason: For d^4 (Mn^{3+}) vacant pair of d orbitals results only by the pairing of 3d electrons which leaves two, one and zero unpaired electrons, respectively.

ii. **Assertion:** $[CoF_6]^{3-}$ is outer orbital complex involving sp^3d^2 hybridisation.

Reason: $[CoF_6]^{3-}$ are dimagnetic corresponding unpaired electrons.

iii. **Assertion:** VBT can distinguish between weak and strong ligands.
Reason: VBT does not make exact predictions regarding the tetrahedral and square planar structures of 4-coordinate complexes.

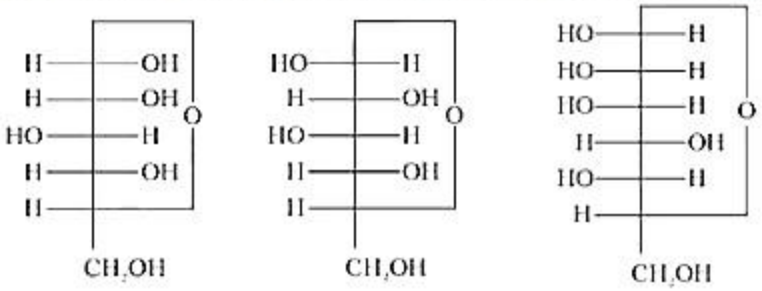
iv. **Assertion:** In the formation of this complex, since the inner d orbital (3d) is used in hybridisation, the complex, $[Co(NH_3)_6]^{3+}$ is called an inner orbital complex.

Reason: The paramagnetic octahedral complex, $[CoF_6]^{3-}$ uses outer orbital (4d) in hybridisation (sp^3d^2). It is thus called the outer orbital complex.

v. **Assertion:** In the diamagnetic octahedral complex, $[Co(NH_3)_6]^{3+}$, the cobalt ion is in +3 oxidation state and has the electronic configuration $3d^6$.

Reason: The octahedral complex has the hybridisation of sp^3.

3. The nitrogen's lone pair in pyrrolidine is best described as occupying what type of orbital?
   a. s
   b. sp^2
   c. sp^3
   d. sp
4. Three cyclic structures of monosaccharides are given below which of these are anomers.



(I) (II) (III)

   a. III is anomer of I and II
   b. I and II
   c. II and III
   d. I and III

OR

Which of the following bases is not present in DNA?

   a. Adenine
   b. Thymine
   c. Uracil
   d. Guanine
5. The molality of 98% H_2SO_4 (density = 1.8 g/mL) by weight is:
   a. 4 M
   b. 6 M
   c. 18 M
   d. 10 M
6. Which branched chain isomer of the hydrocarbon with molecular mass 72u gives only one isomer of monosubstituted alkyl halide?
   a. Tertiary butyl chloride

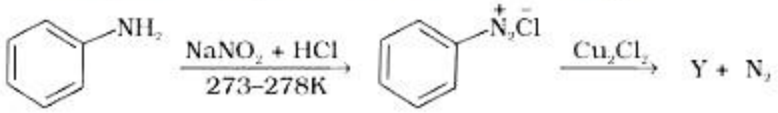
b. Neohexane

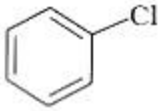
c. Isohexane

d. Neopentane

OR

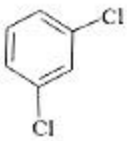
Identify the compound Y in the following reaction.



a. 

b. 

c. 

d. 

7. Amongst the following, the strongest base in aqueous medium is _____.

a. $(CH_3)_2NH$

b. $NCCH_2NH_2$

c. CH_3NH_2

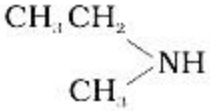
d. $C_6H_5NHCH_3$

OR

Which of the following should be most volatile?

I. $CH_3CH_2CH_2NH_2$

II. $(CH_3)_3N$

III. 

IV. $CH_3CH_2CH_3$

a. IV

b. II

c. I

d. III

8. Which of the following is not a favorable condition for physical adsorption?
   a. Higher critical temperature of adsorbate
   b. High pressure
   c. High temperature
   d. NegativeΔH

OR

Method by which lyophobic sol can be protected.

   a. By addition of oppositely charged sol.
   b. By addition of lyophilic sol.
   c. By addition of an electrolyte.
   d. By boiling.

