



FOR  
2021 EXAM

CBSE  
CLASS 12

*SET OF 10 SAMPLE PAPERS*

**CHEMISTRY**

- BASED ON LATEST PATTERN AS PER CBSE SAMPLE QUESTION PAPER
- INCLUDES CASE BASED QUESTIONS
- ALONG WITH DETAILED SOLUTIONS

**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 ozonizers 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 adsorbate 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 of 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<sub>2</sub>/Pd
- c. NaOH/Pd
- d. HCl/Pd

4. Which of the following is a fibrous protein?

- a. Glycoprotein
- b. Keratin
- c. Proteoses
- d. Prolamine

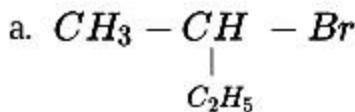
OR

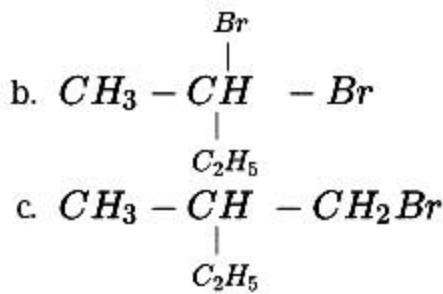
The combination of nitrogen – containing heterocyclic base with 1' position of sugar is known as

- 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  $\text{OH}^-$  ion?





- 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:  $\text{CH}_3\text{NHCH}_2\text{CH}_3$ ;  $\text{CH}_3\text{OCH}_2\text{CH}_3$ ;  $(\text{CH}_3)_3\text{N}$ ; and  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ .

- a. Low to high;  $\text{CH}_3\text{OCH}_2\text{CH}_3$ ;  $(\text{CH}_3)_3\text{N}$ ;  $\text{CH}_3\text{NHCH}_2\text{CH}_3$ ;  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ .
- b. Low to high;  $\text{CH}_3\text{NHCH}_2\text{CH}_3$ ;  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ ;  $(\text{CH}_3)_3\text{N}$ ;  $\text{CH}_3\text{OCH}_2\text{CH}_3$ .
- c. Low to high;  $(\text{CH}_3)_3\text{N}$ ;  $\text{CH}_3\text{OCH}_2\text{CH}_3$ ;  $\text{CH}_3\text{NHCH}_2\text{CH}_3$ ;  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ .
- d. Low to high;  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ ;  $\text{CH}_3\text{NHCH}_2\text{CH}_3$ ;  $(\text{CH}_3)_3\text{N}$ ;  $\text{CH}_3\text{OCH}_2\text{CH}_3$ .

8. Which of the following is a homoleptic complex?

- a.  $[\text{Cr}(\text{NH}_3)_3\text{Cl}_3]$
- b.  $[\text{CoCl}_2(\text{en})_2]^+$
- c.  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$
- d.  $[\text{Cu}(\text{NH}_3)_4]^{+2}$

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) $[\text{Co}(\text{NH}_3)_6]^{3+}$	(i) Violet
(b) $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$	(ii) Green
(c) $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$	(iii) Pale blue
(d) $(\text{Ni}(\text{H}_2\text{O})_4(\text{en}))^{2+}$ (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  $\text{K}_4[\text{Fe}(\text{CN})_6]$  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:**  $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_2$  and  $[\text{Fe}(\text{H}_2\text{O})_6]\text{Cl}_2$  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<sup>-</sup> is an ambident nucleophile.

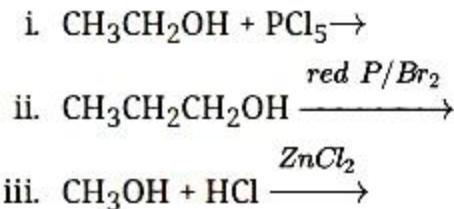
- a. The assertion is wrong but the reason is the correct statement.
- b. Assertion and reason both are correct and reason is correct explanation of assertion.
- c. Assertion and reason both are wrong statements.
- d. Assertion is correct but reason is wrong statement.

### Section B

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

OR

Complete the following reactions:

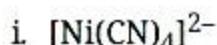


18. Mention a large scale use of the phenomenon called reverse osmosis?

19. Write the IUPAC name of  $[\text{Co}(\text{NH}_3)_3\text{ONO}]\text{Cl}_2$

OR

Write the IUPAC names and hybridisation of the following complexes:



ii.  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$  (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  $0.6 \text{ mol L}^{-1}$  to  $0.2 \text{ mol L}^{-1}$  in 5 min. Calculate the rate constant of the reaction.
22. How are the following conversions carried out?
- Propene to propan-2-ol
  - Phenol to salicylaldehyde
23. Explain the following observations:
- The transition elements have great tendency for complex formation.
  - 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.

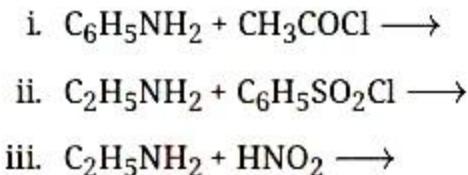
### Section C

26. Considering the parameters such as bond dissociation enthalpy, electron gain enthalpy and hydration enthalpy, compare the oxidising power of  $\text{F}_2$  and  $\text{Cl}_2$ .

OR

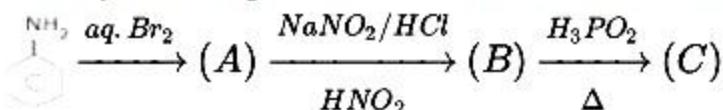
Explain why  $\text{NH}_3$  is basic while  $\text{BiH}_3$  is only feebly basic.

27. Complete the following reaction equations:



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:
- Catalytic reduction of butanol.
  - Hydration of propene in the presence of dilute sulphuric acid.
  - Reaction of propanone with methyl magnesium bromide followed by hydrolysis.
- Section D**
31. a. Explain the following:
- Transition elements tend to be unreactive with increasing atomic number in the series.
  - 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  $\text{NH}_4\text{Cl}$  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.

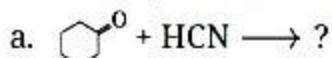
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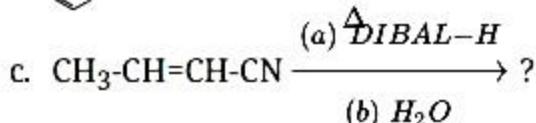
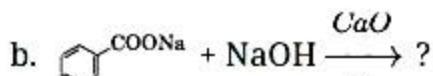
What may be the possible oxidation state of the transition element with the following d electron configurations in the ground state of their atoms as  $3d^3$ ,  $3d^5$ ,  $3d^8$  and  $3d^4$ ?

32. a. Write the main product formed when propanal reacts with the following reagents:
- 2 moles of  $\text{CH}_3\text{OH}$  in presence of dry HCl
  - Dilute NaOH
  - $\text{H}_2\text{N}-\text{NH}_2$  followed by heating with KOH in ethylene glycol
- b. Arrange the following compounds in increasing order of their property as indicated :
- $\text{F}-\text{CH}_2\text{COOH}$ ,  $\text{O}_2\text{N}-\text{CH}_2\text{COOH}$ ,  $\text{CH}_3\text{COOH}$ ,  $\text{HCOOH}$  - acidic character
  - Acetone, Acetaldehyde, Benzaldehyde, Acetophenone - reactivity towards addition of HCN

OR

- i. Write the product(s) in the following reactions:

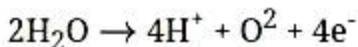




- ii. Give simple chemical tests to distinguish between the following pairs of compounds:
- Butanal and butan-2-one
  - Benzoic acid and phenol

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



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

OR

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

- $\text{Mg(s)} | \text{Mg}^{2+}(0.001\text{M}) || \text{Cu}^{2+}(0.001\text{M}) | \text{Cu(s)}$
- $\text{Fe(s)} | \text{Fe}^{2+}(0.001\text{M}) | | \text{H}^+(1\text{M}) | \text{H}_2(\text{g})(1\text{bar}) | \text{pt(s)}$
- $\text{Sn(s)} | \text{Sn}^{2+}(0.050\text{M}) | | \text{H}^+(0.020\text{M}) | \text{H}_2(\text{g})(1\text{bar}) | \text{pt(s)}$
- $\text{Pt(s)} | \text{Br}_2(1) | \text{Br}^-(0.010\text{M}) | \text{H}^+(0.030\text{M}) | \text{H}_2(\text{g})(1\text{bar}) | \text{pt(s)}$

Given:

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

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

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

$$E^0(\text{Sn}^{2+}/\text{Sn}) = -0.14\text{V} \quad E^0(\text{Br}_2/\text{Br}^-) = +1.08\text{V}$$

**CBSE Class 12 Chemistry**  
**Sample paper 01 (2020-21)**

**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<sub>2</sub>/Pd

**Explanation:** -NO<sub>2</sub> group is reduced to -NH<sub>2</sub> using H<sub>2</sub>/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<sub>2</sub> group.  
 $C_6H_5NH_2 + CH_3COOCOCH_3 \rightarrow C_6H_5NHCOCH_3$ .

Now, -NHCOCH<sub>3</sub> 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)  $[\text{Cu}(\text{NH}_3)_4]^{+2}$

**Explanation:** Complexes in which the central metal is bound to only one kind of donor groups are called homoleptic complexes.  $[\text{Cu}(\text{NH}_3)_6]^{+2}$  is a homoleptic complex because in this only ammonia group is the donor group bound to  $\text{Cu}^{+2}$ .

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  $\text{CN}^-$  has charge of  $-1$ . So the overall charge carried by 6  $\text{CN}^-$  ligands is  $-6$ . Each potassium ion  $\text{K}^+$  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

$$x + (-6) = -4$$

$$x = -4 - (-6)$$

$$x = -4 + 6$$

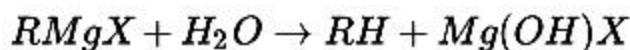
$$x = +2$$

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.



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  $\text{Co}^{2+}$  and Fe as  $\text{Fe}^{2+}$ . Both of the complexes become stable by oxidation of metal ion to  $\text{Co}^{3+}$  and  $\text{Fe}^{3+}$

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  $\text{H}_2$  gas and Sodium ethoxide.

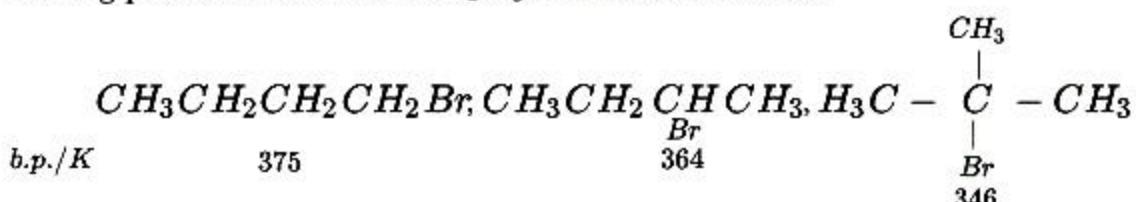
16. (a) The assertion is wrong but the reason is the correct statement.

**Explanation:** Haloalkanes react with  $\text{AgCN}$  to form alkyl isocyanides as the main product

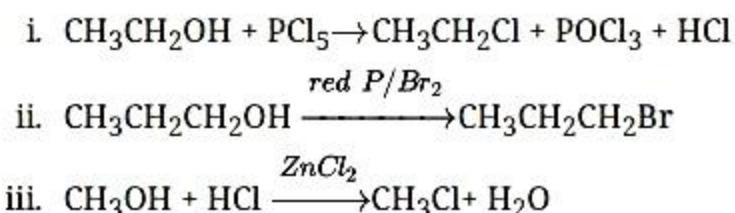
while KCN forms alkyl cyanides as the chief product.

### Section B

17. The boiling points of isomeric haloalkanes 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  $C_4H_9Br$  follow the order.



OR

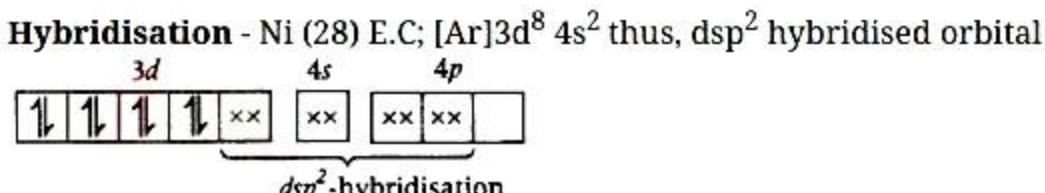


18. Reverse osmosis is used in the desalination of water to get drinking water from sea water. Here the salts in sea water which makes the water hard and unfit for drinking purpose is removed along with impurities.

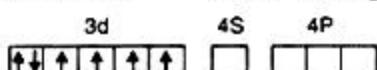
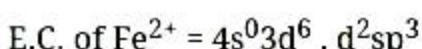
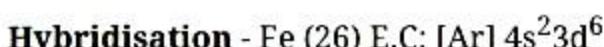
19. Hexaammine nitritocobalt III chloride

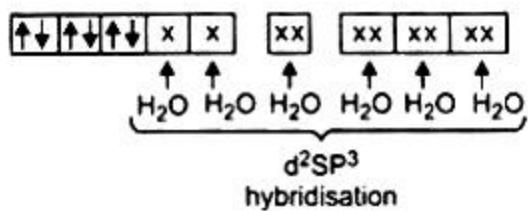
OR

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



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





20. Unit of k for zero order reaction is mol L<sup>-1</sup> s<sup>-1</sup>.

21. Rate constant,

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

Given, [R]<sub>0</sub> = 0.6 mol L<sup>-1</sup>

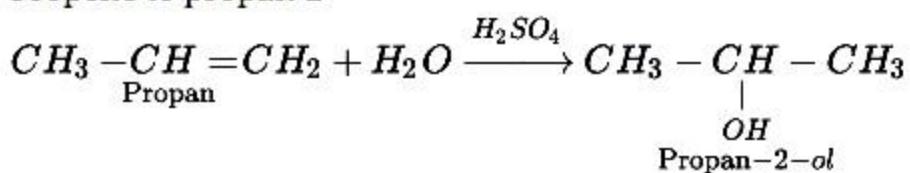
[R] = 0.2 mol L<sup>-1</sup>, t = 5min

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

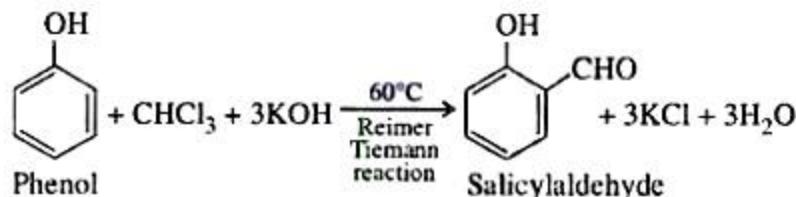
$$k = \frac{2.303}{5} \log 3 \quad (\log 3 = 0.4771)$$

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

22. i. Propene to propan-2-



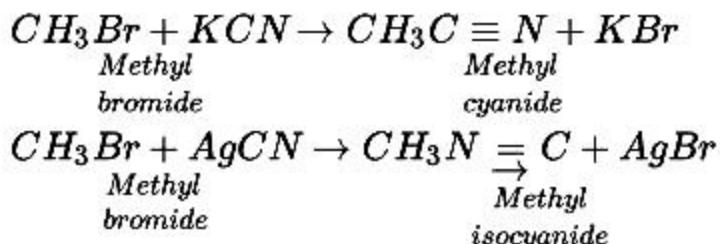
ii. Phenol to salicylaldehyde



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.



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

### Section C

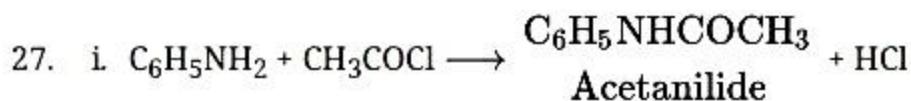
26. Fluorine is a much stronger oxidizing agent than chlorine. The oxidizing power depends on three factors.

  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.

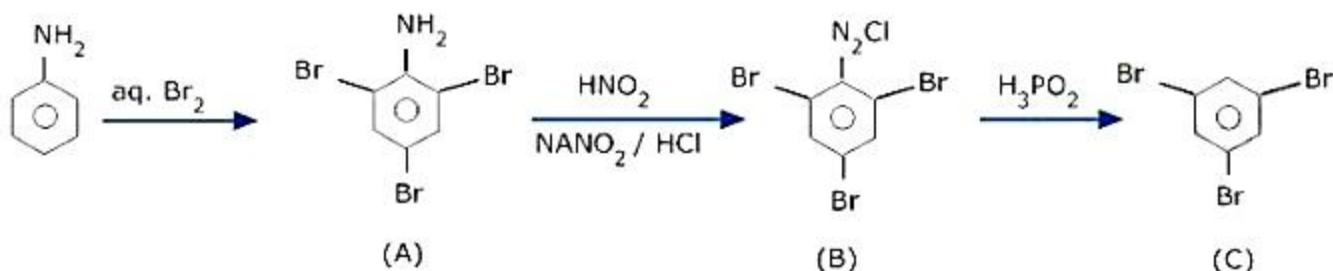
OR

$\text{NH}_3$  is distinctly basic while  $\text{BiH}_3$  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.



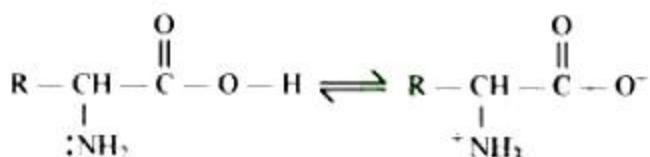


OR



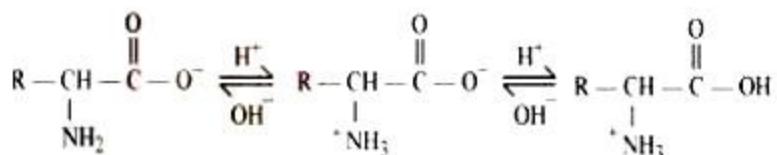
28. The state of various substances to categorize as solid, liquid or gaseous depends on the nature of the constituent particles and the interactions and bonding between them. Liquids and gases are categorized as fluids because the liquid and gases have a property to flow i.e. the molecules can move 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.

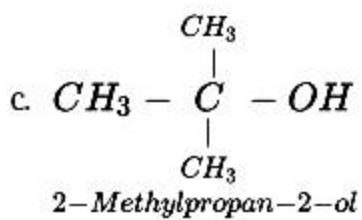


### Zwitter ion

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



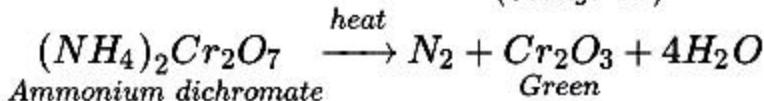
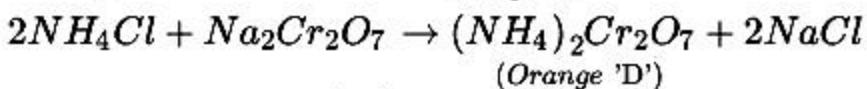
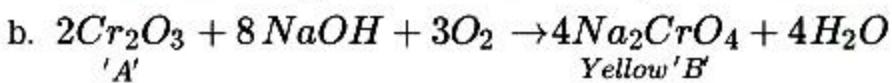
30. a.  $CH_3 - CH_2 - CH_2CH_2 - OH$   
                                 Butan - 1 - ol  
     b.  $CH_3 - CH(OH) - CH_3$   
                                 Propan - 2 - ol



## 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.



So, Compound A =  $\text{Cr}_2\text{O}_3$ , compound B=  $\text{Na}_2\text{CrO}_4$ , compound C =  $\text{Na}_2\text{Cr}_2\text{O}_7$ , compound D=  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$

OR

	<b>Electronic configuration in ground state</b>	<b>Stable oxidation states</b>
(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:

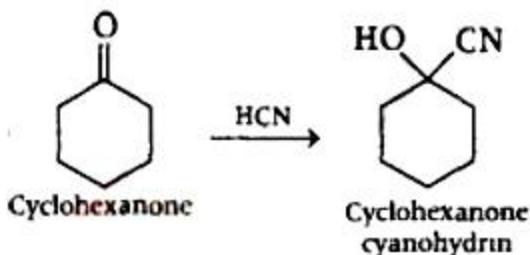
- i.  $3d^3$  (Vanadium) is +5
- ii.  $3d^5$  (Chromium) is +3 , +6
- iii.  $3d^5$  (Manganese) is +2 , +7
- iv.  $3d^8$  (Cobalt) is +2 , +3

32. a. i.  $\text{CH}_3\text{CH}_2\text{CH}(\text{OCH}_3)_2$   
 ii.  $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}(\text{CH}_3)\text{CHO}$   
 iii.  $\text{CH}_3\text{CH}_2\text{CH}_3$
- b. i. Increasing order of acidic character:  
 $\text{CH}_3\text{COOH} < \text{HCOOH} < \text{FCH}_2\text{COOH} < \text{O}_2\text{N}-\text{CH}_2\text{COOH}$
- ii. Increasing order of reactivity towards addition of HCN:  
 Acetophenone < Benzaldehyde < acetone < acetaldehyde

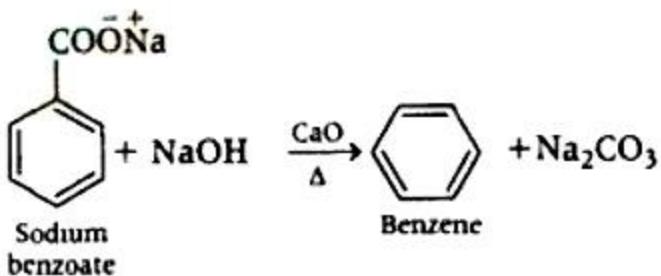
OR

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

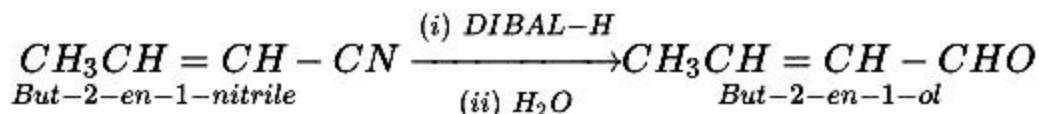
a.