9. The extent of adsorption increases with the
   a. Decrease in the surface area of the adsorbent
   b. Decrease in the pressure of the gas
   c. Increase in the surface area of the adsorbent
   d. Increase in temperature

10. Which is the correct increasing order of boiling points of the following compounds?
    1-Iodobutane, 1-Bromobutane, 1-Chlorobutane, Butane
    a. Butane < 1-Iodobutane < 1-Bromobutane < 1-Chlorobutane
    b. Butane < 1-Chlorobutane < 1-Iodobutane < 1-Bromobutane
    c. Butane < 1-Chlorobutane < 1-Bromobutane < 1-Iodobutane
    d. 1-Iodobutane < 1-Bromobutane < 1-Chlorobutane < Butane

11. What is the total number of atoms per unit cell in a face centered cubic structure?

a. 4
b. 2
c. 6
d. 1

12. **Assertion:** The complex $[Co(NH_3)_3Cl_3]$ does not give precipitate with silver nitrate solution.
Reason: The given complex is non-ionizable.
    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.
13. **Assertion:** Insulin is a globular protein.
Reason: Gum is a polymer of more than one type of monosaccharides.
    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:** A solution having greater vapour pressure has a higher boiling point.
Reason: Elevation in boiling point is directly proportional to the lowering of vapour pressure.
    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

OR

Assertion: 1 M solution of Glauber's salt is isotonic with 1 M solution of KNO_3.

Reason: Solutions having same molar concentrations of solute may or may not have same osmotic pressure.

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:** p-nitrophenol is more acidic than phenol.
Reason: Nitro group helps in the stabilization of the phenoxide ion by dispersal of negative charge due to resonance.
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.

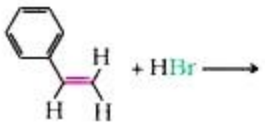
16. **Assertion:** The nitration of chlorobenzene leads to the formation of m-nitrochlorobenzene.
Reason: —NO_2 group is an m-directing group.
a. Assertion is wrong but reason is correct statement.
b. Assertion and reason both are correct statements but reason is not correct explanation of assertion.
c. Assertion and reason both are correct and reason is correct explanation of assertion.
d. Assertion and reason both are wrong statements.

Section B

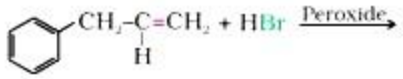
17. Write the structure of the major organic product in each of the following reactions:
$CH_2CH = C(CH_3)_2 + HBr \rightarrow$

OR

Write the products of the following reactions:

i.  $+ HBr \longrightarrow$

ii. $CH_3 - CH_2 - CH = CH_2 + HCl \longrightarrow$

iii. 

18. Under what condition do non-ideal solutions show negative deviations?
19. Write an equation for formation of:
    a. Sulphur sol
    b. Ferric hydroxide sol

OR

Define the following terms with a suitable example of each:

i. Associated colloids
ii. O/W emulsion

20. Rate constant 'k' of a reaction varies with temperature 'T' according to the equation

$$\log k = \log A - \frac{E_a}{2.303R}\left(\frac{1}{T}\right)$$

where E_a is the activation energy. When a graph is plotted for log k vs $\frac{1}{T}$, a straight line with a slope of -4250 K is obtained. Calculate 'E_a' for the reaction.

(R = 8.314 $JK^{-1}mol^{-1}$)

21. Write balanced chemical equations for the following processes:
    a. Cl_2 is passed through slaked lime.
    b. SO_2 gas is passed through an aqueous solution of Fe(III) salt.
22. Name the different reagents needed to perform the following reactions :
    i. Phenol to benzene.
    ii. Dehydration of propan-2-ol to propene.
23. State reasons for the following: Unlike Cr^{3+}, Mn^{2+}, Fe^{3+} and the subsequent other M^{2+} ions of the 3d-series of elements, the 4d and the 5d-series metals generally do not form stable cationic species.
24. What happens when
    a. Thionyl chloride acts upon 1 - propanol.
    b. Ethanol reacts with PBr_3

25. Why is glass considered as super cooled liquid?

Section C

26. Why are halogens strong oxidising agents?

OR

Explain the following situation:

i. In the structure of HNO_3 molecule the N - O bond (121 pm) is shorter than N - OH bond (140 pm).

ii. SF_4 is easily hydrolysed whereas SF_6 is not easily hydrolysed.

iii. XeF_2 has a straight linear structure and not a bent angular structure.

27. Account for the following observations:

i. Silver chloride dissolves in aqueous methylamine solution.

ii. Tertiary amines do not undergo acylation reaction.

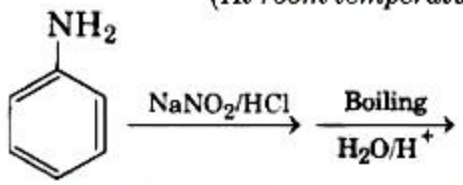
iii. Aniline readily reacts with bromine to give 2, 4, 6-tribromoaniline.

OR

Complete the following reaction:

i. $CH_3CH_2NH_2 + CHCl_3 + \text{alc. KOH} \longrightarrow$

ii. $C_6H_5N_2^+Cl^- \xrightarrow[(At\ room\ temperature)]{H_2O}$

iii. 

28. Explain the basis of similarities and differences between metallic and ionic crystals.

29. What do you understand by the term glycosidic linkage?

30. Give structures of the products you would except when each of the following alcohols

i. Butan-1-ol

ii. 2-Methylbutan-2-ol react with

a. HCl - $ZnCl_2$

b. HBr and

c. $SOCl_2$

Section D

31. Give reasons:-
    a. The oxygen molecule is diatomic whereas sulphur molecule is polyatomic.
    b. The most common oxidation state of oxygen is -2.
    c. H_2O is liquid whereas H_2S is gas at room temperature.
    d. The increasing order of acidic character in 16th group hydrides is $H_2O < H_2S < H_2Te$
    e. SF_6 is exceptionally stable, SH_6 does not exist.

OR

    i. Account for the following:
        a. Acidic character increases from HF to HI.
        b. There is large difference between the melting and boiling points of oxygen and sulphur.
        c. Nitrogen does not form pentahalide.
    ii. Draw the structure of the following:
        a. ClF_3
        b. XeF_4

32. i. Illustrate the following name reaction: Cannizzaro's reaction
    ii. How would you obtain
        a. butanoic acid from butanol?
        b. benzoic acid from ethyl benzene?

OR

    i. Write the structures of A and B in the following reactions:
        a. $CH_3COCl \xrightarrow{H_2, Pd-BaSO_4} A \xrightarrow{H_2N-OH} B$
        b. $CH_3MgBr \xrightarrow[(ii)\ H_3O^+]{(i)\ CO_2} A \xrightarrow{PCl_5} B$
    ii. Distinguish between
        a. C_6H_5-$COCH_3$ and C_6H_5-CHO
        b. CH_3-COOH and HCOOH
    iii. Arrange the following in increasing order of their boiling points:

CH_3CHO, CH_3COOH, CH_3CH_2OH

33. a. Define the terms specific conductance and molar conductivity for solution of electrolytes.

    b. Write the cell formulation and calculate the standard cell potential of the galvanic cell in operation of which the following reaction takes place.

    $2Cr(s) + 3Cd^{2+}(aq) \rightarrow 2Cr^{2+}(aq) + 3Cd(s)$

    Calculate $\Delta_r G^0$ for the above reaction.

    Given : E^0Cr^{3+}/Cr = -0.74 V

    $E^0_{Cd^{2+}/Cd} = -0.40V$ 1 F = 96500 C mol^{-1}

OR

Write the Nernst equation and emf of the following cells at 298 K:

i. $Mg(s)|Mg^{2+}(0.001\,M)||\ Cu^{2+}(0.0001\,M)|Cu(s)$
ii. $Fe(s)\ |\ Fe^{2+}(0.001\,M)\ ||\ H^+(1M)\ |\ H_2(g)(1bar)|Pt(s)$
iii. $Sn(s)|Sn^{2+}(0.050\,M)||\ H^+(0.020\,M)|H_2(g)\ (1\,bar)|Pt(s)$
iv. $Pt(s)|Br_2(l)|Br^-(0.010\,M)\ ||\ H^+(0.030M)|H_2(g)\ (1\,bar)|Pt(s)$

CBSE Class 12 - Chemistry

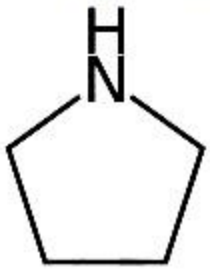
Sample Paper 10 (2020-21)

Solution

Section A

1. i. (a) scandium
   ii. (b) decreases
   iii. (a) tetrahedral
   iv. (b) $FeCr_2O_4$
   v. (c) VO^{2+}
2. i. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion
   ii. (d) Assertion is wrong statement but reason is correct statement
   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. (c) Assertion is correct statement but reason is wrong statement
3. (c) sp^3

   Explanation: Pyrrolidine is tetrahydropyrrole.



   The nitrogen atom in pyrollidine is sp^3 hybridized. Two sp^3 hybridized orbitals are involved in pairing with carbon, one sp^3 hybridized orbital is involved in pairing with hydrogen and one sp^3 hybridized orbital is occupied by a lone pair.
4. (b) I and II

   Explanation: Cyclic structures of monosaccharides which differ in the structure at carbon- 1 position are known as anomers.

   Here, I and II are anomer because they differ from each other at carbon- 1 only.

OR

(c) Uracil

Explanation: DNA contains four bases viz. adenine (A), guanine (G), cytosine (C) and thymine (T). So Uracil is not present in DNA.

5. (c) 18 M

Explanation: % of the sulphuric acid in the solution = 98 %

This means that 98 g of the sulphuric acid is present in the 100 g of the solution.

Molar Mass = 98 g/mole.

$\because$ No. of moles = Mass/Molar mass

$\therefore$ No. of moles = 98/98

= 1 moles.

Also, Density of the solution = 1.8 g/cm^3.

$\because$ Density = Mass/Volume.

$\therefore$ Volume = 100/1.8

= 55.56 cm^3

= 0.0556 L.

Now, Using the Formula,

Molarity = No. of moles of solute/ volume of the solutions in litre.

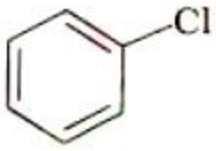
= 1/0.0556

= 17.98 M $\simeq$ 18 M

6. (d) Neopentane

Explanation: Neopentane has all same type of hydrogen and has molecular weight 72u.