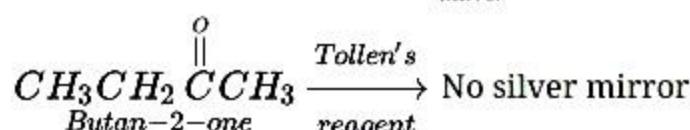
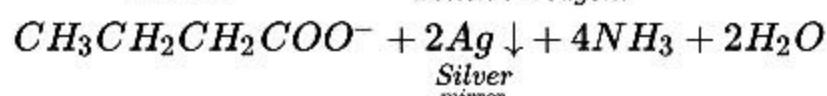
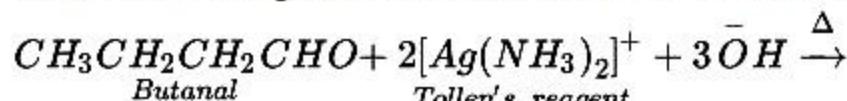
- b. The sodium benzoate reacts with soda lime to give benzene



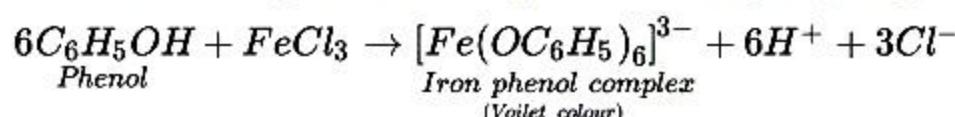
- c. But-2-en-1 nitrile on reaction with DIBAL-H followed by water give



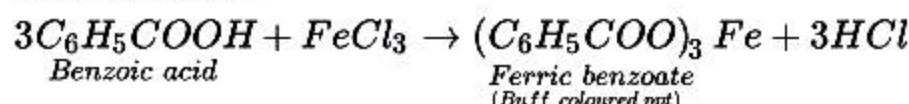
- ii. a. Butanal being an aldehyde reduces Tollen's reagent to shiny silver mirror but butan-2-one being a ketone does not reduce Tollen's reagent.



- b. Phenol and benzoic acid can be distinguished by ferric chloride test. Phenol reacts with neutral  $\text{FeCl}_3$  to form ferric phenoxide complex giving violet colouration.



But benzoic acid reacts with neutral  $\text{FeCl}_3$  to give a buff coloured precipitate of ferric benzoate.



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

(ii) Anode is negatively charged.

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

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

$$2\text{H}_2\text{O} \rightarrow 4\text{H}^+ + \text{O}_2 + 4\text{e}^-$$

- 2 moles of  $\text{H}_2\text{O}$  require

1 mole of  $\text{H}_2\text{O}$  will need  $4 \times 96500$

$$c. \text{ 1 mole of } H_2O \text{ will need } = \frac{1}{2} = 195000 \text{ eV}$$

OR

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

$$E_{cell} = E_{cell}^0 - \frac{0.0591}{n} \log \frac{[Mg^{2+}]}{[Cu^{2+}]}$$

$$= \{0.34 - (-2.36)\} - \frac{0.0591}{2} \log \frac{.001}{.0001}$$

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

$$= 2.7 - 0.02955 = 2.67 \text{ V (approximately)}$$

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

$$\begin{aligned} E_{cell} &= E_{cell}^0 - \frac{0.0591}{n} \log \frac{[Fe^{2+}]}{[H^+]^2} \\ &= \{0 - (-0.44)\} - \frac{0.0591}{2} \log \frac{0.001}{1^2} \\ &= 0.44 - 0.02955(-3) \\ &= 0.52865 \text{ V} = 0.53 \text{ V (approximately)} \end{aligned}$$

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

$$\begin{aligned} E_{cell} &= E_{cell}^0 - \frac{0.0591}{n} \log \frac{[Sn^{2+}]}{[H^+]^2} \\ &= \{0 - (-0.14)\} - \frac{0.0591}{2} \log \frac{0.050}{(0.020)^2} \\ &= 0.14 - 0.0295 \times \log 125 \\ &= 0.14 - 0.062 \\ &= 0.078 \text{ V} \\ &= 0.08 \text{ V (approximately)} \end{aligned}$$

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

$$\begin{aligned} E_{cell} &= E_{cell}^0 - \frac{0.0591}{n} \log \frac{1}{[Br^-][H^+]^2} \\ &= (0 - 1.09) - \frac{0.0591}{2} \log \frac{1}{(0.010)^2(0.030)^2} \\ &= -1.09 - 0.02955 \times \log \frac{1}{0.00000009} \\ &= -1.09 - 0.02955 \times \log \frac{1}{9 \times 10^{-8}} \\ &= -1.09 - 0.02955 \times \log(1.11 \times 10^7) \\ &= -1.09 - 0.02955(0.0453 + 7) \\ &= -1.09 - 0.208 \\ &= -1.298 \text{ V} \end{aligned}$$

**CBSE Class 12 Chemistry  
Sample paper 02 (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:**

Nitrogen differs from the rest of the members of group 15 due to its smaller size, high electronegativity, high ionisation enthalpy, and non-availability of d orbitals. Nitrogen has a unique ability to form  $p\pi-p\pi$  multiple bonds with itself. Nitrogen exists as a diatomic molecule with a triple bond one s and two p between the two atoms.

Phosphorus, arsenic and antimony form single bonds as P-P, As-As and Sb-Sb while bismuth forms metallic bonds in an elemental state. Dinitrogen is produced commercially by the liquefaction and fractional distillation of air. Liquid dinitrogen (b.p. 77.2 K) distils out first leaving behind liquid oxygen (b.p. 90 K). In the laboratory, dinitrogen is prepared by treating an aqueous solution of ammonium chloride with sodium nitrite. Dinitrogen is a colourless, odourless, tasteless and non-toxic gas. It has two stable isotopes  $^{14}\text{N}$  and  $^{15}\text{N}$ . It has very low solubility in water. The main use of dinitrogen is in the manufacture of ammonia and other industrial chemicals containing nitrogen.

**The following questions are multiple-choice questions. choose the most appropriate answer**

- i. N–N bond is weaker than the single P–P bond because
  - a. high interelectronic repulsion of the bonding electrons
  - b. high interelectronic repulsion of the non-bonding electrons
  - c. no repulsion between bonding electrons
  - d. no repulsion between non-bonding electrons
- ii. Very pure nitrogen can be obtained by the
  - a. thermal decomposition of sodium
  - b. thermal decomposition of barium azide
  - c. thermal decomposition of ammonium dichromate
  - d. both (a) and (b)
- iii. Dinitrogen is rather inert at room temperature because of
  - a. low bond enthalpy of  $\text{N}\equiv\text{N}$  bond
  - b. high bond enthalpy of  $\text{N}\equiv\text{N}$  bond
  - c. low freezing point
  - d. low boiling point
- iv. Dinitrogen combines with dioxygen only at very high temperature (at about 2000 K) to form
  - a. nitric oxide
  - b. nitrate
  - c. nitrites
  - d. nitric acid
- v. Liquid dinitrogen is used as a refrigerant to
  - a. preserve biological materials
  - b. preserve food items
  - c. in cryosurgery
  - d. all of these

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

Colloidal particles always carry an electric charge. The nature of this charge is the same on all the particles in a given colloidal solution and may be either positive or negative. The charge on the sol particles is due to one or more reasons, viz., due to electron capture by sol particles during electrodispersion of metals. When two or more ions are present in the dispersion medium, preferential adsorption of the ion common to the colloidal particle usually takes place. When silver nitrate solution is added to the potassium iodide

solution, the precipitated silver iodide adsorbs iodide ions from the dispersion medium, and negatively charged colloidal solution results. acquired a positive or a negative charge by selective adsorption on the surface of a colloidal particle. The combination of the two layers of opposite charges around the colloidal particle is called Helmholtz electrical double layer. The presence of equal and similar charges on colloidal particles is largely responsible for providing stability to the colloidal solution.

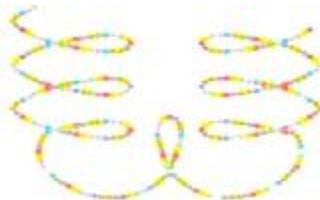
**In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.**

- 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:** The presence of equal and similar charges on colloidal particles is largely responsible in providing stability to the colloidal solution.  
**Reason:** The repulsive forces between charged particles having the same charge prevent them from aggregating and provide stability.
- ii. **Assertion:** The first layer is mobile in Helmholtz electrical double layer.  
**Reason:** The potential difference between the fixed layer and the diffused layer of opposite charges is called zeta potential.
- iii. **Assertion:** The sol particle in colloid has a charge.  
**Reason:** The charge in sol is due to electron capture by sol particles during the electrodispersion of metals.
- iv. **Assertion:** Methylene blue sol is a negatively charged sol.  
**Reason:** When KI solution is added to  $\text{AgNO}_3$  solution, positively charged sol formed.
- v. **Assertion:** If  $\text{FeCl}_3$  is added to an excess of hot water, a positively charged sol of hydrated ferric oxide is formed.  
**Reason:** When ferric chloride is added to NaOH a negatively charged sol is obtained with adsorption of  $\text{OH}^-$  ions.
3. Methylamine reacts with  $\text{HNO}_2$  to form \_\_\_\_\_.  
a.  $\text{CH}_3\text{-O-N=O}$

- b.  $\text{CH}_3\text{CHO}$
  - c.  $\text{CH}_3\text{-O-CH}_3$
  - d.  $\text{CH}_3\text{OH}$
4. Insulin is a protein which contains \_\_\_\_\_ amino acids
- a. 70
  - b. 51
  - c. >100
  - d. 120

OR

The following structure of protein is called



- a. quaternary structure
  - b. Secondary structure
  - c. Tertiary structure
  - d. primary structure
5. The osmotic pressure of a solution containing 0.02 mole of solute at 300 K will be:
- a.  $0.02 \times 0.0821 \times 300 \text{ atm}$
  - b.  $\frac{0.02 \times 300}{0.0821} \text{ atm}$
  - c.  $0.02 \times 0.821 \times 300 \text{ atm}$
  - d.  $\frac{0.02 \times 0.0821}{300} \text{ atm}$
6. A mixture containing two enantiomers in equal proportions:
- a. will be called a racemic mixture
  - b. will be called a racemic mixture and will have a zero optical rotation.
  - c. will have inverted configuration
  - d. will have zero optical rotation

OR

Ethyl benzene cannot be prepared by \_\_\_\_\_.  
a. Clemmensen reduction

- b. Wurtz – Fittig reaction
  - c. Friedel – Crafts reaction
  - d. Wurtz reaction
7. Hoffmann Bromamide Degradation reaction is shown by \_\_\_\_\_.
- a.  $\text{ArNH}_2$
  - b.  $\text{ArCONH}_2$
  - c.  $\text{ArNO}_2$
  - d.  $\text{ArCH}_2\text{NH}_2$

OR

Which of the following respond to the isocyanide test?

- a. Primary amines
  - b. Tertiary amines
  - c. Primary and secondary amines
  - d. Secondary amines
8. Which complex gives three chloride ions per formula unit?
- a.  $\text{CrCl}_3 \cdot 5\text{H}_2\text{O}$
  - b.  $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$
  - c.  $\text{CrCl}_3 \cdot 4\text{H}_2\text{O}$
  - d. All of these

OR

Which of the following complexes can form d and 1 isomers?

- a. Trans -  $[\text{Co}(\text{en})_2\text{Cl}_2]^+$
  - b.  $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$
  - c. Cis -  $[\text{Co}(\text{en})_2\text{Cl}_2]^+$
  - d.  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$
9. In which of the following compounds, the central metal atom/ion is in the lowest oxidation state?
- a.  $[\text{Co}(\text{NH}_3)_5\text{Br}]_2\text{SO}_4$

- b.  $Mn_2(CO)_{10}$
- c.  $Fe_3[Fe(CN)_6]_2$
- d.  $K[PtCl_3(C_2H_4)]$

10. Which of the following is an example of vic-dihalide?

- a. 1, 2-dichloroethane
- b. Dichloromethane
- c. Ethylidene chloride
- d. Allyl chloride

11. What type of interaction hold the molecules together in a polar molecular solid?

- a. London forces
- b. Hydrogen bonding
- c. Dipole - dipole interaction
- d. Metallic bonding

12. **Assertion:**  $[Ni(CO)_4]$  is diamagnetic complex.

**Reason:** It involves  $sp^3$  hybridisation and there is no unpaired electron.

- 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:** Molarity of a solution in liquid state changes with temperature.

**Reason:** The volume of a solution changes with a change in temperature.

- a. Assertion and reason both are correct statements and reason is the correct

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

OR

**Assertion:**  $\Delta H_{mix}$  and  $\Delta V_{mix}$  are zero for the ideal solution.

**Reason:** The interactions between the particles of the components of a solution are almost identical as between particles in the liquids.

- 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:** Boiling points of alcohols and ethers are high.

**Reason:** They can form intermolecular hydrogen-bonding.

- 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:** 1-Iodopropane and 2-iodopropane are chain isomers.

**Reason:** These differ in the position of I in the carbon chains.

- 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. Suggest a possible reason for the following observations:

- i. The order of reactivity of haloalkanes is RI > RBr > RCl.
- ii. neo-pentyl chloride,  $(\text{CH}_3)_3\text{C}-\text{CH}_2\text{Cl}$  does not follow  $\text{S}_{\text{N}}2$  mechanism.

OR

Write the structure of the major organic product in the following reaction:

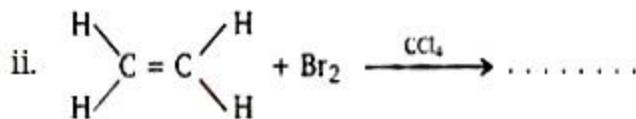
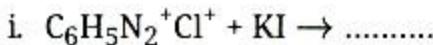


18. A 5% solution (by mass) of cane sugar ( $M \cdot W 342$ ) is isotonic with 0.877% solution of substance X. Find the molecular weight of X.
19. Give IUPAC name of linkage isomer of  $[(\text{NH}_3)_3\text{Pt}(\text{NO}_2)]\text{Cl}$ .

OR

What is crystal field splitting energy?

20. Calculate the half life of first order reaction whose rate constant is  $200\text{s}^{-1}$ .
21. At 298K, the rate of the chemical reaction doubles on increase of temperature by 10 K. Calculate  $E_a$  of this reaction.
22. Arrange the following compounds in increasing order of their acid strength.  
Propane - 1-ol, 2, 4, 6 - trinitrophenol, 3-nitrophenol, 3 , 5-dinitrophenol, 4-methyl, phenol.
23. Although  $\text{Cr}^{3+}$  and  $\text{Co}^{2+}$  ions have same number of unpaired electrons but the magnetic moment of  $\text{Cr}^{3+}$  is 3.87 B.M. and that of  $\text{Co}^{2+}$  is 4.87 B.M. Why?
24. Complete the following reaction equation:



25. What is the two dimensional coordination number of a molecule in square close-packed layer?

### Section C

26. Draw the structure of  $\text{H}_3\text{PO}_2$ .

OR

Draw the structural formulae of the following:

1.  $\text{BF}_3$
2. Peroxodisulphate ion ( $\text{S}_2\text{O}_8^{2-}$ )
3.  $\text{XeF}_4$

27. Give one chemical test to distinguish between primary, secondary and tertiary amines.

OR

Write structures of different isomers corresponding to the molecular formula  $\text{C}_3\text{H}_9\text{N}$ .

Write IUPAC names of the isomers which will liberate nitrogen gas on treatment with nitrous acid.

28. Silver crystallizes in fcc lattice. If edge length of the cell is  $4.077 \times 10^{-8} \text{ cm}$  and density is  $10.5 \text{ g cm}^{-3}$ . Calculate the atomic mass of silver.
29. Define having an aldehyde group:
- i. Glucose does not give 2, 4-DNP test. What does this indicate?
  - ii. Draw the Haworth structure of a - D - (+) - Glucopyranose.
  - iii. What is the significance of D and (+) here?
30. How the following conversions can be carried out?
- i. 2-Bromopropane to 1-bromopropane
  - ii. Chloroethane to butane
  - iii. Benzene to diphenyl

#### Section D

31. i. Give reasons for the following observations.
- a.  $\text{Cu}^+$  ion is not stable in aqueous solution.
  - b. Mn(II) ion shows maximum paramagnetic character amongst the bivalent ions of first transition series.
  - c. Scandium ( $Z = 21$ ) salts are white.
- ii. Describe the reactions involved in the preparation of  $\text{K}_2\text{Cr}_2\text{O}_7$  from chromite ore.

OR

On the basis of Lanthanoid contraction, explain the following:

- i. Nature of bonding in  $\text{La}_2\text{O}_3$  and  $\text{Lu}_2\text{O}_3$ .
- ii. Trends in the stability of oxo salts of lanthanoids from La to Lu.
- iii. Stability of the complexes of lanthanoids.

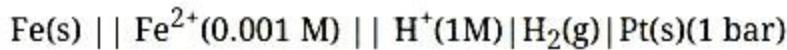
- iv. Radii of 4d and 5d block elements.
  - v. Trends in the acidic character of lanthanoid oxides.
32. Arrange the following compounds in increasing order of their reactivity in nucleophilic addition reactions.
- i. Ethanal, Propanal, Propanone, Butanone.
  - ii. Benzaldehyde, p-Tolualdehyde, p-Nitrobenzaldehyde, Acetophenone.
- Hint: Consider steric effect and electronic effect.
33. Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration.

OR

- i. Write the products formed when  $\text{CH}_3\text{CHO}$  reacts with the following reagents:
    - a. HCN
    - b.  $\text{H}_2\text{N-OH}$
    - c.  $\text{CH}_3\text{CHO}$  in the presence of dilute NaOH
  - ii. Give simple chemical tests to distinguish between the following pairs of compounds:
    - a. Benzoic acid and phenol
    - b. Propanal and propanone
34. Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration.

OR

- a. Explain with one example each the terms weak and strong electrolytes.
- b. Write the Nernst equation and calculate the emf of the following cell.



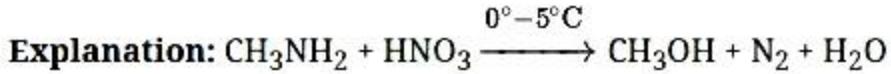
$$E^0(\text{Fe}^{2+}/\text{Fe}) = -0.44 \text{ V}$$

**CBSE Class 12 Chemistry**  
**Sample paper 02 (2020-21)**

**Solution**

**Section A**

1. i. (b) high interelectronic repulsion of the non-bonding electrons  
ii. (d) both (a) and (b)  
iii. (b) high bond enthalpy of  $\text{N}\equiv\text{N}$  bond  
iv. (a) nitric oxide  
v. (d) all of these
2. i. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion  
ii. (d) Assertion is wrong statement but Reason is correct statement  
iii. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion  
iv. (d) Assertion is wrong statement but reason is correct statement  
v. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion
3. (d)  $\text{CH}_3\text{OH}$



4. (b) 51

**Explanation:** Insulin contain 51 amino acids

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)  $0.02 \times 0.0821 \times 300 \text{ atm}$

**Explanation:**  $0.02 \times 0.0821 \times 300 \text{ atm}$

since  $\text{OP} = \text{CRT}$

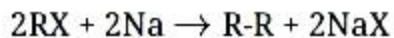
6. (b) will be called a racemic mixture and will have a zero optical rotation.

**Explanation:** Enantiomers are chiral molecules that are mirror images of one another. Furthermore, the molecules are non-superimposable on one another. This means that the molecules cannot be placed on top of one another and give the same arrangement of atoms in space. If they are present in equal proportions, the mixture is called a racemic mixture and it is optically inactive, as one isomer will rotate light in the direction opposite to another.