OR

(a) 

Explanation: Haloarenes can be prepared from amines by Sandmeyer's reaction. In this process, a primary aromatic amine that is dissolved or suspended in cold aqueous mineral acid is treated with sodium nitrite and a diazonium salt is formed. This freshly prepared salt, when mixed with cuprous chloride, resulting in the replaces the diazonium group with -Cl, forming the aryl chloride.

7. (a) $(CH_3)_2NH$

   Explanation: Greater is the stability of the substituted ammonium cation, stronger should be the corresponding amine as a base. Thus, the order of the basicity of aliphatic amines should be: primary > secondary > tertiary, which is opposite to the inductive effect based order. Further $C_6H_5NHCH_3$ is less basic than both CH_3 NH_2 and $(CH_3)_2NH$ due to the delocalization of the lone pair of electrons present on the nitrogen atom into the benzene ring.

   OR

   (a) IV

   Explanation: Hydrocarbon are more volatile than the amine.

8. (c) High temperature

   Explanation: At high temperature, the amount of gas adsorbed get decrease. So high temperature is not a favorable condition for adsorption. Adsorption decreases with increases in temperature.

   OR

   (b) By addition of lyophilic sol.

   Explanation: Lyophobic sols are unstable and can be easily coagulated by adding electrolyte. This can be avoided by adding lyophilic sol which forms a thin film or protective layer and thus protect the latter from electrolytes.

9. (c) Increase in the surface area of the adsorbent

   Explanation: Both physisorption and chemisorption increases with increase in surface area of the adsorbent. Surface area can be increased by powdering the adsorbent.

10. (c) Butane < 1-Chlorobutane < 1-Bromobutane < 1-Iodobutane

    Explanation: Due to the polar nature of alkyl halides and the increase in molecular weight compared to their parent alkanes, the boiling points of alkyl halides are higher than that of their parent alkanes. The boiling points of alkyl halides depend on the molecular mass and the size of the halogen atom (decrease from I to F). With the increase in size, mass, and the number of electrons in halogen atoms, the magnitude of Van Der Waals forces increase and the boiling point also increases. The boiling point of alkyl halides reduces in the order RI > RBr > RCl > RF.

    Therefore, the order of increasing order of boiling points should be Butane < 1-

Chlorobutane < 1-Bromobutane < 1-Iodobutane.

11. (a) 4

    Explanation: 8 corners atoms $\times \frac{1}{8}$ atom per unit cell =1 atom

    6 face centred atoms $\times \frac{1}{2}$ atom per unit cell = 3 atoms

    Total no. of atoms per unit cell= 1 atom + 3 atoms = 4 atoms

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

    Explanation: Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

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) Assertion is INCORRECT but, reason is CORRECT

    Explanation: Assertion is INCORRECT but, reason is CORRECT

OR

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

Explanation: Assertion is INCORRECT but, reason is CORRECT.

15. (a) Assertion and reason both are correct and the reason is the correct explanation of assertion.

    Explanation: p-Nitrophenol is more acidic than phenol because the nitro group stabilizes phenoxide ion by dispersal of negative charge.

16. (a) Assertion is wrong but reason is correct statement.

    Explanation: The —NO_2 group is a meta-directing group by m-nitro chlorobenzene is not a stable compound, and the products of the reactions contain nitro groups at o- and p-positions.

Section B

17. $\underset{2-Methylbut-2-ene}{CH_3CH=C(CH_3)_2} + HBr \xrightarrow{Markovnikov's\ addition} CH_3-CH_2-\overset{\overset{CH_3}{|}}{\underset{\underset{Br}{|}}{C}}-CH_3$

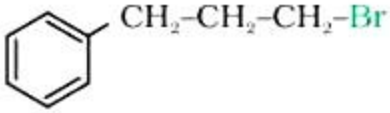
    2 - Bromo - 2 - methylbutane

OR

Following product is form

i. 

ii. $CH_3 - CH_2 - \underset{\underset{Cl}{|}}{CH} - CH_3$

iii. 

18. When the new forces of attraction between components are greater than those in the pure components. That is when two components A and B are mixed, the interactions between A....B is greater than A...A and B...B interaction then the binary non-ideal solution would show negative deviation from Raoult's law.