OR

(d) Wurtz reaction

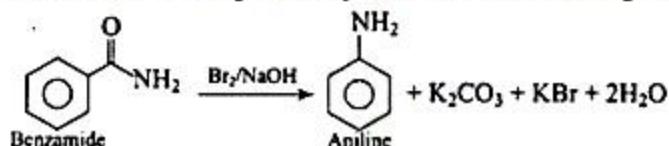
**Explanation:** Alkyl halides react with sodium in dry ether to give hydrocarbons containing double the number of carbon atoms present in the halide. This reaction is known as the Wurtz reaction.



So,  $C_6H_5CH_2CH_3$  is not prepared by the Wurtz reaction.

7. (b)  $ArCONH_2$

**Explanation:** Hofmann bromamide degradation is shown by  $Ar - C = O - NH$  amide is converted into primary amine via undergoing intramolecular migration of phenyl group.



OR

(a) Primary amines

**Explanation:** Only primary amines undergo carbarylamine reaction (isocyanide test) because only they can form isocyanide with chloroform and alc.KOH.



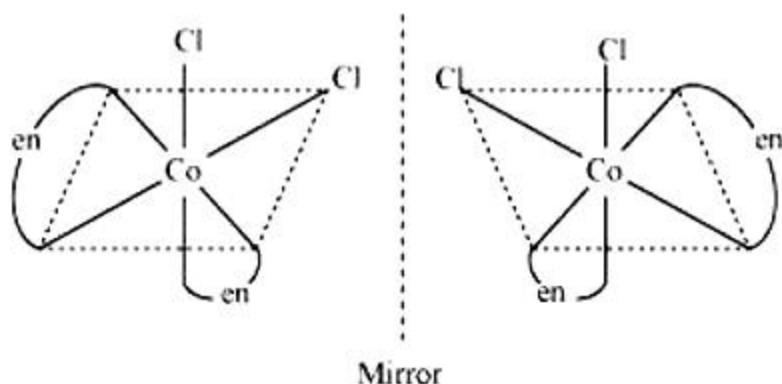
8. (b)  $CrCl_3 \cdot 6H_2O$

**Explanation:**  $CrCl_3 \cdot 6H_2O$  can be written as  $[Cr(H_2O)_6]Cl_3$ . The three chloride ions are outside the square bracket means they satisfy the primary valence and hence are ionisable. Thus, it will give three chloride ions per formula unit.

OR

(c) Cis -  $[\text{Co}(\text{en})_2\text{Cl}_2]^+$

**Explanation:** Cis -  $[\text{Co}(\text{en})_2\text{Cl}_2]^+$  has non superimposable mirror images as shown.



Hence, it shows optical isomerism and can form d (dextrorotatory) and l (laevorotatory) isomers.

9. (b)  $\text{Mn}_2(\text{CO})_{10}$

**Explanation:** CO is a neutral ligand. The overall charge on the given complex is 0. So, Mn has zero oxidation state.

10. (a) 1,2-dichloroethane

**Explanation:** Dihaloalkanes having the same halogen are classified as geminal halides or gem-dihalides and vicinal halides or vic-dihalides. Gem-dihalides are molecules where halogen atoms are present on the same carbon atom where Vic-dihalides are those dihaloalkanes where the halogen atoms are present on two adjacent carbon atoms. In common naming system, the gem-dihalides are named as alkylidene halides, vic-dihalides are named as alkylene dihalides. Dichloromethane contains only one carbon, so adjacent halogen atoms cannot occur in the molecule. 1,2-dichloroethane contains two carbon atoms with adjacent halogen atoms. Ethylidene chloride, as its common name states, is a gem-dihalide. Allyl chloride contains only one chlorine atom.

11. (c) Dipole - dipole interaction

**Explanation:** Polar molecule will act as a dipole.

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

**Explanation:** Molarity changes with temperature because volume changes with a change in temperature.

OR

(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.

15. (b) Assertion and reason both are wrong statements.

**Explanation:** Boiling points of alcohol are higher than ethers. Alcohols can form intermolecular hydrogen bonding whereas ethers cannot.

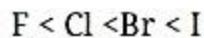
16. (d) Assertion is INCORRECT but, reason is CORRECT.

**Explanation:** Assertion is INCORRECT but, reason is CORRECT.

### Section B

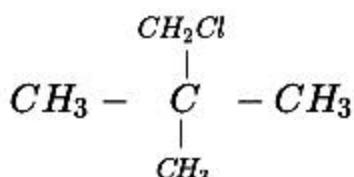
17. i. When alkyl group is the same, the reactivity of alkyl halide is decided by the halogen present. Greater the size of a halogen atom, larger is the R-X bond length, and weaker is the bond. Thus, more reactive is alkyl halide. On going down the group size of the halides increases.

The order of the size of halogen is



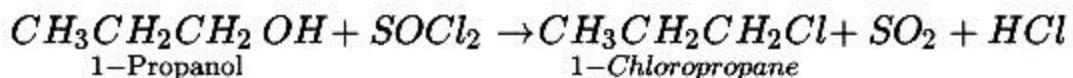
Thus, the order of reactivity is R-I > R-Br > R-Cl

- ii. In neopentyl chloride, the leaving group is Chloride ( $Cl^-$ ) ion therefore, the nucleophile will attack the C atom attached to Cl atom from the back side, according  $S_N^2$  mechanism. As we know for  $S_N^2$  mechanism to proceed the C atom at which the nucleophile will attach itself should be unhindered but in neopentyl this C atom is sterically hindered due to presence of three bulky  $-CH_3$  groups which do not allow the nucleophile to approach the C atom to which leaving group is attached. Hence, the  $S_N^2$  mechanism is not followed by neopentyl chloride.



Neopentyl chloride

OR



18. Given, W(cane sugar) = 5 g

$$W(X) = 0.877 \text{ g}$$

$$M(\text{cane sugar}) = 342 \text{ g mol}^{-1}$$

$\pi$  (cane sugar) =  $\pi$  (X) [ $\because$  solution is isotonic]

$$\frac{W(\text{cane sugar}) \times 1000}{\frac{M(\text{cane sugar}) \times V}{5 \text{ g}}} = \frac{W(X) \times 1000}{M(X) \times V}$$

$$\frac{342 \text{ g mol}^{-1}}{5 \text{ g}} = \frac{0.877 \text{ g}}{M(X)}$$

$$m(x) = 59.9 \text{ g mol}^{-1}$$

19. The linkage isomer is  $[\text{Pt}(\text{ONO})(\text{NH}_3)_3]\text{Cl}$

IUPAC Name - triaminenitrito-o-platinum II chloride.

OR

The difference of energy between two sets of d-orbitals after splitting is called crystal field splitting energy or crystal field stabilizing energy (CFSE).

20. As we know for first order reaction

$$t_{1/2} = \frac{0.693}{k}$$

Given,  $k = 200 \text{ s}^{-1}$

$$So, t_{1/2} = \frac{0.693}{200} = 3.47 \times 10^{-3} \text{ s.}$$

21. It is given that  $T_1 = 298 \text{ K}$

$$\therefore T_2 = (298 + 10) \text{ K} = 308 \text{ K}$$

We also know that the rate of the reaction doubles when temperature is increased by  $10^\circ$ .

Therefore, let us take the value of  $k_1 = k$  and that of  $k_2 = 2k$

$$Also, R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$$

Now, substituting these values in the equation:

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303R} \left[ \frac{T_2 - T_1}{T_1 T_2} \right]$$

We get:

$$\begin{aligned}\log \frac{2k}{k} &= \frac{E}{2.303 \times 8.314} \left[ \frac{10}{298 \times 308} \right] \\ \Rightarrow \log 2 &= \frac{E_a}{2.303 \times 8.314} \left[ \frac{10}{298 \times 308} \right] \\ \Rightarrow E_a &= \frac{2.303 \times 8.314 \times 298 \times 308 \times \log 2}{10} \\ &= 52897.78 \text{ J mol}^{-1} \\ E_a &= 52.9 \text{ kJ mol}^{-1}\end{aligned}$$

22. For a compound to act as an acid, it, first of all, has to lose a proton. On losing the proton, the anionic part so formed should be stable.

The more stable the anionic part will be, the more will be a tendency of the compound to lose the proton and thus more acidic will be the compound.

Now if there is any electron withdrawing group on the benzene ring, the OH will easily lose the proton and become stable. In the case of the above-mentioned list, 2, 4, 6-trinitrophenol will be maximum acidic as on losing the proton, there are three electron withdrawing groups that will stabilise the anionic part. Second will be nitro phenol.

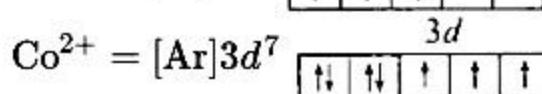
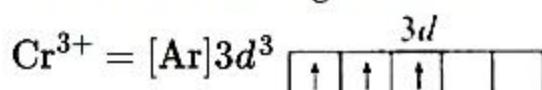
Although there is just one nitro group but it shows -R effect and thus stabilizes the compound after losing the proton. The third will be 3,5-di nitro phenol. Although in this case, the nitro group can not show resonance since it is at meta position but it will be acting as an electron withdrawing group by its inductive effect.

Then comes the phenol only as there is no stabilising or destabilising group. Then there is p-methyl phenol as again the negative charge will be stabilised by resonance. This will be less acidic than phenol as there is CH<sub>3</sub> group which is having +I effect. The last will be phenol as it will be forming just a primary carbocation with only +I stabilization.

So the order will be

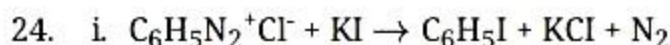
2, 4, 6-trinitrophenol > 3-nitrophenol > 3,5-di nitro phenol > phenol > 4-methyl phenol > propane-1-ol

23. The electronic configuration of Cr<sup>3+</sup> and Co<sup>2+</sup> ions are

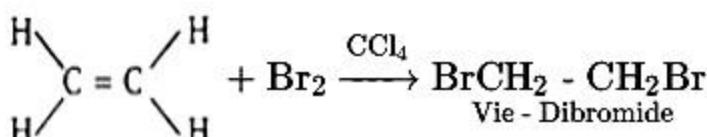


Due to symmetrical electronic configuration, there is no orbital contribution in Cr<sup>3+</sup> ion.

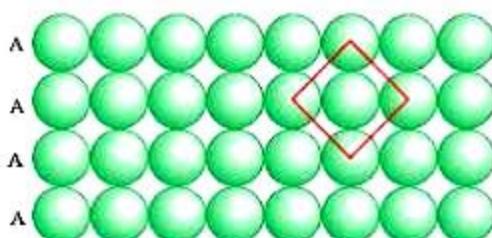
However, appreciable contribution occurs in  $\text{Co}^{2+}$  ion. Therefore, magnetic moment variation occur.



ii.

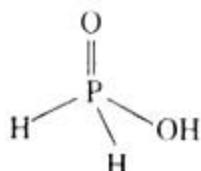


25. In the two dimensional square close packed layer, the atom touches 4 nearest neighbouring atoms. Hence, its coordination number = 4



### Section C

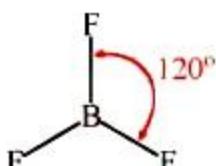
26. The phosphorus acid is a dibasic acid having an oxidation state of P = + 3 as shown below;



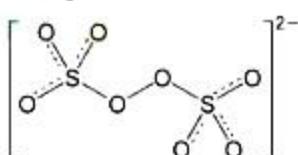
OR

Structures of compounds are given below:

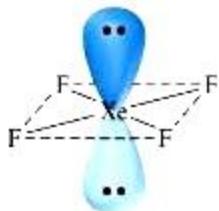
i.  $\text{BF}_3$



ii.  $\text{S}_2\text{O}_9^-$

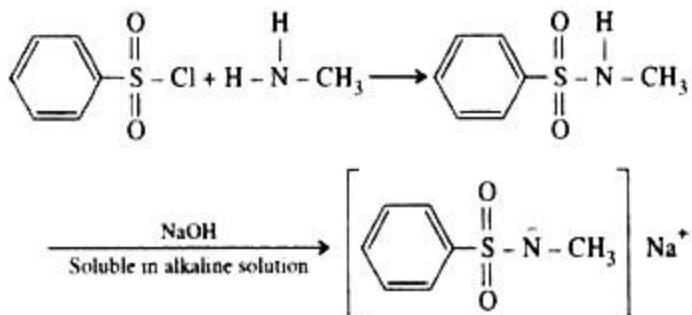


iii.  $\text{XeF}_4$

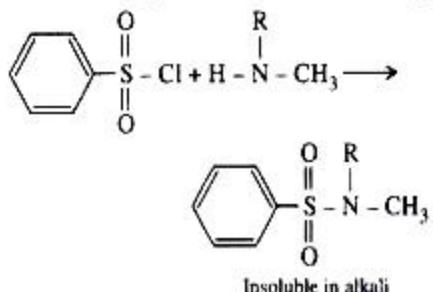


27. The Primary, secondary and tertiary amines can be distinguished by Hinsberg test. The given amine is shaken with benzene sulphonyl chloride.

i. Primary amine forms sulphonamide which is soluble in alkali.



ii. Secondary amine forms sulphonamide which is insoluble in alkali.

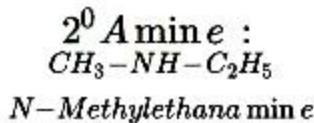
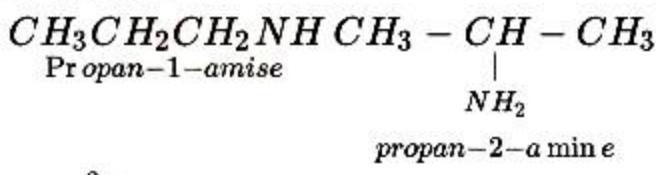


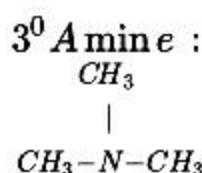
iii. Tertiary amine will not react with Hinsberg's reagent because there is no hydrogen present on nitrogen.

OR

Following four structural isomers are possible:

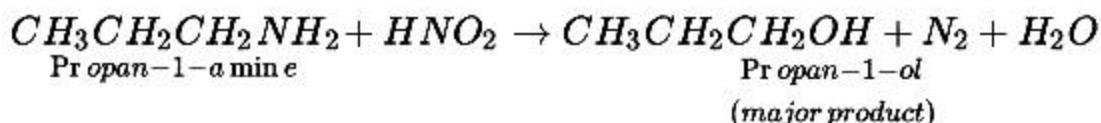
$1^0$  Amines:





### *N,N-Dimethylmethaneamine*

Only 1° amine react with  $\text{HNO}_2$  to liberate  $\text{N}_2$  gas.



28. We know that, Atomic mass =  $M = \frac{d \times a^3 \times N_A}{z}$

Where  $d$  = Density of the material =  $10.5 \text{ g/cm}^3$

$$a = \text{Length of the edge of the cell} = 4.077 \times 10^{-8} \text{ cm}$$

$$N_A = \text{Avagadro number} = 6.023 \times 10^{23} \text{ mol}^{-1}$$

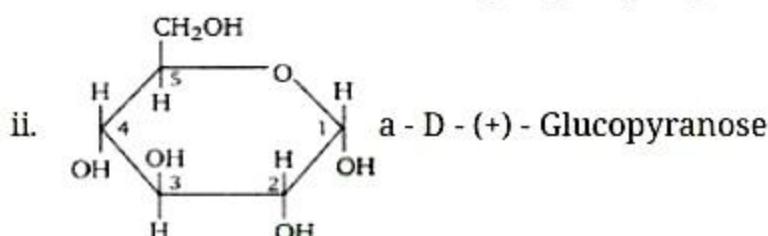
$z \equiv \text{No. of atoms} \equiv 4$

Now, put the values

$$M = \frac{10.5 g cm^{-3} \times (4.077 \times 10^{-8} cm)^3 \times (6.023 \times 10^{23} mol^{-1})}{4}$$

∴ Atomic mass of silver = 107.08g mol<sup>-1</sup>

29. i. This indicates that the aldehyde group in glucose is not free.



- iii. 'D' gives the configuration, i.e. the - OH group at carbon 5 is on the right hand side + indicates that the isomer is dextrorotatory.

- ### 30. i. 2-Bromopropane to 1-bromopropane

- a. alc KOH heat
  - b. HBr peroxide

- ## ii. Chloroethane to butane

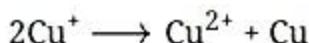
### Na wurtz reaction

- ### iii. Benzene to diphenyl

- a. Bromine, ferric bromide
  - b. Na Dry ether fitting reaction

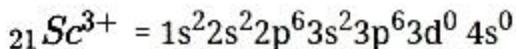
## Section D

31. i. a. Copper (I) ions are unstable in aqueous solution and undergo disproportionation.



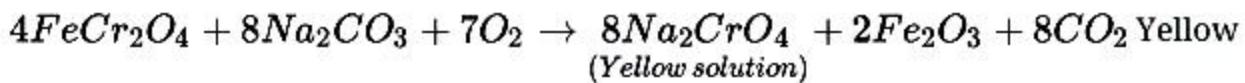
The stability of  $\text{Cu}^{2+}$  (aq) rather than  $\text{Cu}^+$  (aq) is due to the much more negative  $\Delta_{hyd}\ H$  of  $\text{Cu}^{2+}$ (aq) than  $\text{Cu}^+$ , which compensates more for the second ionisation enthalpy of Cu.

- b. Because, it has maximum number of unpaired electron.  
c. Sc shows only +3 oxidation state in its salts.

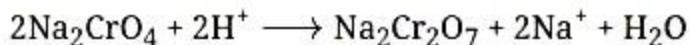


The ions having  $d^0$  or  $d^{10}$  configuration are colourless or white.

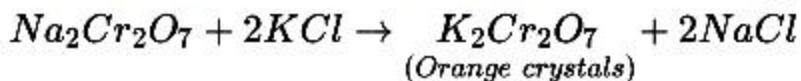
- ii. Preparation of  $\text{K}_2\text{Cr}_2\text{O}_7$  from chromite are Chromite ore ( $\text{FeCr}_2\text{O}_4$ ) is fused with sodium or potassium carbonate in free excess of air.



solution of sodium chromate is filtered, acidified with  $\text{H}_2\text{SO}_4$  to obtain sodium dichromate.



Sodium dichromate is treated with the solution of potassium chloride.



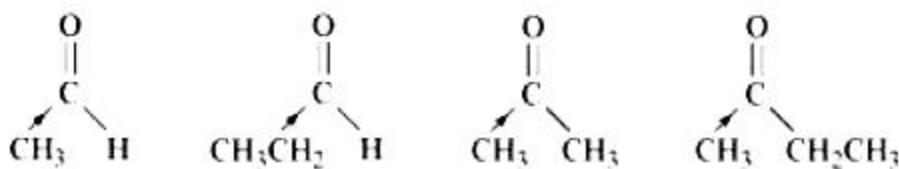
OR

On the basis of lanthanoid contraction:

- Due to lanthanide contraction, the size of the atom decreases with the decrease in size, the covalent character increases. Therefore,  $\text{La}_2\text{O}_3$  is more ionic while  $\text{Lu}_2\text{O}_3$  is more covalent in nature.
- As the size decreases from (lanthanum) La to (lutetium) Lu, the stability of the oxo-salts also decreases.
- Stability of complexes from La to Lu, increases as the size of the central atom decreases.
- Radii of the elements of 4d-and 5d-blocks in the same vertical columns are nearly the same.

v. The acidic nature of lanthanoid oxides increases from La to Lu.

32. i.



Ethanal      Propanal      Propanone      Butanone

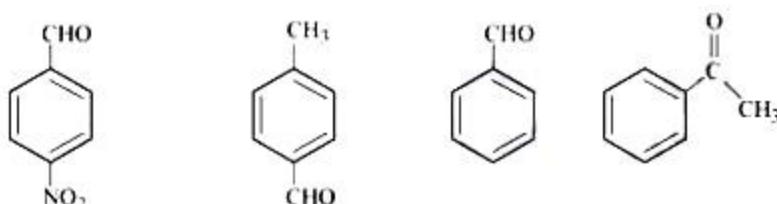
The +I effect of the alkyl group increases in the order:

Ethanal < Propanal < Propanone < Butanone

The electron density at the carbonyl carbon increases with the increase in the +I effect. As a result, the chances of attack by a nucleophile decrease. Hence, the increasing order of the reactivities of the given carbonyl compounds in nucleophilic addition reactions is:

Butanone < Propanone < Propanal < Ethanal

ii.