19. a. $SO_2 + 2H_2S \xrightarrow{Oxidation} 3S + 2H_2O$

    b. $FeCl_3 + 3H_2O \xrightarrow{Hydrolysis} \underset{(Sol)}{Fe(OH)_3} + 3HCl$

OR

i. **Associated colloids (Micelles):** There are some substances which at low concentration behave as a normal strong electrolyte but at higher concentration exhibit colloidal behavior due to the formation of aggregates. The aggregated particles thus, formed are called micelles. These are also known as associated colloid. For e.g. grease droplet surrounded by stearate ions.

ii. **O/W emulsion:** In oil in water (O/W) type emulsion, oil acts as a dispersed phase and water acts as a dispersion medium. The principal emulsifying agents for O/W emulsions are proteins, gums, natural and synthetic soaps, etc.,

20. Given, Slope= - 4250 K, R = 8.314 JK^{-1} mol^{-1}

From Arrhenius equation,

log k = $\log A - \frac{E_a}{2.303RT}$

Comparing with straight line equation, y = mx + c

$-\frac{E_a}{2303R} = -4250$

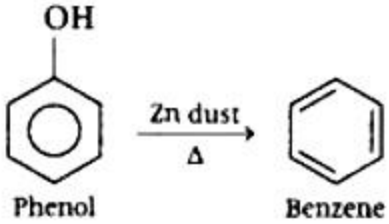
$\Rightarrow$ E_a = 2.303 × 8.314 × 4250

= 81.37 kJmol^{-1}

21. a. $2Ca(OH)_2 + 2Cl_2 \rightarrow CaCl_2 + Ca(OCl)_2 + 2H_2O$

    b. $SO_2 + 2Fe^{3+} + 2H_2O \rightarrow 2Fe^{2+} + SO_4^{2-} + 4H^+$

22. i. Zn dust and heat



    ii. 85% H_3PO_4/440 K

$$\underset{Propan-2-ol}{CH_3 - \overset{OH}{\overset{|}{C}}H - CH_3} \xrightarrow[440\ K]{85\%/H_3PO_4} \underset{Propene}{CH_3 - CH = CH_2} + H_2O$$

23. The energy required to remove electron that is to form cationic species is more in 4d and 5d series because of greater effective nuclear charge which is due to lanthanoid contraction. Thus, 4d and 5d series metals generally do not form stable cationic species.

24. a. When thionyl chloride acts upon 1- propanol, 1-chloropropane is formed.

$$CH_3CH_2CH_2OH + SOCl_2 \rightarrow CH_3CH_2CH_2Cl + SO_2 + HCl$$

    b. When ethanol reacts with PBr_3, bromoethane is formed.

$$3CH_3CH_2OH + PBr_3 \rightarrow 3CH_3CH_2Br + H_3PO_3$$

25. Glass is an amorphous solid. Like liquids it has tendency to flow, though very slowly. The proof of this fact is that the glass panes in the windows or doors of old buildings are invariably found to be slightly thicker at the bottom that at the top.

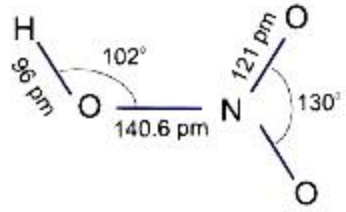
Section C

26. The general electronic configuration of halogens is np^5, where n = 2-6. Thus, halogens need only one more electron to complete their octet and to attain the stable noble gas configuration. Also, halogens are highly electronegative with low dissociation energies and high negative electron gain enthalpies. Therefore, they have a high tendency to gain an electron. Hence, they act as strong oxidizing agents.
    The relative oxidising power is; $F_2 > Cl_2 > Br_2 > I_2$.

OR

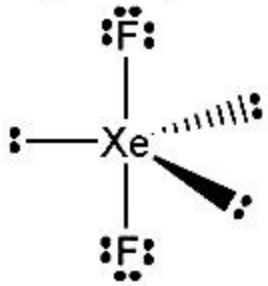
    i. Due to the smaller size of N - O, than N - OH, the N - O bond length of HNO_3 is smaller

than N - OH bond length.



ii. SF_6 does not undergo hydrolysis because the six F atoms protect the sulphur atom from attack by water due to steric hindrance. SF_4 readily undergoes hydrolysis. This is because the four F atoms cannot protect the S-atoms from attack by water.

iii. As XeF_2 has 5 pairs (10 electrons) around Xe forming a sp^3d hybridization. Therefore, its geometry is linear.



27. i. AgCl forms a complex with methylamine

$$AgCl + 2CH_3NH_2 \rightarrow \underset{Soluble}{[Ag(CH_3NH_2)_2^+Cl^-}$$

ii. Tertiary amines do not undergo acylation because they do not have hydrogen attached to nitrogen.

iii. In aniline, -NH2 group is electron releasing, therefore, it increases electron density at o- and p-positions. Therefore, it forms 2, 4, 6- tribromoaniline.

OR

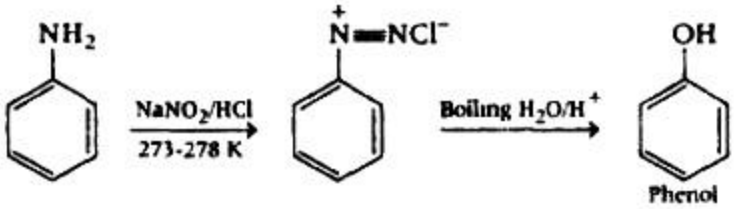
i. Carbylamine reaction, i.e. conversion of $-NH_2$ group in -NC group.

$$CH_3CH_2NH_2 + CHCl_3 + 3KOH(alc.) \xrightarrow{\Delta} \underset{\text{Ethyl isocyanide}}{CH_3CH_2 - N \equiv C} + 3KCl + 3H_2O$$

ii. Benzene diazonium chloride form phenol with the reaction of water molecules and N_2 is liberated.

$$C_6H_5N_2^+Cl^- \xrightarrow[298K]{H_2O} \underset{Phenol}{C_6H_5OH} + N_2\uparrow + HCl$$

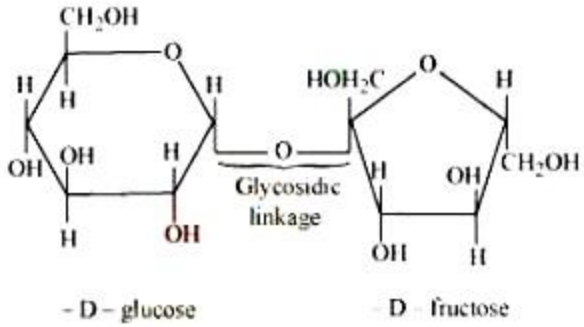
iii. Dlazonium salts form alcohol with boiling water and acidic medium.



28. **Similarities:**
    i. Both ionic and metallic crystals have electrostatic forces of attraction. In ionic crystals these are between oppositely charged ions. In metals these are among the valence electrons and the kernels.
    ii. Both have high melting point.

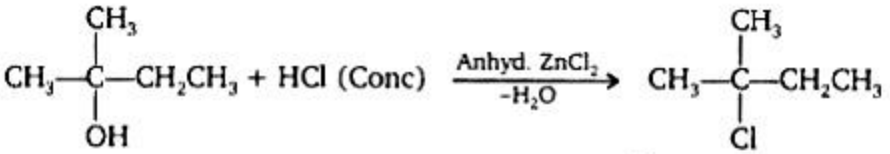
    Differences:

    i. Ionic bond is strong due to electrostatic forces of attraction whereas metallic bond may be weak or strong depending upon the number of valence electrons and the size of kernels.
    ii. In ionic bond, ions are not free to move. Hence, they cannot conduct electricity in solid state. They can do so only in molten state or in aqueous solution.
    iii. In metals, electrons are free to move. Hence, they conduct electricity in solid state.
29. Glycosidic linkage refers to the linkage formed between two monosaccharide units through an oxygen atom by the loss of a water molecule.
    For example, in a sucrose molecule, two monosaccharide units, $\propto$ -glucose and β -fructose, are joined together by a glycosidic linkage.

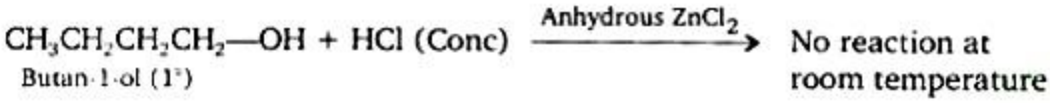


Surcose

30. i. a. With HCl - $ZnCl_2$ (lucas reagent) 2-Methylbutane-2-ol
    ii. Being a 3° alcohol, reacts with Lucas reagent to produce turbidity immediately due to the formation of insoluble tert-alkyl chloride while butane-l-ol (i) being a 1°alcohol does not react with Lucas reagent at room temperature.

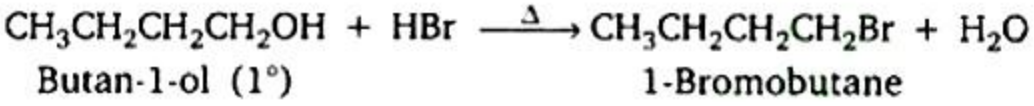


2-Chloro-2-methylbutane
(white turbidity)

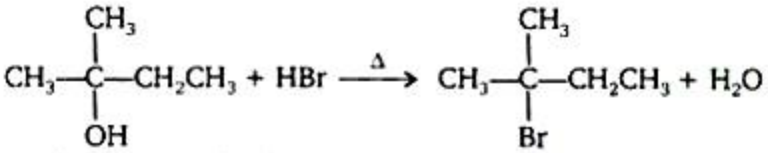


Butan-1-ol (1°)

a. Both the alcohols react to produce the corresponding alkyl bromides.

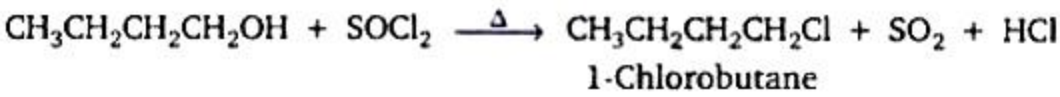


Butan-1-ol (1°) 1-Bromobutane

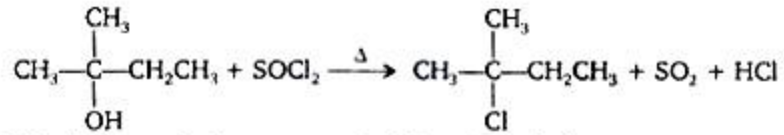


2-Methylbutan-2-ol (3°) 2-Bromo-2-methylbutane

b. Both the alcohols react to form the corresponding alkyl chlorides.