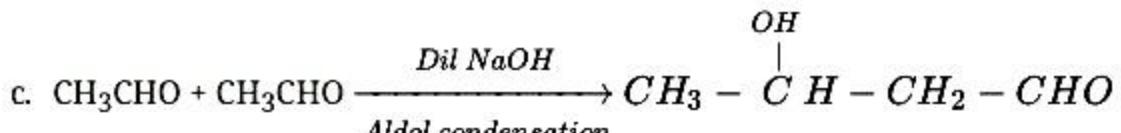
p - Nitrobenzaldehyde    p - Tolualdehyde    Benzaldehyde    Acetophenone

The +I effect is more in ketone than in aldehyde. Hence, acetophenone is the least reactive in nucleophilic addition reactions. Among aldehydes, the +I effect is the highest in p-tolualdehyde because of the presence of the electron-donating -CH<sub>3</sub> group and the lowest in p-nitrobenzaldehyde because of the presence of the electron-withdrawing -NO<sub>2</sub> group. Hence, the increasing order of the reactivities of the given compounds are:

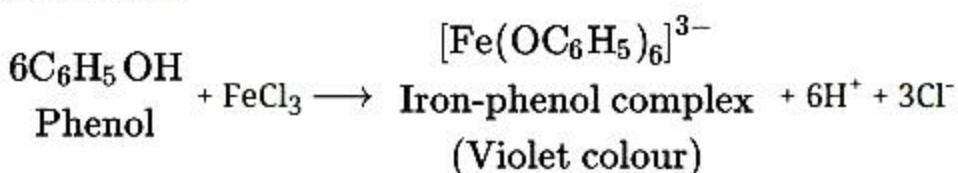
Acetophenone < p-tolualdehyde < Benzaldehyde < p-Nitrobenzaldehyde

OR

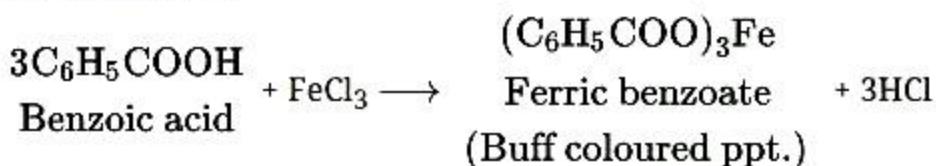
- i. a.  $\text{CH}_3\text{CHO} + \text{HCN} \longrightarrow \text{CH}_3\text{CH(OH)CN}$   
 Acetaldehyde cyanohydrin
- b.  $\begin{array}{c} \text{H}_3\text{C} \\ | \\ \text{H} \end{array} \text{C}=\text{O} + \text{NH}_2\text{OH} \longrightarrow \begin{array}{c} \text{H}_3\text{C} \\ | \\ \text{H} \end{array} \text{C}=\text{NOH} + \text{H}_2\text{O}$   
 Ethanal oxime



- ii. a. Phenol and benzoic acid can be distinguished by the ferric chloride test. Phenol reacts with neutral  $\text{FeCl}_3$  to form ferric phenoxide complex giving violet colouration.

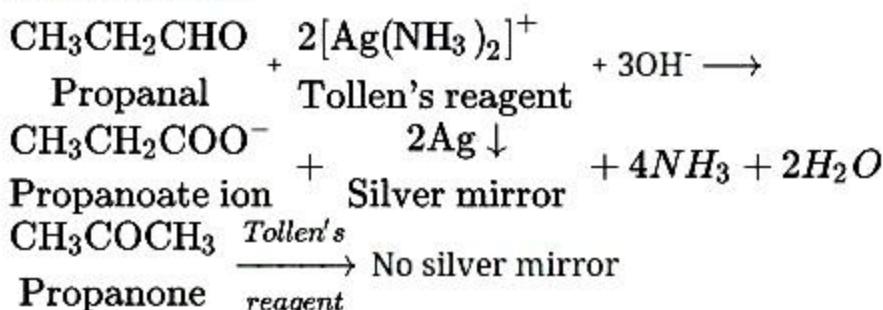


But benzoic acid reacts with neutral  $\text{FeCl}_3$  to give a buff coloured precipitate of ferric benzoate.



b. **Propanal and propanone:**

These compounds can be distinguished by using Tollen's test. Propanal being an aldehyde reduces Tollen's reagent to shining silver mirror and propanone being a ketone does not.



33. Both conductivity and molar conductivity change with the concentration of the electrolyte. Conductivity always decreases with decrease in concentration both, for weak and strong electrolytes. This can be explained by the fact that the number of ions per unit volume that carry the current in a solution decreases on dilution. The conductivity of a solution at any given concentration is the conductance of one unit volume of solution kept between two platinum electrodes with unit area of cross section and at a distance of unit length.

This is clear from the equation:

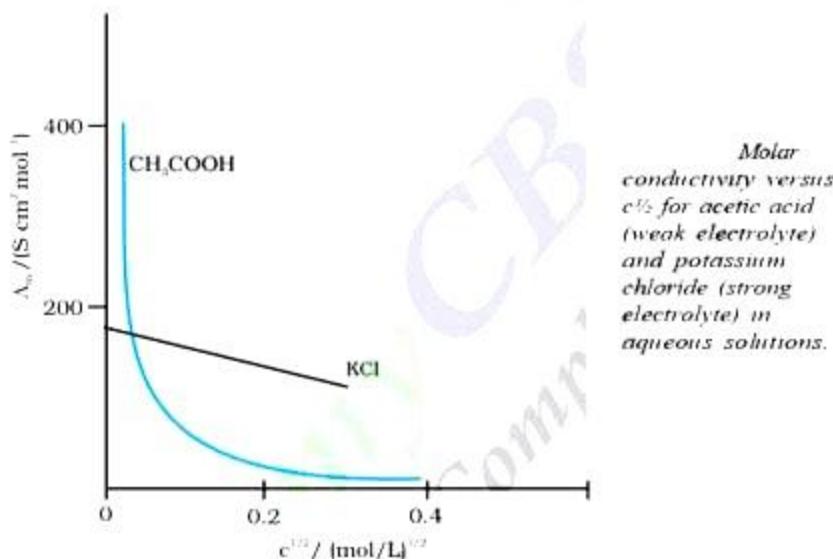
$$G = \frac{\kappa A}{l} = \kappa \quad (\text{both } A \text{ and } l \text{ are unity in their appropriate units in m or cm})$$

Molar conductivity of a solution at a given concentration is the conductance of the

volume V of solution containing one mole of electrolyte kept between two electrodes with area of cross section A and distance of unit length. Since  $l = 1$  and  $A = V$  (Volume containing 1 mole of electrolyte). Therefore,

$$\Lambda_m = \frac{\kappa A}{l} = \kappa V$$

Molar conductivity increases with decrease in concentration. This is because the total volume, V, of solution containing one mole of electrolyte also increases. It has been found that decrease in  $\kappa$  on dilution of a solution is more than compensated by increase in its volume. Physically, it means that at a given concentration,  $\Lambda_m$  can be defined as the conductance of the electrolytic solution kept between the electrodes of a conductivity cell at unit distance but having area of cross section large enough to accommodate sufficient volume of solution that contains one mole of the electrolyte. When concentration approaches zero, the molar conductivity is known as limiting molar conductivity and is represented by the symbol  $\Lambda_m^\circ$ . The variation in  $\Lambda_m$  with concentration is different for strong and weak electrolytes as shown in the figure.



For strong electrolytes,  $\Lambda_m$  increases slowly with dilution and can be represented by the equation:

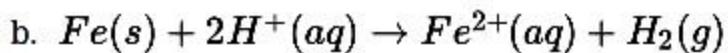
$$\Lambda_m = \Lambda_m^\circ - Ac^{1/2}$$

Weak electrolytes like acetic acid have lower degree of dissociation at higher concentrations and hence for such electrolytes, the change in  $\Lambda_m$  with dilution is due to increase in the degree of dissociation and consequently the number of ions in total volume of solution that contains 1 mol of electrolyte. In such cases  $\Lambda_m$  increases steeply on dilution, especially near lower concentrations as shown in the given figure above.

OR

- a. Weak Electrolysis: Those electrolytes which do not dissociate into ions completely in aqueous solution, e.g.  $\text{CH}_3\text{COOH}$

Strong electrolytes: Strong electrolytes are those which dissociate into ions completely in aqueous solution e.g. KCl



$$\begin{aligned}E_{\text{cell}} &= [E^0(\text{H}^+/\text{H}_2) - E^0(\text{Fe}^{2+}/\text{Fe})] - \frac{0.0591}{2} \log \frac{[\text{Fe}^{2+}]}{[\text{H}^+]^2} \\&= [0 - (0.44)] - \frac{0.0591}{2} \log \frac{0.001}{1^2} \\&= +0.44V + \frac{0.1773}{2} \\&= 0.44 \text{ V} + 0.0886 \text{ V} \\&= 0.5286 \text{ V}\end{aligned}$$

**CBSE Class 12 Chemistry  
Sample paper 03 (2020-21)**

**Maximum Marks: 70**

**Time Allowed: 3 hours**

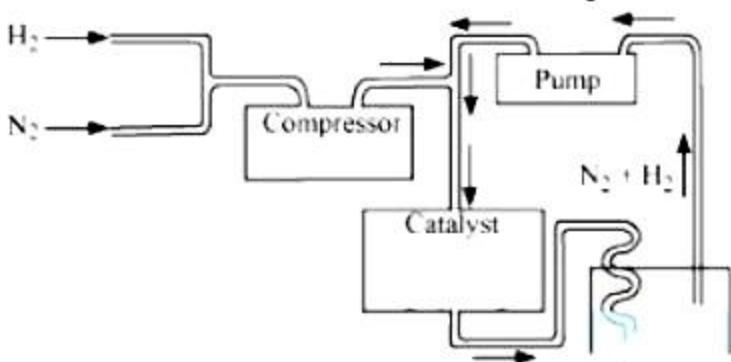
**General Instructions:**

- 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:**

Ammonia is present in small quantities in air and soil where it is formed by the decay of nitrogenous organic matter e.g., urea. On a large scale, ammonia is manufactured by Haber's process. In accordance with Le Chatelier's principle, high pressure would favour the formation of ammonia. Ammonia is a colourless gas with a pungent odour. Its freezing and boiling points are 198.4 and 239.7 K respectively. In the solid and liquid states, it is associated through hydrogen bonds as in the case of water and that accounts for its higher melting and boiling points than expected on the basis of its molecular mass. Ammonia gas is highly soluble in water. Its aqueous solution is weakly basic due to the formation of OH<sup>-</sup> ions. The presence of a lone pair of electrons on the nitrogen atom of the ammonia molecule makes it a Lewis base.



**The following questions are multiple-choice questions. Choose the most appropriate choice**

- i. On a small scale, ammonia is obtained from ammonium salts which decompose when treated with
  - a. caustic soda
  - b. calcium chloride
  - c. sodium hydroxide
  - d. sodium chloride
- ii. The optimum conditions for the production of ammonia are a pressure of
  - a.  $200 \times 10^5$  Pa
  - b.  $400 \times 10^5$  Pa
  - c.  $100 \times 10^5$  Pa
  - d.  $300 \times 10^5$  Pa
- iii. The catalyst which is used in the preparation of NH<sub>3</sub> by Haber's process
  - a. Mg<sub>2</sub>O<sub>3</sub> + K<sub>2</sub>O
  - b. Al<sub>2</sub>O<sub>3</sub> + K<sub>2</sub>O
  - c. NaO<sub>3</sub> + K<sub>2</sub>O
  - d. None of these
- iv. The ammonium molecule has:
  - a. five bond pair and two lone pair
  - b. four lone pair and one bond pair
  - c. three bond pair and one lone pair
  - d. three bond pair and two lone pair
- v. A compound reacts with ammonia to form deep colour solution, identify the

compound

- a.  $\text{Au}^{2+}$
- b.  $\text{Cu}^{2+}$
- c.  $\text{Al}^{3+}$
- d.  $\text{Mg}^{2+}$

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

A colloid is a heterogeneous system in which one substance is dispersed as very fine particles in another substance called dispersion medium. The essential difference between a solution and a colloid is that of particle size. In a solution, the constituent particles are ions or small molecules. In a colloid, the dispersed phase may consist of particles of a single macromolecule. A colloid is classified on the basis of various criteria. Depending upon the nature of the interaction between the dispersed phase and the dispersion medium, colloidal sols are divided into two categories, namely into lyophilic and lyophobic sols. Depending upon whether the dispersed phase and the dispersion medium are solids, liquids, or gases. The most common division are sols (solids in liquids), gels (liquids in solids), and emulsions (liquids in liquids)

**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 statements and reason is correct explanation for assertion
  - b. Assertion and reason both are correct statements 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:** The range of diameters of the colloidal particles is between 1 and 1000 nm.  
**Reason:** Colloidal particles are larger than simple molecules but small enough to remain suspended.
  - ii. **Assertion:** Lyophilic sols are irreversible sols.  
**Reason:** Lyophilic sols are quite stable and cannot be easily coagulated.
  - iii. **Assertion:** Lyophobic sol are prepared only by special methods  
**Reason:** Lyophobic sol can not be prepared by simply mixing the substance with the dispersion medium.

iv. **Assertion:** Firefighting foams, used at emergency airplane landings is a colloidal system.

**Reason:** In cell proteins and nucleic acids are colloidal-sized particles.

v. **Assertion:** Whipped cream is a foam, which is a gas dispersed in a liquid.

**Reason:** Lyophobic sols are highly stabilized sol.

3. Which of the following is a 3° amine?

- a. N-methylaniline
- b. Tert-butylamine
- c. 1-methylcyclohexylamine
- d. Triethylamine

4. Nucleotides are joined together by

- a. peptide linkage
- b. disulphide linkage
- c. glycosidic linkage
- d. phosphodiester linkage

OR

Fat soluble vitamins are stored in

- a. Eyes
- b. Stomach
- c. Adipose and liver
- d. Pancreas

5. Which among the following is miscible in each other?

- a. Methanol and benzene
- b. Benzene and water
- c. All of these
- d. Methanol and water

6. Which one is the correct increasing order of boiling points of the following compounds?

1-Bromoethane, 1-Bromopropane, 1-Bromobutane, Bromobenzene

- a. 1-Bromoethane < 1-Bromopropane < 1-Bromobutane < Bromobenzene
- b. Bromobenzene < 1-Bromobutane < 1-Bromopropane < 1-Bromoethane
- c. Bromobenzene < 1-Bromoethane < 1-Bromopropane < 1-Bromobutane
- d. 1-Bromopropane < 1-Bromobutane < 1-Bromoethane < Bromobenzene

OR

Decomposition of benzene diazonium chloride by using  $\text{Cu}_2\text{Cl}_2/\text{HCl}$  to form chlorobenzene is:

- a. Wurtz – Fittig reaction
  - b. Friedel – Crafts reaction
  - c. Sandmeyer's reaction
  - d. Finkelstein reaction
7. Sec – Butylamine is the common name of which compound?
- a. N – ethylethanamine
  - b. 2 – butanamine
  - c. N – methyl – 1 – propanamine
  - d. 1 – butanamine

OR

Aniline does not undergo Friedel – Crafts reaction because:

- a. Anilium ion deactivates any further reaction
  - b. Aluminium chloride reacts with Aniline
  - c. All of these
  - d.  $\text{AlCl}_3$  act as a catalyst
8. Match the complex ions given in Column I with the hybridisation and number of unpaired electrons given in Column II and assign the correct code :

Column I (Complex ion)	Column II (Hybridisation, number of unpaired electrons)
(a) $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$	(i) $\text{dsp}^2$ , 1
(b) $[\text{Co}(\text{CN})_4]^{2-}$	(ii) $\text{sp}^3\text{d}^2$ , 5
(c) $[\text{Ni}(\text{NH}_3)_6]^{2+}$	(iii) $\text{d}^2\text{sp}^3$ , 3
(d) $[\text{MnF}_6]^{4-}$	(iv) $\text{sp}^3$ , 4
	(v) $\text{sp}^3\text{d}^2$ , 2

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

- 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)

OR

Which of the following species is not expected to be a ligand?

- a.  $\text{NH}_4^+$
  - b.  $\text{NH}_2\text{CH}_2\text{NH}_2$
  - c. CO
  - d. NO
9. In the formation of complex entity, the central atom/ion acts as:
- a. Lewis acid
  - b. Lewis base
  - c. Bronsted acid
  - d. Bronsted base
10. Arrange the following in the increasing order of nucleophilicity:
- $\text{I}^-$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$
- a.  $\text{Cl}^- < \text{Br}^- < \text{I}^-$
  - b.  $\text{I}^- < \text{Cl}^- < \text{Br}^-$
  - c.  $\text{Br}^- < \text{Cl}^- < \text{I}^-$
  - d.  $\text{I}^- < \text{Br}^- < \text{Cl}^-$
11. Packing efficiency for simple cubic structure is
- a. 74%
  - b. 52.36%
  - c. 100%
  - d. 68%
12. **Assertion:** Linkage isomerism arises in coordination compounds containing ambidentate ligand.
- Reason:** Ambidentate ligand has two different donor atoms.
- a. Assertion and reason both are true, the reason is the correct explanation of assertion.
  - b. Assertion and reason both are true but the reason is not the correct explanation of assertion.

- c. The assertion is true, the reason is false.
- d. The assertion is false, the reason is true.

13. **Assertion:** Glycine must be taken through diet.

**Reason:** It is an essential amino acid.

- a. Assertion and reason both are correct statements and reason explain the assertion.
- b. Both assertion and reason are wrong statements.
- c. The assertion is the correct statement and reason is the wrong statement.
- d. The assertion is the wrong statement and reason is the correct statement.

14. **Assertion:** Iodine is more soluble in  $\text{CCl}_4$  than in water.

**Reason:** Non-polar solutes are more soluble in non-polar solvents.

- 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:** Sodium chloride is used to clear snow on the roads.

**Reason:** Sodium chloride depresses the freezing point of water.

- 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:** Bond angle in ethers is slightly less than the tetrahedral angle

**Reason:** There is a repulsion between the two bulky (-R) groups.

- a. Assertion and reason both are correct and reason is 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:** Phosphorus chlorides (tri and Penta) are preferred over thionyl chloride for

the preparation of alkyl chlorides from alcohol.

**Reason:** Phosphorus chlorides give pure alkyl halides.

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

### Section B

17. How will you bring the following conversion?

Ethanol to but-1-yne

OR

How the following conversions can be carried out?

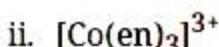
- i. tert-Butyl bromide to isobutyl bromide
- ii. Aniline to phenylisocyanide

18. 200 cm<sup>3</sup> of an aqueous solution of a protein contains 1.26 g of the protein. The osmotic pressure of such a solution at 300 K is found to be  $2.57 \times 10^{-3}$  bar. Calculate the molar mass of the protein.

19. Explain [Co(NH<sub>3</sub>)<sub>6</sub>]<sup>3+</sup> is an inner orbital complex whereas [Ni(NH<sub>3</sub>)<sub>6</sub>]<sup>2+</sup> is an outer orbital complex.

OR

Draw the structures of isomers, if any and write the names of the following complex.

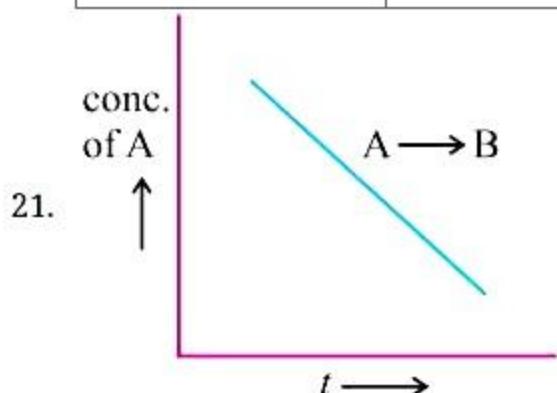


(Atomic no. of Cr = 24, Co = 27)

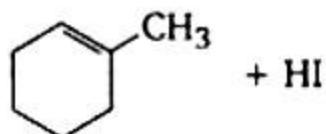
20. The reaction between A and B is first order with respect to A and zero order with respect to B. Fill in the blanks in the following table:

Experiment	A/mol <sup>-1</sup>	B/mol <sup>-1</sup>	Initial rate /mol L <sup>-1</sup> min <sup>-1</sup>
I	0.1	0.1	$2.0 \times 10 - 2$
II	-	0.2	$4.0 \times 10 - 2$

III	0.4	0.4	-
IV	-	0.2	$2.0 \times 10 - 2$



- i. What is the order of the reaction?
  - ii. What is the slope of the curve?
22. What happens when phenol is treated with ice-cold bromine dissolved in  $\text{CS}_2$ ?
23. Account for the following statement: Zinc salts are white while  $\text{Cu}^{2+}$  salts are coloured.  
[At. No. Zn = 30, Cu = 29]
24. Draw the structure of the major monohalo product in the following reaction:



25. What are the types of lattice imperfections found in crystals?

### Section C

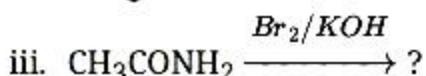
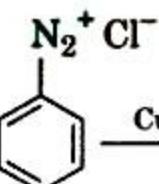
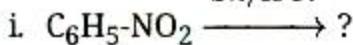
26. Explain the chemistry behind brown ring test for detection of nitrate ions.

OR

What prompted Bartlet to the discovery of noble gas compound?

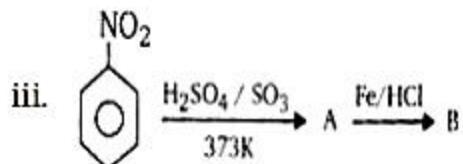
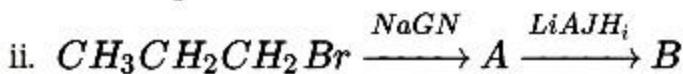
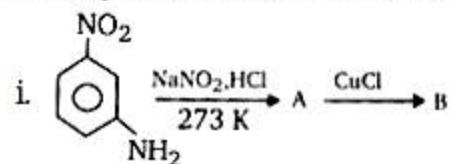
27. Write major product(s) in the following reactions:

$\text{Sn}/\text{HCl}$



OR

Identify A and B in the following reactions:



28. What is the coordination number in:

- Square close packing
- Hexagonal close packing.

29. Define the following as related to proteins.

- Peptide linkage
- Primary structure
- Denaturation

30. How are the following conversion carried out.

- Propene to propan-2-ol?
- Benzyl chloride to benzyl alcohol?
- Anisole to p-bromoanisole?

#### Section D

31. The elements of 3d transition series are given as: Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn.

Answer the following:

- Write the element which shows the maximum number of oxidation states. Give reason.
- Which element has the highest melting point?
- Which element shows only +3 oxidation state?
- Which element is a strong oxidising agent in +3 oxidation state and why?
- Write the electronic configuration of Sc and Zn.

OR

- Account for the following :

- i. Manganese shows maximum number of oxidation states in 3d series.
- ii.  $E^\circ$  value for  $Mn^{3+}/Mn^{2+}$  couple is much more positive than that for  $Cr^{3+}/Cr^{2+}$ .
- b. Write the chemical equations for the preparation of  $KMnO_4$  from  $MnO_2$ .

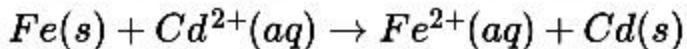
32. i. Account for the following :

- a. Cl-CH-OOH is a stronger acid than  $CH_3COOH$ .
- b. Carboxylic acids do not give reactions of carbonyl group
- ii. Write the chemical equations to illustrate the following name reactions.
  - a. Rosenumund reduction
  - b. Cannizzaro's reaction
- iii. Out of  
 $CH_3CH_2 - CO - CH_2 - CH_3$  and  $CH_3CH_2 - CH_2 - CO - CH_3$  which gives iodoform test?

OR

- i. Draw the structures of the following compounds:
  - a. 4-chloropentan-2-one
  - b. p-nitropropiophenone
- ii. Give tests to distinguish between the following pair of compound: Ethanal and propanal.

33. Calculate the equilibrium constant for the reaction.



Given :  $E^\circ(Cd^{2+}/Cd) = 0.40V$ ,  $E^\circ(Fe^{2+}/Fe) = -0.44V$

OR

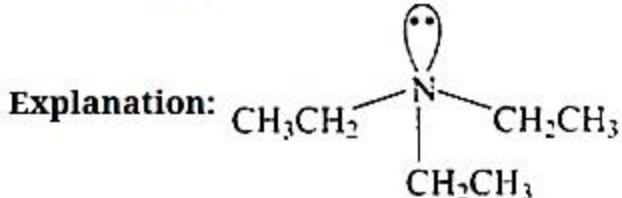
- i. Define Kohlraush's law.
- ii. Suggest a way to determine the  $\Lambda_m^\circ$  for  $CH_3COOH$ .
- iii. The  $\Lambda_m^\circ$  for sodium acetate, HCl, NaCl are 91.0, 425.9 and  $126.4\text{ S cm}^2\text{ mol}^{-1}$  respectively at 298 K. Calculate  $\Lambda_m^\circ$  for  $CH_3COOH$ .

**CBSE Class 12 Chemistry**  
**Sample paper 03 (2020-21)**

**Solution**

**Section A**

1. i. (a) caustic soda  
ii. (a)  $200 \times 10^5$  Pa  
iii. (b)  $\text{Al}_2\text{O}_3 + \text{K}_2\text{O}$   
iv. (c) three bond pairs and one lone pair  
v. (b)  $\text{Cu}^{2+}$
2. i. (b) Assertion and reason both are correct statements and reason is not correct explanation for assertion  
ii. (d) Assertion is wrong but reason is correct statement  
iii. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion  
iv. (b) Assertion and reason both are correct statements and reason is not correct explanation for assertion  
v. (c) Assertion is correct but reason is wrong statement
3. (d) Triethylamine



Triethylamine ( $3^\circ$  amine) - replacement of 3 hydrogens by alkyl/aryl tertiary amine is formed.

4. (d) phosphodiester linkage

**Explanation:** Nucleotides are together by phosphodiester linkage between 5' and 3' carbon atoms of the pentose sugar.

OR

- (c) Adipose and liver

**Explanation:** Vitamins which are soluble in fat and oils but insoluble in water are fat

soluble vitamins. These are vitamins A, D, E and K. They are stored in liver and adipose (fat storing) tissues.

5. (d) Methanol and water

**Explanation:** Methanol and Water both are Polar. There is intermolecular Hydrogen Bonding interaction.

6. (a) 1-Bromoethane < 1-Bromopropane < 1-Bromobutane < Bromobenzene

**Explanation:** The boiling point increases with an increase in molecular mass of the alkyl halide and greater in aryl halide.

OR

- (c) Sandmeyer's reaction

**Explanation:**  $C_6H_5N_2^+Cl^- + Cu_2Cl_2/HCl \rightarrow C_6H_5Cl$

Mixing the solution of the freshly prepared diazonium salt with cuprous chloride or cuprous bromide results in the replacement of the diazonium group by -Cl or -Br. This is called Sandmeyer's reaction.

7. (b) 2 – butanamine

**Explanation:** Sec – Butylamine is the common name of 2-butanamine ( $CH_3CH_2CHNH_2CH_3$ ).

OR

- (b) Aluminium chloride reacts with Aniline

**Explanation:**  $AlCl_3$  being a lewis acid reacts with the lone pair of  $-NH_2$  group of aniline forming an adduct ( $C_6H_5NH_2^+AlCl_3$ ) which deactivates the benzene system hence no Friedel-Crafts reaction occurs.

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

**Explanation:**

- $[Cr(H_2O)_6]^{3+}$  -  $d^2sp^3$ , 3
- $[Co(CN)_4]^{2-}$  -  $dsp^2$ , 1
- $[Ni(NH_3)_6]^{2+}$  -  $sp^3d^2$ , 2
- $[MnF_6]^{4-}$  -  $sp^3d^2$ , 5

OR



**Explanation:** Ligand must donate a pair of electron or loosely held electron pair to metal and from an M-L bond.

9. (a) Lewis acid

**Explanation:** The central metal atom/ion behaves as a Lewis acid while the ligand acts as a Lewis base. The ligand can be a negatively charged ion or a neutral molecule that donates its electron pair to the central metal atom/ion which acts as an electron pair acceptor (Lewis acid).

10. (a)  $\text{Cl}^- < \text{Br}^- < \text{I}^-$

**Explanation:** Nucleophilicity means the tendency of a nucleophile to attack a center of a positive charge. As the size of the nucleophile increases, its basicity decreases, and hence its nucleophilicity increases. As we move down the group 17 size of the anions increases and thus the nucleophilicity increases as  $\text{Cl}^- < \text{Br}^- < \text{I}^-$

11. (b) 52.36%

**Explanation:** Packing efficiency

$$\begin{aligned} &= \frac{\text{Volume of one atom}}{\text{Volume of cubic unit cell}} \times 100\% \\ &= \frac{\frac{4}{3}\pi r^3}{8r^3} \times 100 = \frac{\pi}{6} \times 100 \\ &= 52.36\% = 52.4\% \end{aligned}$$

12. (a) Assertion and reason both are true, the reason is the correct explanation of assertion.

**Explanation:** Linkage isomerism arises due to two different donor atoms in ambidentate ligand.

13. (b) Both assertion and reason are wrong statements.

**Explanation:** Glycine can be synthesized by the body and is a non-essential amino acid.

14. (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.

OR

(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.

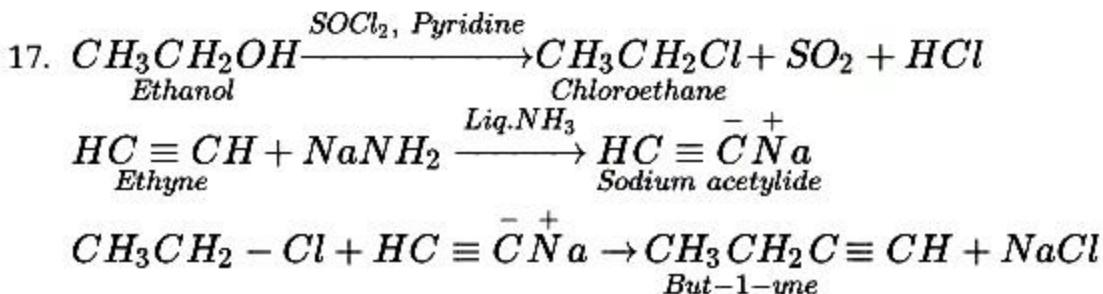
15. (d) The assertion is a wrong statement but the reason is the correct statement.

**Explanation:** The bond angle in ethers is slightly more than the tetrahedral angle due to repulsion between two bulky alkyl group.

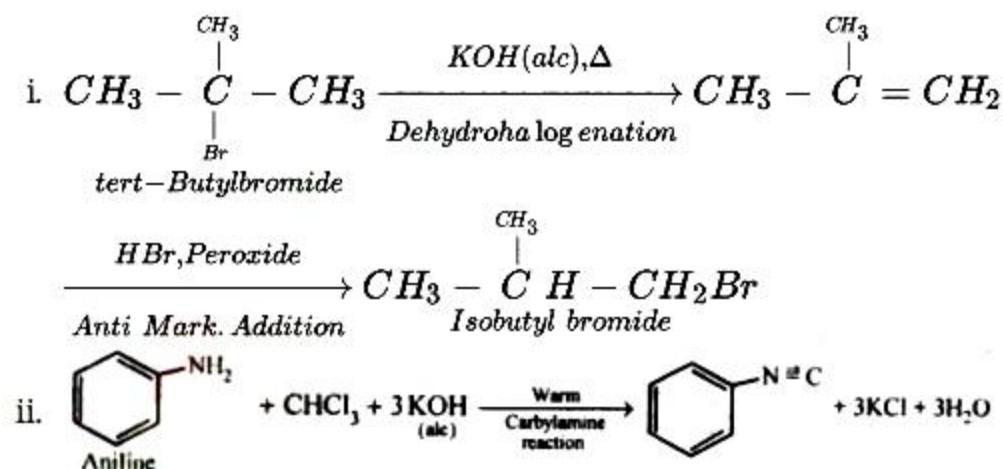
16. (b) Assertion and reason both are wrong statements.

**Explanation:** Thionyl chloride is preferred over phosphorous chlorides because along with the alkyl halides formed, the by-products are  $\text{SO}_2$  and  $\text{HCl}$ , which are gaseous and hence can escape the reaction leaving pure halides.

### Section B



OR



18. The various quantities known to us are as follows osmotic pressure of solution  $\Pi = 2.57 \times 10^{-3}$  bar.

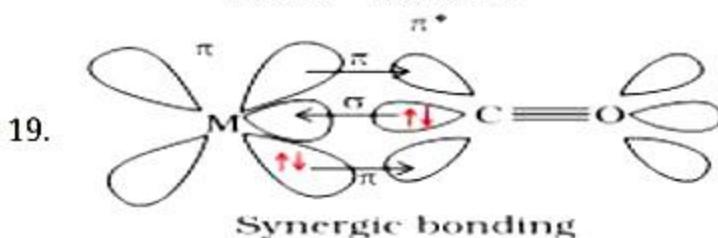
$$V = 200 \text{ cm}^3 = 0.200 \text{ litre}$$

$$T = 300 \text{ K}$$

$$R = 0.083 \text{ L bar mol}^{-1} \text{ K}^{-1}$$

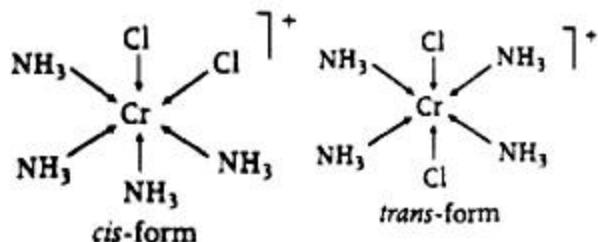
Substituting these values in equation (2.42) we get

$$M_2 = \frac{1.26g \times 0.083\text{L bar K}^{-1}\text{mol}^{-1} \times 300\text{K}}{2.57 \times 10^{-3}\text{bar} \times 0.200\text{L}} = 61.022 \text{ g mol}^{-1}$$



OR

- i. IUPAC name of  $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]^+$  is tetra ammine dichlorido chromium (III) ion. The two isomers can be represented as :

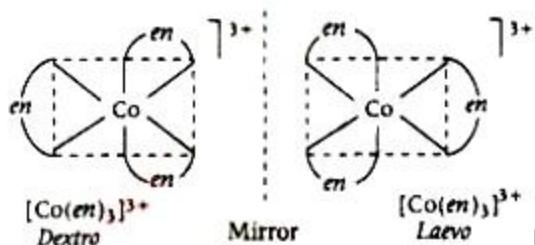


- ii.  $[\text{Co}(\text{en})_3]^{3+}$

#### IUPAC name

Tris( ethane -1,2 - diamine) cobalt (III) ion

**Structure:** There are two optical isomers of  $[\text{Co}(\text{en})_3]^{3+}$ , one is dextro and other is laevo whose structures are:



20. The given reaction is of the first order with respect to A and of zero order with respect to B.

Therefore, the rate of the reaction is given by,

$$\text{Rate} = k[A]^1[B]^0$$

$$\text{Rate} = k[A]$$

From experiment I, we obtain

$$2.0 \times 10^{-2} \text{ mol L}^{-1} \text{ min}^{-1} = k(0.1 \text{ mol L}^{-1})$$

$$k = 0.2 \text{ min}^{-1}$$

From experiment II, we obtain

$$4.0 \times 10^{-2} \text{ mol L}^{-1} \text{ min}^{-1} = 0.2 \text{ min}^{-1} [A], \text{ so } [A] = 0.2 \text{ mol L}^{-1}$$

From experiment III, we obtain

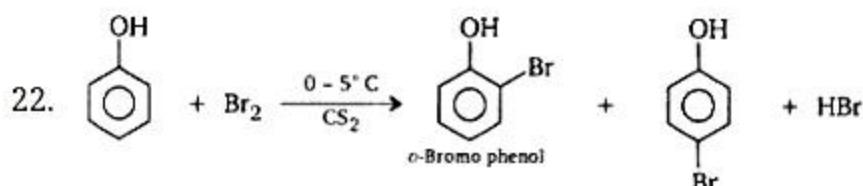
$$\text{Rate} = 0.2 \text{ min}^{-1} \times 0.4 \text{ mol L}^{-1} = 0.08 \text{ mol L}^{-1} \text{ min}^{-1}$$

From experiment IV, we obtain

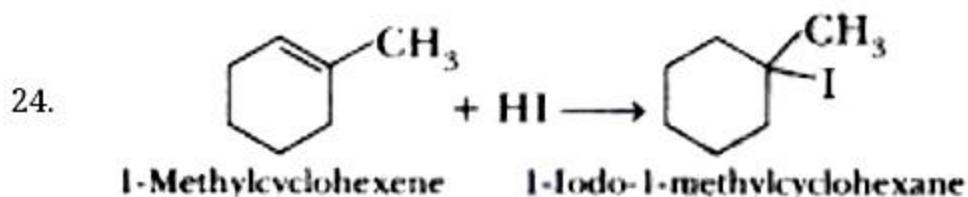
$$2.0 \times 10^{-2} \text{ mol L}^{-1} \text{ min}^{-1} = 0.2 \text{ min}^{-1} [A], \text{ so } [A] = 0.1 \text{ mol L}^{-1}$$

21. i. Zero order reaction.

ii.  $[R] = [R_0] - kt \therefore \text{Slope} = -k$



23. In zinc salts,  $\text{Zn}^{2+}$  does not have unpaired electrons, therefore cannot undergo d-d transitions. Whereas in  $\text{Cu}^{2+}$  ions there is one unpaired electron in d orbital due to which it can undergo d-d transitions and hence  $\text{Cu}^{+2}$  salts are coloured.



25. a. Stoichiometric defects i.e., Schottky defect and Frenkel defect.  
b. Non-stoichiometric defects i.e., metal excess defect, metal deficiency and  
c. Impurity defects

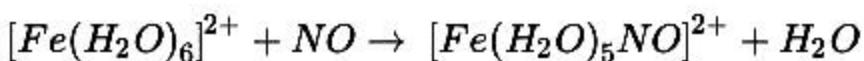
### Section C

26. The brown ring test for nitrate ions depends on the ability of  $\text{Fe}^{2+}$  to reduce nitrates to nitric oxide, which reacts with  $\text{Fe}^{2+}$  to form a brown coloured complex.

In this test, aqueous solution of salt is shaken in a test tube and mixed with an equal volume of freshly prepared ferrous sulphate solution. Now, concentrated sulphuric acid is added dropwise along the walls of the tube without disturbing it till a dark brown fine ring appears at the interface, where the oily layer of sulphuric acid and aqueous layer meet.

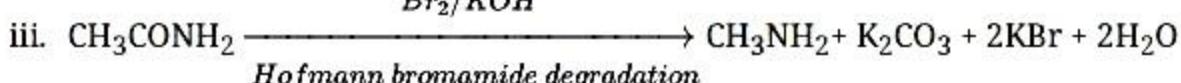
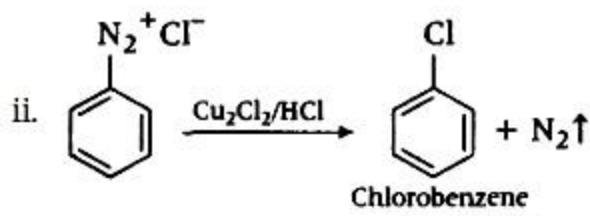
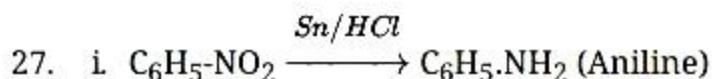
The chemical reactions involved are given below:



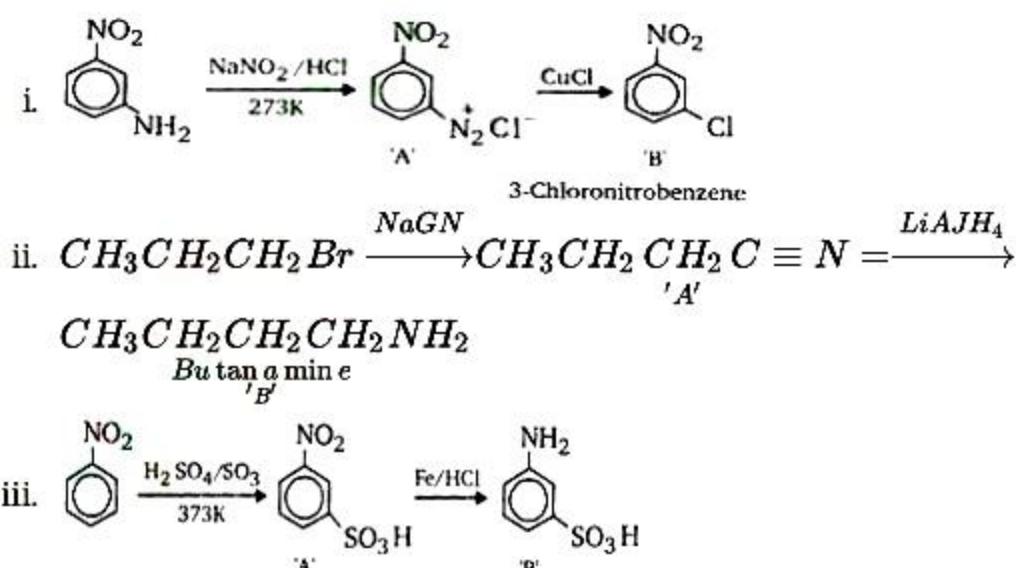


OR

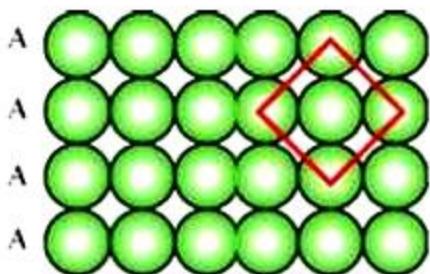
Bartlet (1962) prepared a red compound of formula  $O_2^+ [PtF_6]^-$  dioxygenyl hexafluoroplatinate (V). He argued that the first ionization energy of oxygen  $O_2$  [=1180 kJ mol<sup>-1</sup>] was almost identical with that of xenon (1170 kJ mol<sup>-1</sup>). He thought that if oxygen could form such compounds, xenon should also forms similar compounds. He prepared  $Xe^+ [PtF_6]^-$  (a red compound) by mixing  $PtF_6$  with xenon.