1-Chlorobutane



2-Methylbutan-2-ol 2-Chloro-2-methylbutane

Section D

31. i. Oxygen being small in size forms effective and strong P $\pi - P\pi$ bonds with other oxygen atoms. Therefore oxygen molecule is diatomic and discrete whereas Sulphur due to its larger size, its orbitals cannot overlap effectively to form P $\pi - P\pi$ bonds & completes valency by forming σ bonds with many sulphur atom. Therefore sulphur molecule is polyatomic solid.

ii. Since oxygen is highly electronegative, it has little tendency to give electrons. Therefore its most common oxidation state is -2.

iii. H_2O is liquid at room temperature due to the presence of intermolecular Hydrogen bonding which is absent in H_2S

iv. As we move down the group, the size of the atom increases this makes the bond of the element with hydrogen weak. Due to weaker bonds, the bond dissociation enthalpy decreases making the molecule more acidic. Therefore the order of acidic strength is

$H_2O < H_2S < H_2Te$.

v. SF_6 exceptionally stable due to steric reasons. Hydrogen being electropositive or less electronegative than fluorine cannot make the s- electrons of sulphur to participate in bonding. Therefore, SH_6 does not exist.

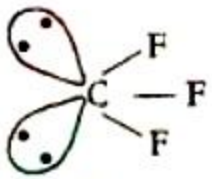
OR

i. a. The acidic strength of hydrogen halides increases from HF to HI. This is because, down the group, the size of halogen atoms increases and the stability of these halides decreases down the group due to a decrease in bond dissociation enthalpy of H-X bond from HF to HI. The order of acidic strength of halogen acids is given as HI > HBr > HCl > HF.

b. Because of small size and high electronegativity oxygen form $p\pi$ - $p\pi$ multiple bonds exists as a diatomic, O_2 molecule. These molecules are held together by weak Van der Waal forces. Sulphur on the other hand due to its higher tendency for catenation and a lower tendency for $p\pi - p\pi$ multiple bond formation forms octa-atomic, S_8 molecule. Because of the bigger size of S_8 molecule than O_2 molecule, the force of attraction holding the S_8 molecules together are much stronger than O_2 molecules. Hence, there is large difference between the melting and boiling points of oxygen and sulphur.

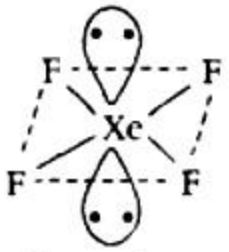
c. Nitrogen does not form pentahalides due to the non-availability of the d-orbitals in its valence shell. So it can not expand its coordination beyond 4.

ii. a. Structure of ClF_3 is T-shaped involving sp^3d^2 hybridisation. The structure is given below:



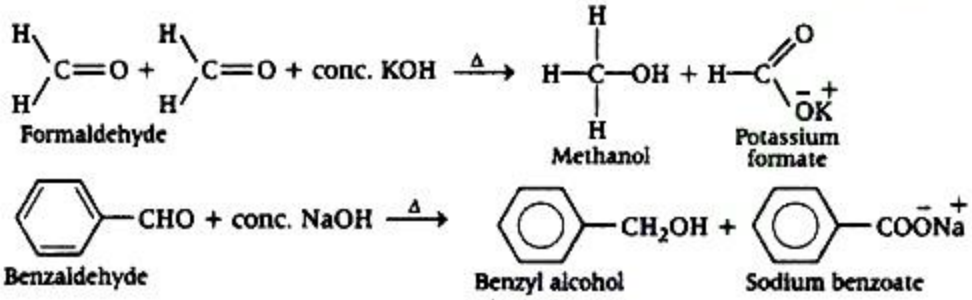
Bent-'T' shape

b. Structure of XeF_4 is square planar involving sp^3d^2 hybridisation. The structure is given below:



Square planar

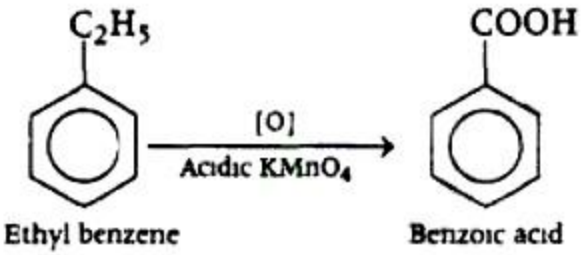
32. i. **Cannizzaro's reaction:** Aldehydes which do not have α-H atoms undergo self oxidation and reduction reaction on treatment with cone. alkali this reaction is known as Cannizzaro reaction. In this reaction, one molecule of aldehyde is reduced to alcohol while another molecule is oxidised to the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



ii. a. $CH_3CH_2CH_2CH_2OH \xrightarrow[(ii)\ Dil\ H_2SO_4]{(i)\ K_2Cr_2O_7} CH_3CH_2CH_2COOH$

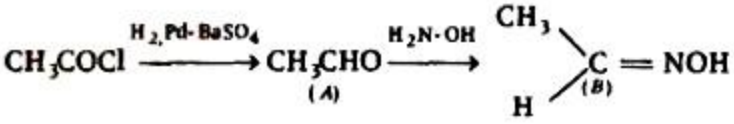
Butanol — *Butanoic acid*

b.