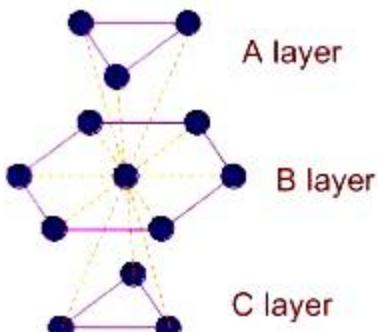
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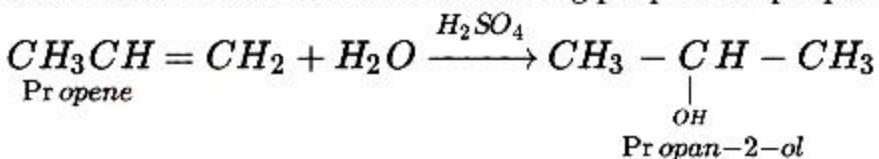
28. a. In square close packing, the coordination no. is 4.



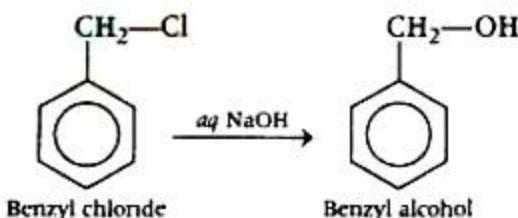
- b. In hexagonal close packing, the coordination no. is 12.



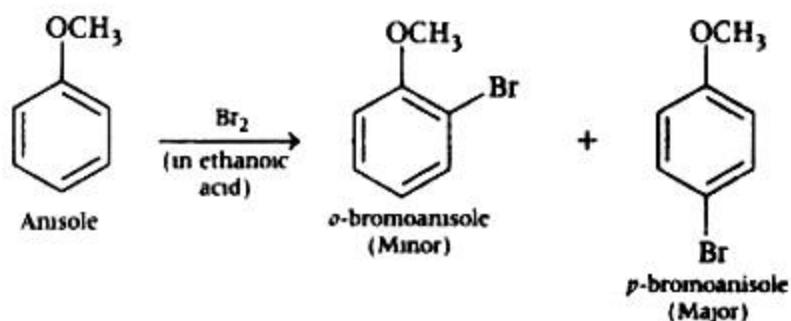
29. i. **Peptide linkage.** Amino acids are bifunctional molecules with  $\text{NH}_2$  group at one end and  $\text{COOH}$  at the other. Therefore, the  $\text{COOH}$  of one molecule and  $\text{NH}_2$  of another molecule interact by elimination of  $\text{H}_2\text{O}$  to form an amide like linkage called peptide bond or peptide linkage.
- ii. **Primary structure.** The sequence in which amino acids are linked with each other in polypeptide chain form primary structure.
- iii. **Denaturation.** The process by which secondary and tertiary structure of proteins get disturbed on change of pH or temperature and they are not able to perform their functions. This is called denaturation of proteins.
30. i. **Propene to propan-2-ol** Addition of  $\text{H}_2\text{SO}_4$  takes place (in accordance with Markownikoffs rule) while converting propene to propan-2-ol.



ii.

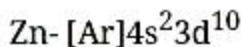
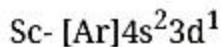


iii.



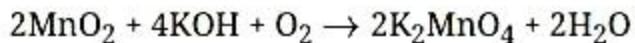
### Section D

31. i. Mn shows the highest number of oxidation state. Mn has electronic configuration [Ar]  $3d^54s^2$ . It has the maximum number of unpaired electrons in d orbitals and all the electrons in s-orbital as well as in d-orbital can take part in bond formation, therefore, it shows +7 highest oxidation state.
- ii. Chromium has the highest melting point among all the given elements.
- iii. Scandium shows only +3 oxidation state.
- iv. In the +3 oxidation state, Mn is a strong oxidising agent because in  $Mn^{3+}$  ion, Mn exists in  $3d^4$  configuration which is less stable and it can reduce to  $Mn^{2+}$  giving a more stable  $3d^5$  configuration. Hence, it acts as a strong oxidising agent.
- v. The electronic configuration is as follows:



OR

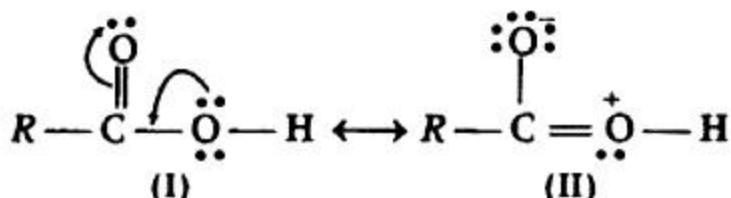
- a. i. Manganese shows maximum number of oxidation states in 3d series due to the presence of maximum number of unpaired electrons.
- ii.  $E^\circ$  value for  $Mn^{3+}/Mn^{2+}$  couple is much more positive than that for  $Cr^{3+}/Cr^{2+}$  because Cr is more stable in +3 oxidation state due to stable  $t_{2g}^3$  configuration whereas Mn is more stable in +2 oxidation state due to half filled  $3d^5$  configuration.
- b. Preparation of  $KMnO_4$  from  $MnO_2$ :



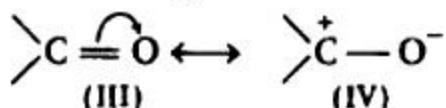
32. i. a.  $Cl-\text{CH}_2\text{COOH}$  is a stronger acid than  $\text{CH}_3\text{COOH}$ . It is because - Cl group exhibits -I-

effect which makes the carboxylate ion more stable. Higher the stability of carboxylate ion, easier is the removal of a proton from the carboxylic acid and stronger is the acid. In  $\text{CH}_3\text{COOH}$ , -  $\text{CH}_3$  group has +I-effect which destabilised it. Hence,  $\text{CH}_3\text{COOH}$  is a weaker acid.

- b. The carboxylic acids may be regarded as a resonance hybrid of structures I and II as.

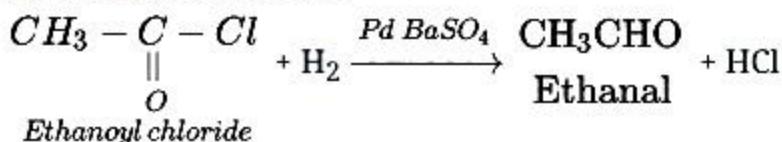


Similarly, the carbonyl group of aldehydes and ketones may be regarded as a resonance hybrid of structures III and IV.

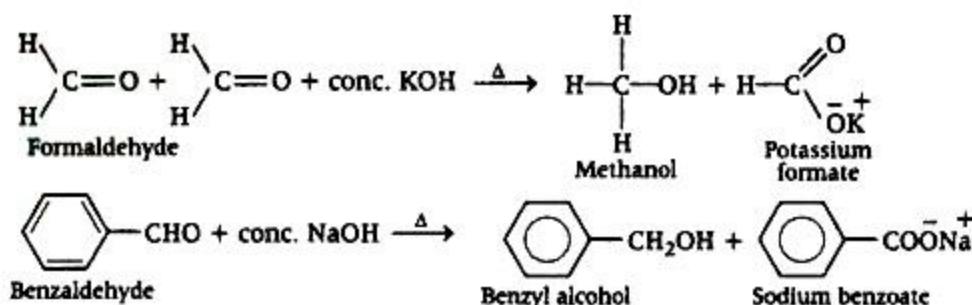


Due to the contribution of structure IV, the carbonyl carbon in aldehydes and ketones is electrophilic. However, due to the contribution of structure II of carboxylic acid, the electrophilic character of carboxyl carbon is reduced.

ii. a. **Rosemund reduction**

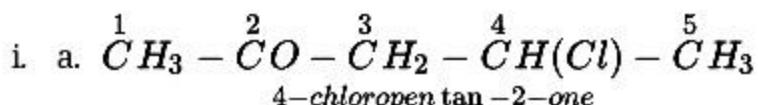


- b. **Cannizzaro reaction** Aldehydes which do not have n-H atoms undergo self oxidation and reduction reaction on treatment with cone. alkali this reaction is known as Cannizzaro reaction. In this reaction, one molecule of aldehyde is reduced to alcohol while another molecule is oxidised to the salt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

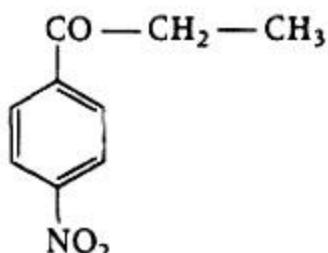


- iii.  $\text{CH}_3\text{CH}_2-\text{CH}_2-\text{CO}-\text{CH}_3$  gives iodoform test as it contains  $\text{CH}_3\text{CO}-$  group.

OR



b.



p-nitropropiophenone

ii. i. **Distinguishing test between ethanal and propanal**

Iodoform test Ethanal because of the presence of CH<sub>3</sub>CO- skeleton gives positive iodoform test whereas propanal due to the absence of such a skeleton does not gives such test.



Ethanal

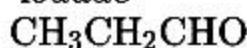
Or

Acetaldehyde

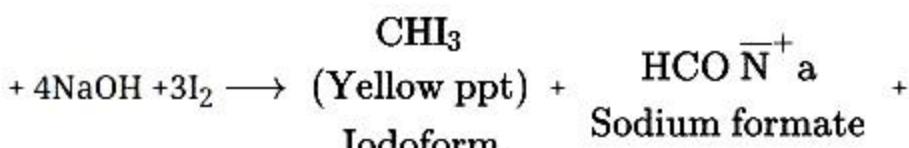
3NaI

Sodium + 3H<sub>2</sub>O

iodade



Propanal



Iodoform

Sodium formate



33.  $E_{cell}^0 = [E_{cathode} - E_{anode}]$

$$= [-0.40 - (-0.44)]$$

$$= [-0.40 + 0.44] = 0.04 \text{ V}$$

Since  $E_{cell}^0 = \frac{0.059}{n} \log K_c$

$$\log K_c = \frac{2 \times 0.04}{0.059} = 1.356$$

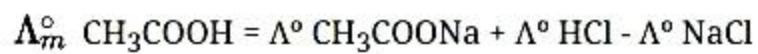
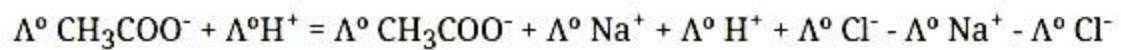
K<sub>c</sub> = anti log

$$(1.356) = 22.70$$

OR

- i. The molar conductivity at infinite dilution for a given salt can be expressed as the sum of the individual contribution from the ions of electrolytes.

ii.  $\Lambda^\circ \text{CH}_3\text{COOH} = ?$



iii.  $\Lambda_m^\circ \text{CH}_3\text{COOH} = \Lambda^\circ \text{CH}_3\text{COONa} + \Lambda^\circ \text{HCl} - \Lambda^\circ \text{NaCl}$

$$= 91.0 + 425.9 - 126.4$$

$$= 390.5 \text{ S cm}^2 \text{ mol}^{-1}$$

**CBSE Class 12 Chemistry  
Sample paper 04 (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:**

Fluorine, chlorine, bromine, iodine and astatine are members of Group 17. These are collectively known as the halogens. The halogens are highly reactive non-metallic elements. Fluorine and chlorine are fairly abundant while bromine and iodine less so. Fluorine is present mainly as insoluble fluorides and small quantities are present in the soil, river water plants and bones and teeth of animals. All these elements have seven electrons in their outermost shell ( $ns^2 np^5$ ). The halogens have the smallest atomic radii in their respective periods due to maximum effective nuclear charge. Halogens display smooth variations in their physical properties. Fluorine and chlorine are gases, bromine is a liquid and iodine is a solid. Their melting and boiling points steadily increase with atomic number. All halogens are coloured.  $F_2$ , has yellow,  $Cl_2$ , greenish-yellow,  $Br_2$ , red and  $I_2$ , violet colour.

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

- i. Which of the following is the correct set of increasing atomic radius
- $F > Cl > Br > I$
  - $Cl > Br > I > F$
  - $Br > I > F > Cl$
  - $F > I > Cl > Br$
- ii. \_\_\_\_\_ is the most electronegative element in the periodic table.
- F
  - I
  - Br
  - Cl
- iii. Why negative electron gain enthalpy of fluorine is less than that of chlorine?
- Due to the small size of fluorine atom
  - Due to strong interelectronic repulsions in the relatively small 2p orbitals of fluorine
  - Both (a) and (b)
  - None of these
- iv. X-X bond dissociation enthalpy show which of the following trends
- $Cl - Cl > Br - Br > I - I$
  - $I - I > Br - Br > Cl - Cl$
  - $Cl - Cl > Br - Br > F - F$
  - $Cl - Cl > F - F > I - I$
- v. Halogens have maximum negative electron gain enthalpy in the respective periods of the periodic table. Why?
- Due to the smallest size
  - High effective nuclear charge
  - They readily accept one electron to acquire noble gas electronic configuration
  - All of these
2. **Read the following and answer any four out of the following questions:**

Some substances at low concentrations behave as normal strong electrolytes, but at higher concentrations exhibit colloidal behaviour due to the formation of aggregates this substance is called associated colloid. The aggregated particles thus formed are micelles. The formation of micelles takes place only above a particular temperature and above a particular concentration. Micelles may contain as many as 100 molecules or more. Soap

is sodium or potassium salt of higher fatty acid. It consists of two parts a long hydrocarbon chain R which is hydrophobic and a polar group COO which is hydrophilic. Micelle consists of a hydrophobic hydrocarbon like central core. The cleansing action of soap is due to the fact that soap molecules form micelle around the oil droplet. Soap helps in emulsification and washing away from oils and fats.

**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 statements and reason is correct explanation for assertion.
- b. Assertion and reason both are correct statements 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:** On dilution associated colloids revert back to individual ions.

**Reason:** Associated colloids have both lyophobic and lyophilic parts.

ii. **Assertion:** Soap is represented as  $\text{RCOO}^-\text{Na}^+$ .

**Reason:** Soap when dissolved in water, do not dissociates into  $\text{RCOO}^-$  and  $\text{Na}^+$  ions.

iii. **Assertion:** Surface active agents such as soaps and synthetic detergents belong to associated colloids.

**Reason:** When soap dissolves in water it dissociates into  $\text{RCOO}^-$  and  $\text{Na}^+$  ions. The  $\text{RCOO}^-$  ion present on the surface of the water with their  $\text{COO}^-$  group in water and the hydrocarbon chains R staying away from it and remain at the surface water.

iv. **Assertion:** Soap molecules form micelle around the oil droplet.

**Reason:** Micelle formed in such a way that hydrophilic part of the stearate ions is in the oil droplet and hydrophobic part projects out of the grease droplet.

v. **Assertion:** Soap helps in emulsification and washing away of oils and fats.

**Reason:** The polar groups of soap interact with water, the oil droplet surrounded by stearate ions is pulled in water and removed from the dirty surface.

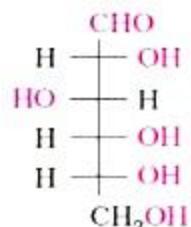
3. Quaternary ammonium salt is formed:

- a. By electrophilic substitution reaction
- b. By nucleophilic addition reaction
- c. By nucleophilic substitution of primary amines

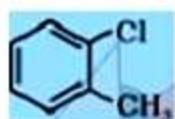
- d. By nucleophilic substitution of tertiary amine
4. Nucleic acids are the polymers of
- a. sugars
  - b. bases
  - c. nucleosides
  - d. nucleotides

OR

The following compound can be called as



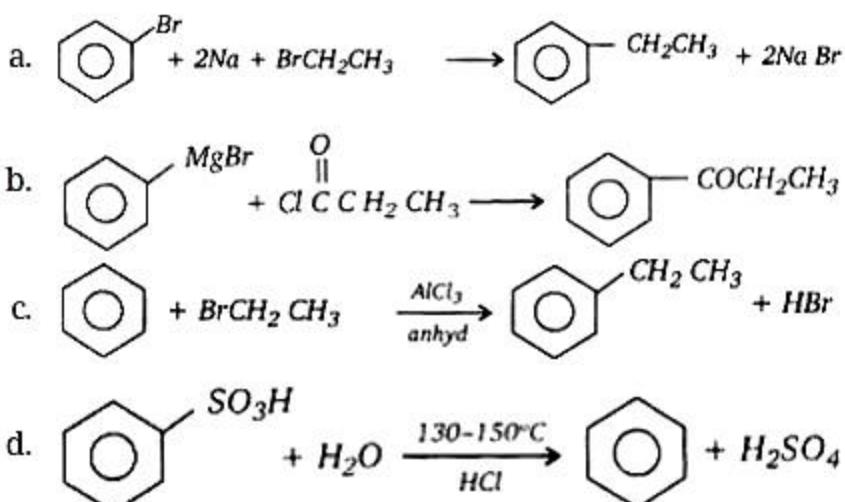
- a. D (-) - glucose
  - b. D(+) - glucose
  - c. L(+) - glucose
  - d. L (-) - glucose
5. Azeotrope mixture are:
- a. constant boiling mixtures
  - b. those will boil at different temperature
  - c. mixture of two solids
  - d. those which can be fractionally distilled
6. Give IUPAC names of the following compound:



- a. Both 1-chloro-2-methylbenzene and 2-chlorotoluene
- b. 2 - Chlorotoluene
- c. O - Chlorotoluene
- d. 1 - Chloro - 2 - methylbenzene

OR

Which of the following is a Wurtz-Fitting reaction?



7. Which of the following methods of preparation of amines will give same number of carbon atoms in the chain of amines as in the reactant?

- a. Treatment of amide with bromine in an aqueous solution of sodium hydroxide
- b. Heating alkylhalide with potassium salt of phthalimide followed by hydrolysis
- c. Reaction of nitrite with LiAlH<sub>4</sub>
- d. Reaction of amide with LiAlH<sub>4</sub> followed by treatment with water

OR

The nitrogen atom of trimethylamine is \_\_\_\_\_ hybridized which is reflected in the CNC bond angle of \_\_\_\_\_.

- a. sp<sup>3</sup>, 120°
- b. sp<sup>2</sup>, 120°
- c. sp<sup>3</sup>, 108°
- d. sp<sup>2</sup>, 108°

8. Mohr's salt is a:

- a. Basic salt
- b. Normal salt
- c. Acidic salt
- d. Double salt

OR

IUPAC name of [Pt(NH<sub>3</sub>)<sub>2</sub>Cl(NO<sub>2</sub>)] is:

- a. Platinum diaminechlorite
  - b. Diamminechlornitrite-N-platinate (II)
  - c. None of these
  - d. Chloronitrito-N-ammine platinum (II)
9. Which of the following is the most likely structure of  $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$  if 1/3 of total chlorine of the compound is precipitated by adding  $\text{AgNO}_3$  to its aqueous solution?
- a.  $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$
  - b.  $[\text{Cr}(\text{H}_2\text{O})_3\text{Cl}_3](\text{H}_2\text{O})_3$
  - c.  $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$
  - d.  $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$
10. Molecules whose mirror image is non-superimposable over them are known as chiral. Which of the following molecules is chiral in nature?
- a. 2-Bromopropan-2-ol
  - b. 2-Bromopropane
  - c. 2-Bromobutane
  - d. 1-Bromobutane
11. Which type of solid conduct electricity in molten state but not in solid state?
- a. Network
  - b. Metallic
  - c. Covalent
  - d. Ionic
12. **Assertion:** Toxic metal ions are removed by the chelating ligands.  
**Reason:** Chelate complexes tend to be more stable.
- a. Assertion and reason both are true, the reason is the 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:** Deoxyribose,  $\text{C}_5\text{H}_{10}\text{O}_4$  is not a carbohydrate.  
**Reason:** Carbohydrates are hydrates of carbon so compounds that follow  $\text{C}_x(\text{H}_2\text{O})_y$  formula are carbohydrates.
- a. Assertion and reason both are correct statements and reason explain the assertion.

- b. Both assertion and reason are wrong statements.
- c. The assertion is the correct statement and reason is the wrong statement.
- d. The assertion is the wrong statement and reason is the correct statement.

14. **Assertion:** 1 M solution of Glauber's salt is isotonic with 1 M solution of  $\text{KNO}_3$ .

**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.

OR

**Assertion:** Elevation in boiling point for two isotonic solutions may not be the same.

**Reason:** Boiling point depends upon the concentration.

- 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.

15. **Assertion:** Phenols give o - and p-nitrophenol on nitration with conc.  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  mixture.

**Reason:** -OH group in phenol is o-, p-directing.

- a. Assertion and reason both are correct and the reason is 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 wrong statement but the reason is the correct statement.

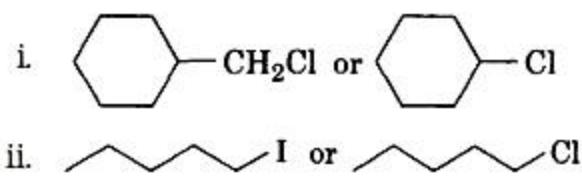
16. **Assertion:** The boiling points of alkyl halides decrease in the order:  $\text{RI} > \text{RBr} > \text{RCI} > \text{RF}$

**Reason:** The boiling points of alkyl chlorides, bromides, and iodides are considerably higher than that of the hydrocarbon of comparable molecular mass.

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

**Section B**

17. Which one in the following pairs of substances undergoes  $S_N2$  substitution reaction faster and why?



OR

Out of o-and p-dibromobenzene which one has a higher melting point and why?

18. Calculate the osmotic pressure in pascals exerted by a solution prepared by dissolving 1.0 g of polymer of molar mass 185,000 in 450 mL of water at 37°C.
19. Arrange the following complexes in the increasing order of conductivity of their solution:  
 $[\text{CO}(\text{NH}_3)_3\text{Cl}_3]$ ,  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$ ,  $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ ,  $[\text{Cr}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$

OR

Describe the shape and magnetic behaviour of the complex  $[\text{Ni}(\text{CN})_4]^{2-}$ .

20. State the role of activated complex in a reaction and state its relation with activation energy.
21. The decomposition of A into product has value of  $k = 4.5 \times 10^3 \text{s}^{-1}$  at 10°C and energy of activation 60 kJ  $\text{mol}^{-1}$ . At what temperature would k be  $1.5 \times 10^4 \text{s}^{-1}$ ?
22. Predict the major product of acid catalysed dehydration of
- i. 1-Methylcyclohexanol and
  - ii. Butan-1-ol
23. Write some characteristics of interstitial compounds.
24. Convert methane to ethane.
25. How can you determine the atomic mass of an unknown metal if you know its density

and the dimension of its unit cell? Explain.

### Section C

26. Oxygen is a gas but sulphur is a solid. Explain.

OR

$\text{SF}_6$  is known but  $\text{SCl}_6$  is not. Why?

27. Write reactions for the conversion of:

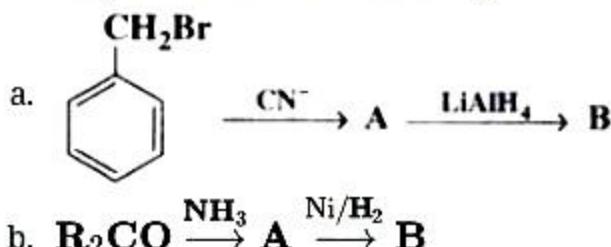
- Aniline to benzene
- Methyl amine to methyl cyanide
- Propanenitrile to ethylamine.

OR

i. Stating the necessary reaction conditions, write chemical equations to obtain the following:

Chlorobenzene from aniline

ii. Identify A and B in the following:



28. Explain how much portion of an atom located at:

- corner.
- body centre of a cubic unit cell is part of its neighbouring unit cell.

29. How can reducing and non-reducing sugars be distinguished? Mention the structural features characterising reducing sugars.

30. How is t-butyl alcohol obtained from acetone?

### Section D

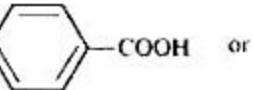
31. Explain the following observations:

- $\text{Cu}^+$  ion is unstable in aqueous solutions.
- Although  $\text{Co}^{2+}$  ion appears to be stable, it is easily oxidised to  $\text{Co}^{3+}$  ion in the presence of a strong ligand.
- The  $E_{\text{Mn}^{2+}/\text{Mn}}^{\circ}$  value for the manganese is much more than expected from the trend

for other elements in the series.

OR

Explain giving reasons:

- i. Transition metals and many of their compounds show paramagnetic behaviour.
  - ii. The enthalpies of atomisation of the transition metals are high.
  - iii. The transition metals generally form coloured compounds.
  - iv. Transition metals and their many compounds act as good catalyst.
32. Which acid of each pair shown here would you expect to be stronger?
- i.  $\text{CH}_3\text{CO}_2\text{H}$  or  $\text{CH}_2\text{FCO}_2\text{H}$
  - ii.  $\text{CH}_2\text{FCO}_2\text{H}$  or  $\text{CH}_2\text{ClCO}_2\text{H}$
  - iii.  $\text{CH}_2\text{FCH}_2\text{CH}_2\text{CO}_2\text{H}$  or  $\text{CH}_3\text{CHFCH}_2\text{CO}_2\text{H}$
  - iv.  or 

OR

Write the chemical equation to illustrate each of the following name reactions:

- i. Rosenmund reduction
  - ii. Hell-Volhard-Zelinsky reaction
  - iii. Cannizzaro reaction
33. The resistance of a conductivity cell when filled with 0.05 M solution of an electrolytes X is 100 ohms at 40°C. The same conductivity cell filled with 0.01 M solution of electrolyte Y has a resistance of 50 ohms. The conductivity of 0.05 M solution of electrolyte X is  $1.0 \times 10^{-4} \text{ S cm}^{-1}$  calculate.
- i. Cell constant
  - ii. Conductivity of 0.01 M Y solution
  - iii. Molar conductivity of 0.01 M Y solution.

OR

Conductivity of 0.00241 M acetic acid is  $7.896 \times 10^{-5} \text{ S cm}^{-1}$ . Calculate its molar conductivity and if for acetic acid is  $390.5 \text{ S cm}^2 \text{ mol}^{-1}$ , what is its dissociation constant?

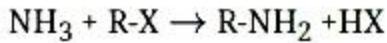
**CBSE Class 12 Chemistry**  
**Sample paper 04 (2020-21)**

**Solution**

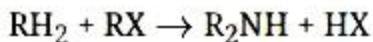
**Section A**

1. i. (a) F>Cl>Br>I  
ii. (a) F  
iii. (c) Both (a) and (b)  
iv. (a) Cl – Cl > Br – Br > I – I  
v. (d) All of these
2. i. (b) Assertion and reason both are correct statements and reason is not correct explanation for assertion.  
ii. (c) Assertion is correct but reason is wrong statement.  
iii. (b) Assertion and reason both are correct statements and reason is not correct explanation for assertion.  
iv. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.  
v. (c) Assertion is correct but reason is wrong statement.
3. (d) By nucleophilic substitution of tertiary amine

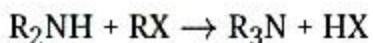
**Explanation:** The primary amine is obtained by nucleophilic substitution of an alkyl halide by NH<sub>3</sub>.



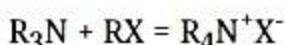
This product then behaves as a nucleophile because of a lone pair of N of RNH<sub>2</sub> and further reacts with an alkyl halide to form secondary and tertiary amines, and finally quaternary ammonium salt.



R<sub>2</sub>NH can further act as a nucleophile and react with RX



R<sub>3</sub>N can further attack RX to give quaternary amine salts

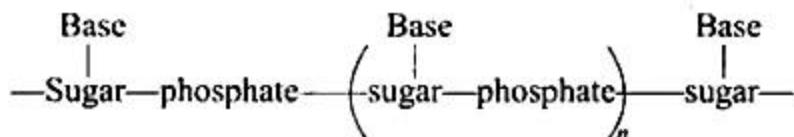


The reaction cannot go any further because now the lone pair is not present on N and its

valency is filled.

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

(b) D(+) - glucose

**Explanation:** Glucose is correctly named as D(+)-glucose. 'D' before the name of glucose represents the configuration whereas '(+)' represents dextrorotatory nature of the molecule. When the -OH group lies on right hand side in the structure it is said to have D configuration. In (+) glucose, -OH on the lowest asymmetric carbon is on the right side so (+) glucose is assigned D-configuration.

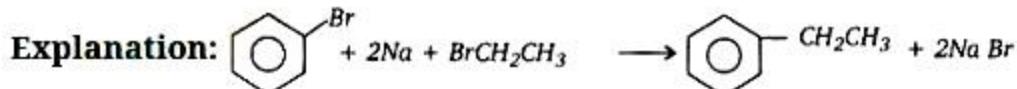
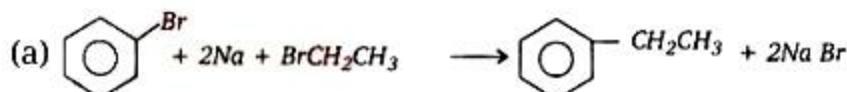
5. (a) constant boiling mixtures

**Explanation:** constant boiling mixtures

6. (a) Both 1-chloro-2-methylbenzene and 2-chlorotoluene

**Explanation:** -Cl (chloro) is given priority over -CH<sub>3</sub> (methyl) group. So it is numbered as 1. So the IUPAC name is 1-chloro-2 methylbenzene. Also toluene is an IUPAC accepted name for methyl benzene. Hence the given compound can be named as 2-chlorotoluene also, in which case -Cl is numbered

OR



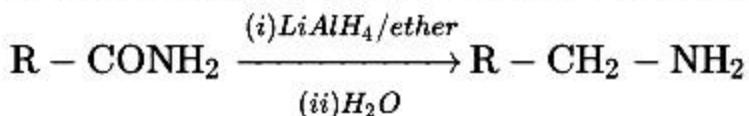
A mixture of an alkyl halide and aryl halide gives an alkylarene when treated with sodium in dry ether and is called Wurtz-Fittig reaction. In above reaction ethyl bromide and bromobenzene react with sodium in dry ether to give ethyl benzene.

7. (a) Treatment of amide with bromine in an aqueous solution of sodium hydroxide

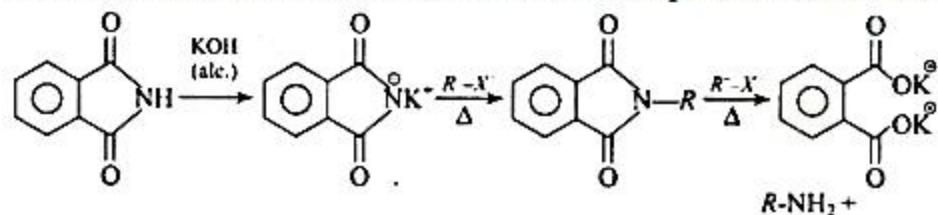
**Explanation:** Aliphatic and aryl/alkyl primary amines can be prepared by the reduction of the corresponding nitriles with lithium aluminium hydride  $\text{LiAlH}_4$ .



Heating alkyl halide with primary, secondary, and tertiary amine can be prepared by reduction of  $\text{LiAlH}_4$  ether followed by treatment with water.



Heating alkyl halide with potassium salt of phthalimide followed by hydrolysis produces primary amine. This process is known as Gabriel's phthalimide reaction. The number of carbon atoms in the chain of amines of the product is the same as a reactant.



OR

(c)  $\text{sp}^3$ ,  $108^\circ$

**Explanation:** The N atom uses its one 2s and three 2p orbitals for  $\text{sp}^3$  hybridization and the bond angle is  $108^\circ$  less than normal tetrahedral bond angle due to lone pair- bond-pair repulsion which is more than bond pair-bond pair repulsion.

8. (d) Double salt

**Explanation:** Mohr Salt is  $\text{FeSO}_4 \cdot (\text{NH}_4)_2 \cdot 6\text{H}_2\text{O}$ . It is obtained by a combination of two different salts which were crystallized in the same regular ionic lattice. It is formed by an equimolar mixture of ferrous sulphate and ammonium sulphate. Since two salts are involved, Mohr salt is a double salt.

OR

(d) Chloronitrito-N-ammine platinum (II)

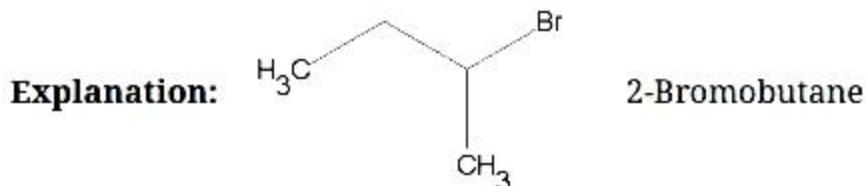
**Explanation:** Chloronitrito-N-ammine platinum (II)

9. (d)  $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$

**Explanation:** In the given molecule, there is 3 Cl present, and  $(\frac{1}{3}) \times 3 = 1$  Cl is

precipitated per molecule. So, 1 Cl satisfies the primary valence and is ionizable. So 1 Cl will be present outside the coordination sphere. So the correct structure is  $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$ .

10. (c) 2-Bromobutane



It is a chiral molecule since it does not contain plane symmetry and centre of symmetry.

11. (d) Ionic

**Explanation:** In solid state the ions are not free to move about, hence they are electrical insulators. However, in molten state or when dissolved in water, the ions become free to move about and they conduct electricity.

12. (a) Assertion and reason both are true, the reason is the correct explanation of assertion.

**Explanation:** When a solution of the chelating ligand is added to a solution containing toxic metals ligands chelates the metal ions by the formation of a stable complex.

13. (b) Both assertion and reason are wrong statements.

**Explanation:** Deoxyribose is a carbohydrate and is the sugar moiety of DNA.

Carbohydrates are optically active polyhydroxy aldehyde or polyhydroxy ketone or substances which give these on hydrolysis.

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

**Explanation:** Assertion is INCORRECT but, reason is CORRECT.

OR

- (d) Both assertion and reason are INCORRECT.

**Explanation:** Both assertion and reason are INCORRECT.

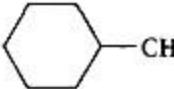
15. (d) The assertion is wrong statement but the reason is the correct statement.

**Explanation:** Phenols give o, p-nitrophenol on nitration with dil. HNO<sub>3</sub> and with conc. HNO<sub>3</sub> + conc. H<sub>2</sub>SO<sub>4</sub>, phenol gives 2, 4, 6-trinitrophenol ( Known as Picric Acid ). Since phenol is very reactive towards the electrophilic substitution reaction so in the nitration reaction even it can react with the dilute nitric acid.

16. (a) Assertion and reason both are correct statements but the reason is not the correct explanation of assertion.

**Explanation:** The boiling points of the alkyl halides decrease in the given order because of the size of the halogen atom. Iodide having the highest atomic number has more electrons, which means an increase in Van Der Waals forces and the higher boiling point.

### Section B

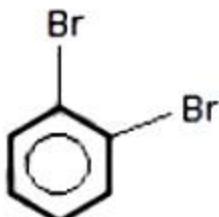
17. i.  It is a primary halide and therefore undergoes  $S_N2$  reaction faster.  
ii.  as iodide ion is a better leaving group because of its larger size therefore, it undergoes  $S_N2$  reaction faster.

OR

Out of the two compounds, p-dibromobenzene has a higher melting point. This is because the symmetry of p-dibromobenzene which makes the molecule fit better in the crystal lattice better as compare to o-dibromobenzene. Due to this, it requires a higher temperature to break the bonds between the molecules and thus has a higher melting point.



p-Dibromobenzene



o-Dibromobenzene

18. It is given that:

$$\text{Volume of water, } V = 450 \text{ mL} = 0.45 \text{ L}$$

$$\text{Temperature, } T = (37 + 273) \text{ K} = 310 \text{ K}$$

$$\text{Number of moles of the polymer, } n = \frac{1}{185000} \text{ mol}$$

We know that:

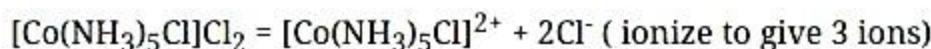
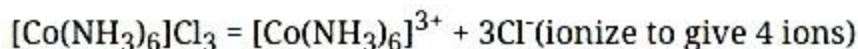
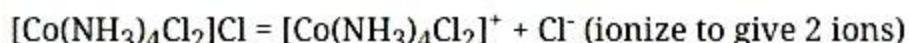
$$\text{Osmotic pressure, } \pi = \frac{n}{V} RT$$

$$= \frac{1}{185000} \text{ mol} \times \frac{1}{0.45} \times 8.314 \times 10^3 \text{ PaLK}^{-1}\text{mol}^{-1} \times 310 \text{ K}$$

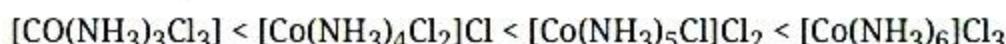
= 30.98 Pa

= 31 Pa (approximately)

19.  $[\text{CO}(\text{NH}_3)_3\text{Cl}_3]$  - does not ionize

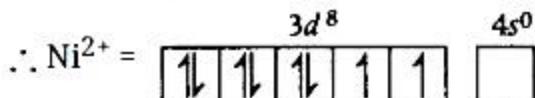


As the number of ions in solution increases, their conductivity also increases. Therefore, conductivity follows the order:

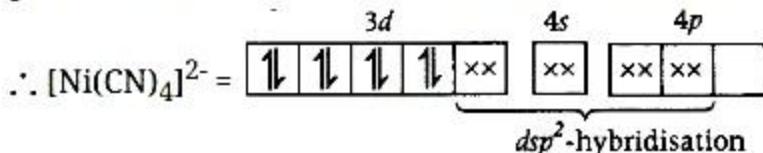


OR

In  $[\text{Ni}(\text{CN})_4]^{2-}$ , nickel is in +2 oxidation state and has the electronic configuration  $3d^8 4s^0$ .



As  $\text{CN}^-$  is a strong field ligand, the pairing of electrons takes place and resulting in  $dsp^2$  hybridisation to form four hybrid orbitals. These hybrid orbitals occupied by electron pairs of four  $\text{CN}^-$  ions. This is an inner orbital complex having square planar geometry.



**Magnetic behaviour:** It is clear from above that, there are no unpaired electrons, so the complex is diamagnetic in nature.

20. Activated complex is the higher energy unstable intermediate state formed from the reactants and get decomposed immediately to give the products. In this bonds of reactant are not fully broken while the bonds of products are not fully formed.

Energy of activated complex = Energy of reactant + Activation energy.

21. The decomposition of A into product has value of  $k = 4.5 \times 10^3 \text{s}^{-1}$  at  $10^\circ\text{C}$  and energy of activation  $60 \text{ kJ mol}^{-1}$ . At what temperature would  $k$  be  $1.5 \times 10^4 \text{s}^{-1}$ ?

Give data:

$$k_1 = 4.5 \times 10^3 \text{s}^{-1}; k_2 = 1.5 \times 10^4 \text{s}^{-1}; E_a = 60 \text{ kJ mol}^{-1}; T_1 = 10^\circ\text{C} = 10 + 273 = 283\text{K};$$

$$T_2 = ?$$

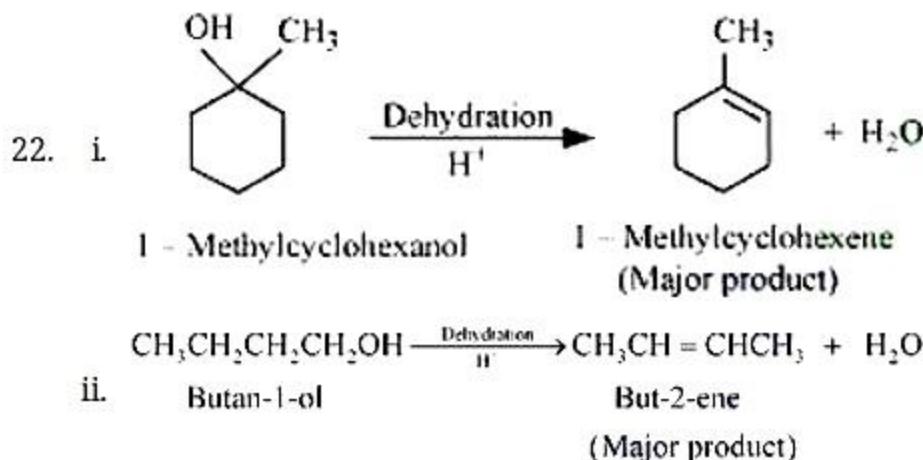
We know that,

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303} \left[ \frac{T_2 - T_1}{T_1 T_2} \right]$$

$$\Rightarrow \log \frac{1.5 \times 10^4 s^{-1}}{4.5 \times 10^3 s^{-1}} = \frac{60 \times 1000 (T_2 - 283)}{2.303 \times 8.314 \times 283 T_2}$$

$$T_2 = \frac{16980000}{57167}$$

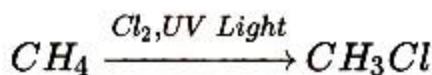
$$T_2 = 297 \text{ K} = 297 - 273 = 24^\circ\text{C}$$



23. Some characteristics of interstitial compounds are as follows:

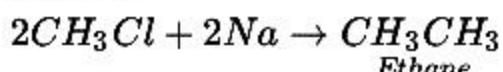
- i. They have high melting points, higher than those of pure metals.
- ii. They are very hard, some compounds approach diamond in hardness
- iii. They retain metallic conductivity.
- iv. They are chemically inert.

24. Step 1: In presence of sunlight with controlled amount of  $\text{Cl}_2$ , methane can be converted to methyl chloride



Methane

Step 2: Wurtz reaction: On reacting methyl chloride with sodium in dry ether, ethane is obtained



25. By knowing the density of an unknown metal and the dimension of its unit cell, the

atomic mass of the metal can be determined.