OR

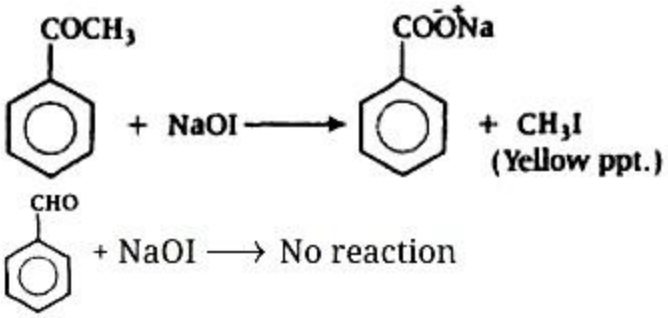
i. a.



b.

$$CH_3MgBr \xrightarrow[(ii)\ H_3O^+]{(i)\ CO_2} \underset{(A)}{CH_3COOH} \xrightarrow{PCl_5} \underset{(B)}{CH_3 - \overset{\overset{O}{\|}}{C} - Cl}$$

ii. a. $C_6H_5COCH_3$ give positive iodoform test whereas C_6H_5CHO does not.



b. HCOOH decolourises pink colour of $KMnO_4$ (acidifier) whereas CH_3COOH does not show this test.

$HCOOH + 2KMnO_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 5CO_2 + 8H_2O + MnSO_4$

$CH_3COOH \xrightarrow{KMnO_4/H^+}$ no discharge of pink colour of $KMnO_4$ solution.

iii. As carboxylic acid have strongest hydrogen bonding therefore, they have highest boiling points. Next, stronger hydrogen bonding is shown by alcohol. Hence, order of boiling point is as follows:

$CH_3CHO < CH_3CH_2OH < CH_3COOH$

33. a. **Specific conductance:** It is defined as conductance of electrolyte when electrodes are 1 cm apart and have area of cross section is 1 cm^2.

Molar conductivity: It is defined as conductance of all the ions produced from 1 mole of electrolyte when electrodes are unit distance apart and have sufficient area of cross section to hold electrolyte.

b. Cr(s) | Cr^{3+}(1M) || Cd^{2+}(1M) | Cd(s)

$E^0_{cell} = E^0_{Cd^{2+}/Cd} - E^0_{Cr^{3+}/Cr}$

= -0.40 V - (-0.74 V)

= 0.34 V

OR

i. The electrode reactions and cell reactions are

At Cathode:

$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

At Anode:

$Mg(s) \rightarrow Mg^{2+}(aq) + 2e^-$

Overall reaction is:

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

Number of moles of electrons for this reaction is **n** = **2**

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

$$E_{cell} = E^{\Theta}_{cell} - \frac{0.0591}{n}\log\frac{[Mg^{2+}]}{[Cu^{2+}]}$$

$$= \{0.34 - (-236)\} - \frac{0.0591}{2}\log\frac{0.001}{0.0001}$$

$$= 2.7 - \frac{0.0591}{2}\log 10$$

= 2.7-0.02955

= 2.6805 V

ii. The electrode reaction and overall cell reactions are:

At Cathode:

$$Fe(s) \rightarrow Fe^{2+}(aq) + 2e^{-}$$

At Anode:

$$2H^{+}(aq) + 2e^{-} \rightarrow H_2(g)$$

Overall reaction of the reaction is:

$$Fe(s) + 2H^{+}(aq) \rightarrow Fe^{2+}(aq) + H_2(g)$$

Number of moles of electrons for this reaction is **n** = **2**

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

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

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

= 0.44 - 0.02955(-3)

= 0.52865 V

iii. The electrode reactions and overall cell reaction are:

At Cathode:

$$Sn(s) \rightarrow Sn^{2+}(aq) + 2e^{-}$$

At Anode:

$$2H^{+}(aq) + 2e^{-} \rightarrow H_2(g)$$

Overall reaction is

$$Sn(s) + 2H^{+}(aq) \rightarrow Sn^{2+}(aq) + H_2(g)$$

Number of moles of electrons for this reaction is **n**=**2**

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

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

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

$= 0.14 - 0.0295 \times log125$

= 0.14 - 0.062

= 0.078 V

iv. The electrode reaction and overall cell reactions are:

At Cathode:

$2H^+(aq) + 2e^- \rightarrow H_2(g)$

At Anode:

$2Br^- \rightarrow Br_2 + 2e^-$

Overall reactions is

$2Br^- + 2H^+ \rightarrow Br_2 + H_2$

Number of moles of electrons for this reaction is **n** = **2**

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

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

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

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

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

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

= -1.298 V