Let edge length of a unit cell of a crystal = 'a' pm,

Density of the metal = 'd' g/cm<sup>3</sup>

Mass of one atom of the metal = 'm'

Number of atoms in the unit cell = 'Z'

Now, Density of unit cell =  $\frac{\text{Mass of the unit cell}}{\text{volume of the unit cell}}$  .....(1)

Volume of the unit cell =  $a^3$  (pm)<sup>3</sup> =  $a^3 \times 10^{-30}$  cm<sup>3</sup> .....(2)

Mass of the unit cell = Number of atoms in the unit cell (Z)  $\times$  Mass of one atom

[ Because, mass of each atom =  $\frac{\text{Atomic mass}}{\text{Avogadro number}} = \frac{M}{N_o}$  ]

Mass of the unit cell =  $\frac{Z \times M}{N_o}$  .....(3)

Put values of (2) and (3) in equation (1), we get.

*Density of unit cell (d) =  $\frac{Z \times M}{a^3 \times 10^{-30} \times N_o}$  g/cm<sup>3</sup>*

*Now, M =  $\frac{d \times a^3 \times 10^{-30} \times N_o}{Z}$  g/mol*

If the edge lengths are different (say a, b and c), Then the above equation becomes:

*M =  $\frac{d \times (a \times b \times c) \times 10^{-30} \times N_o}{Z}$  g/mol*

### Section C

26. Oxygen atoms, owing to small size, form  $p\pi - p\pi$  bond between two atoms and exist as diatomic ( $O_2$ ) molecules. As a result van der Waals' forces acting on these molecules are very less and the molecules exist in gaseous state.

On the other hand, sulphur atoms, unable to form  $\pi$ -bonds due to large size, form single covalent bond between atoms which results in formation of cyclic molecules comprising of 8 atoms ( $S_8$ ).

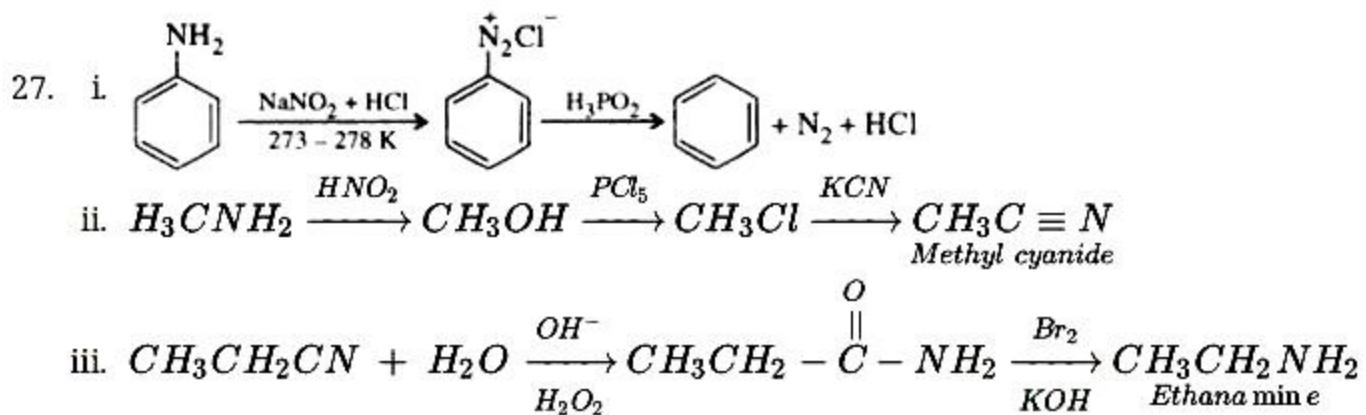
Hence, van der Waals' forces act on these molecules to larger extent and as a result sulphur exists in solid state.

OR

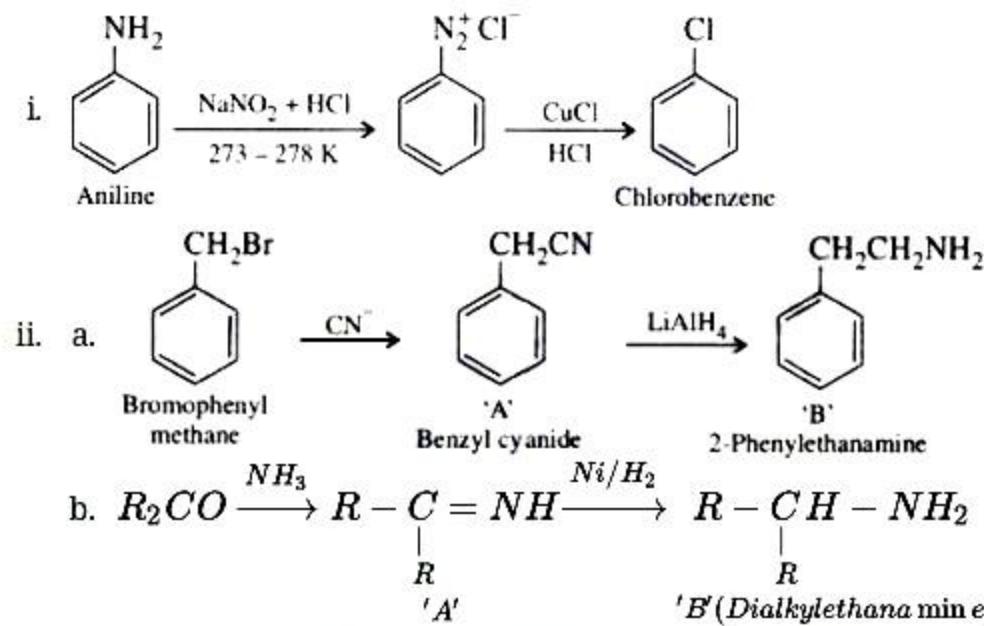
Due to small size, six fluorine atoms can be accommodated around sulphur atom while chlorine atoms being larger in size are difficult to accommodate around sulphur.

The other reason is that the fluorine being highly electronegative and oxidising in nature is capable of unpairing the paired orbitals of the valence shell of sulphur atom and thereby showing the highest, oxidation state of +6 while chlorine is not able to do this. therefore,

$\text{SF}_6$  is known but  $\text{SCl}_6$  is not known.



OR



28. i. In a cubic unit cell: An atom at the corner is shared by eight adjacent unit cells. Hence, portion of the atom at the corner is part of its neighbouring unit cell =  $\frac{1}{8}$   
ii. The atom at the body centre of a cubic unit cell is not shared by other unit cell. Hence, it belongs fully to the unit cell.

- 29. Reducing sugars:** The sugars which reduce Fehling's solution and Tollen's reagent are called reducing sugars.

Example: monosaccharides like glucose, fructose, galactose are reducing sugars.

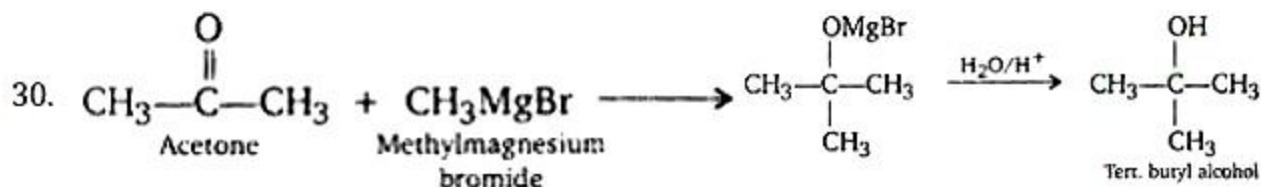
Thus, the presence of free aldehydic or ketonic group is the main feature of reducing sugars.

**Non-reducing sugars:** The sugars which do not reduce Fehling's solution or Tollen's reagent are called non-reducing sugars.

Example: maltose, lactose, sucrose are non-reducing sugars.

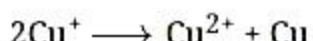
Thus, the absence of free aldehydic or ketonic group is the main feature of non-reducing sugars.

In non-reducing sugars, reducing groups of monosaccharides, i.e. aldehydic or ketonic groups are bonded.



### Section D

31. i. Copper (I) ions are unstable in aqueous solution and undergo disproportionation.



The stability of  $\text{Cu}^{2+}$  (aq) rather than  $\text{Cu}^+$  (aq) is due to the much more negative  $\Delta_{hyd}\text{H}$  of  $\text{Cu}^{2+}$ (aq) than  $\text{Cu}^+$ . which compensates more for the second ionisation enthalpy of Cu.

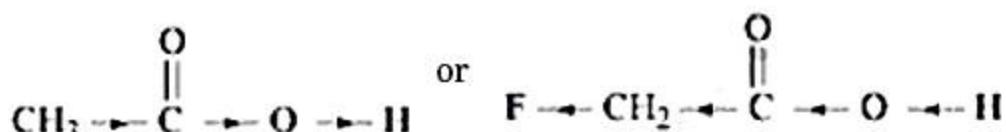
- ii. In  $\text{Co}^{2+}$ , electronic configuration is  $3\text{d}^7$ . There is one unpaired electron even after pairing occurs in the presence of a strong ligand. Hence,  $\text{Co}^{2+}$  is oxidised to more stable  $\text{Co}^{3+}$ .
- iii. In the crystal lattice, transition elements have interstitial vacant spaces into which small sized non-metal atoms such as H, B, C, or N are trapped. These compounds are known as interstitial compounds. These are neither typically ionic nor covalent, e.g.  $\text{TiC}$ ,  $\text{Mn}_4\text{N}$ ,  $\text{Fe}_3\text{H}$ , etc.

OR

- i. Transition metals show paramagnetic behaviour. Paramagnetism arises due to the presence of one or more unpaired electrons in them. For example Mn(Z=25) has configuration  $3\text{d}^5 4\text{s}^2$  and has 5 unpaired electrons.
- ii. Transition elements have high effective nuclear charge and a large number of valence electrons. They form strong metallic bonds. As the number of unpaired electrons increases strength of metallic bonding increases. When interatomic force increases, enthalpy of atomization also increases. Therefore the enthalpy of atomization of transition metals is high.

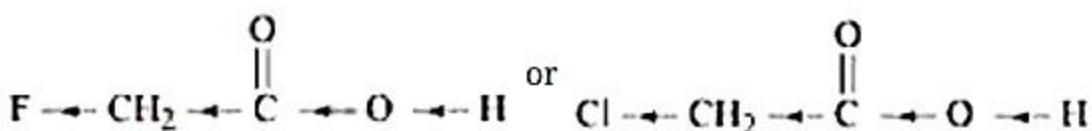
- iii. Most of the complexes of transition metals are coloured. This is because of the absorption of radiation from visible light region to promote an electron from lower energy d-orbitals to higher energy d orbital. In the presence of ligands, the d-orbitals split up into two sets of orbitals having different energies. Therefore, the transition of electrons can take place from lower energy set to higher energy set. The energy required for these transitions is quite small and falls in the visible region of radiation. The ions of transition metals absorb the radiation of a particular wavelength and get excited and on de excitation they emit light in visible region on spectrum, imparting colour to the solution.
- iv. The catalytic activity of the transition elements can be explained by
- Their ability to show variable oxidation states and to form complexes- Transition metals form unstable intermediate compounds. Thus, they provide a new path with lower activation energy for the reaction.
  - Transition metals also provide a suitable surface for the reactions to occur.

32. i



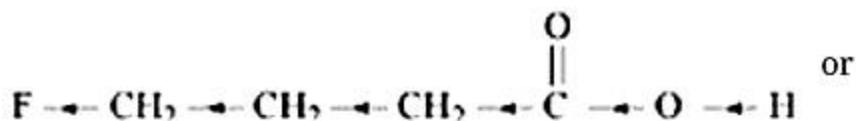
The +I effect of  $\text{CH}_3$  group increases the electron density on the O-H bond. Therefore, release of proton becomes difficult. On the other hand, the -I effect of F decreases the electron density on the O-H bond. Therefore, proton can be released easily. Hence,  $\text{CH}_2\text{FCO}_2\text{H}$  is a stronger acid than  $\text{CH}_3\text{CO}_2\text{H}$ .

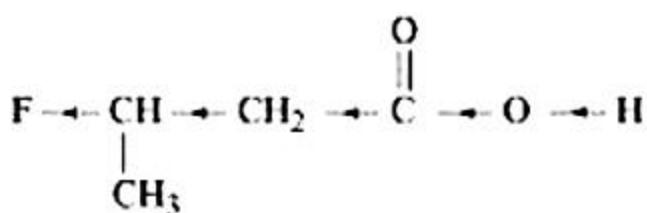
ii.



F has stronger -I effect than Cl. Therefore,  $\text{CH}_2\text{FCO}_2\text{H}$  can release proton more easily than  $\text{CH}_2\text{ClCO}_2\text{H}$ . Hence,  $\text{CH}_2\text{FCO}_2\text{H}$  is stronger acid than  $\text{CH}_2\text{ClCO}_2\text{H}$

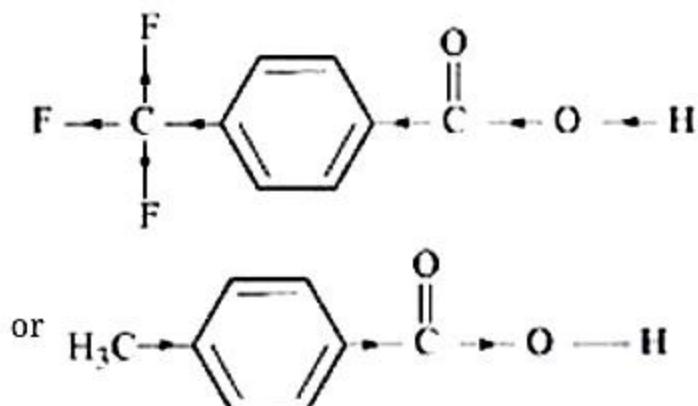
iii.





Inductive effect decreases with an increase in distance. Hence, the +I effect of F in  $\text{CH}_3\text{CHFCH}_2\text{CO}_2\text{H}$  more than it is in  $\text{CH}_2\text{FCH}_2\text{CH}_2\text{CO}_2\text{H}$ . Hence,  $\text{CH}_3\text{CHFCH}_2\text{CO}_2\text{H}$  is stronger acid than  $\text{CH}_2\text{FCH}_2\text{CH}_2\text{CO}_2\text{H}$

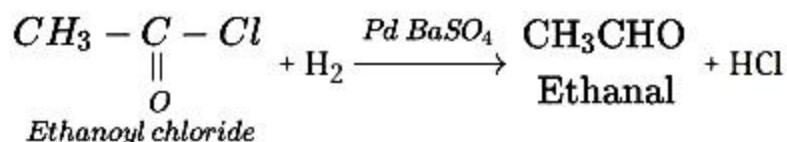
iv.



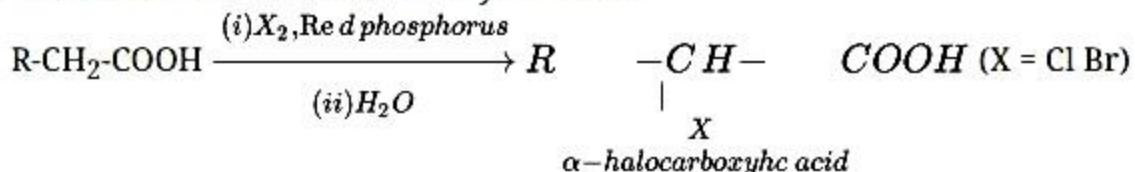
Due to the -I effect of F, it is easier to release proton in the case of compound (A). However, in the case of compound (B), release of proton is difficult due to the +I effect of  $-CH_3$  group. Hence, (A) is a stronger acid than (B).

OR

### i. Rosemund reduction

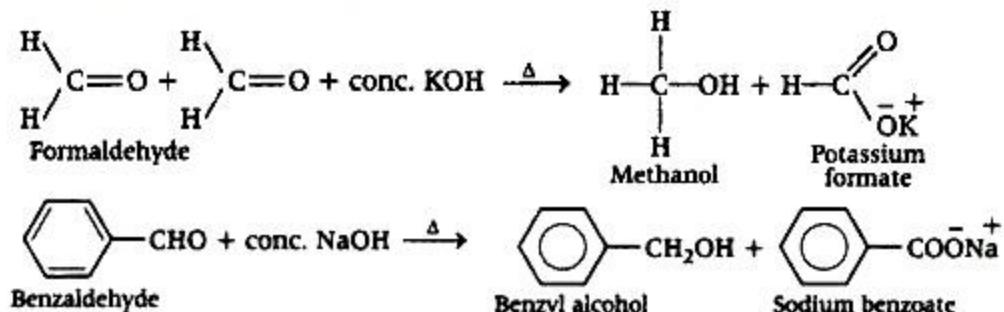


- ii. Hell-Volhard-Zelinsky (HVZ) Reaction Carboxylic acids having  $\alpha$ -hydrogen atom are halogenated at the  $\alpha$ -position on treatment with chlorine or bromine in the presence of small amount of red phosphorus to give  $\alpha$ -halocarboxylic acids. The reaction is known as Hell-Volhard Zelinsky reaction.



- iii. **Cannizzaro reaction** Aldehydes which do not have n-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.



### 33. For electrolyte X

$$\text{Molarity} = 0.05 \text{ M}$$

$$\text{Resistance} = 100\Omega$$

$$\text{Conductivity} = 1.0 \times 10^{-4} \text{ S cm}^{-1}$$

### For electrolyte Y

$$\text{Molarity} = 0.01 \text{ M}$$

$$\text{Resistance} = 50\Omega$$

$$\text{Conductivity} = ?$$

$$\text{i. Cell constant} = \text{Conductivity (K)} \times \text{Resistance (R)}$$

$$G^* = 1.0 \times 10^{-4} \times 100$$

$$= 10^{-2} \text{ cm}^{-1}$$

$$\text{ii. Conductivity of solution Y is}$$

$$K = \frac{G^*}{R} = \frac{10^{-2}}{50}$$

$$= 0.02 \times 10^{-2}$$

$$= 2 \times 10^{-4} \text{ S cm}^{-1}$$

$$\text{iii. Concentration C} = 0.01 \text{ M}$$

$$= 0.01 \text{ mol L}^{-1}$$

$$= 0.01 \times 1000 \text{ mol ml}^{-3}$$

$$= 10 \text{ mol cm}^{-3}$$

$\therefore$  Molar concentration

$$\lambda_m = \frac{K}{C} = \frac{2 \times 10^{-4}}{10}$$

$$= 0.2 \times 10^{-4} \text{ S cm}^2 \text{ mol}^{-1}$$

OR

$$\text{Given that, } \kappa = 7.896 \times 10^{-5} \text{ S m}^{-1}$$

$$C = M = 0.00241 \text{ mol L}^{-1}$$

The formula of molar conductivity,

$$\Lambda_m = (k \times 1000)/M$$

Plug the value we get

$$\Lambda_m = \frac{(7.896 \times 10^{-5} \times 1000)}{0.00241}$$

$$= 32.76 \text{ S cm}^2 \text{ mol}^{-1}$$

The formula of degree of dissociation

$$\alpha = \Lambda_m / \Lambda_{\text{om}}$$

Plug the value we get

$$\alpha = 32.76 \text{ S} / 390.5$$

$$= 0.084$$

The formula of dissociation constant

$$K = C\alpha/(1 - \alpha)$$

Plug the values we get

$$K = 0.00241 \times 0.084 / (1 - 0.084)$$

$$= 1.86 \times 10^{-5} \text{ mol L}^{-1}$$

**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**

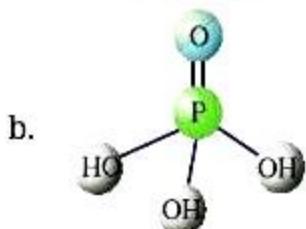
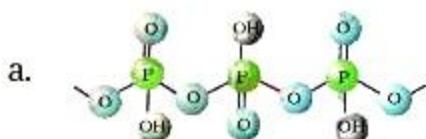
**1. Read the passage given below and answer any four out of the following questions:**

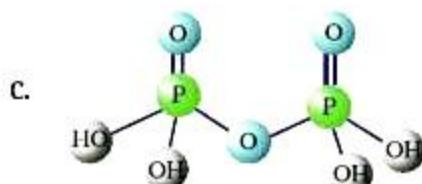
Phosphorus forms two types of halides which are phosphorus Trichloride and phosphorus pentachloride. Phosphorus forms a number of oxoacids Orthophosphoric acid, Orthophosphorous acid, Pyrophosphoric acid, Hypophosphorous acid, Cyclotrimetaphosphoric acid and Polymetaphosphoric acid. Phosphorus trichloride 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<sup>+</sup> 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  $\text{SO}_2\text{Cl}_2$  on phosphorus.
- phosphorus trichloride
  - phosphorus pentachloride
  - both (a) and (b)
  - none of these
- ii. Oxaacids of phosphorus contain at least
- one  $\text{P}=\text{O}$  and one  $\text{P}-\text{OH}$  bond
  - one  $\text{P}=\text{O}$  and two  $\text{P}-\text{OH}$  bond
  - three  $\text{P}=\text{O}$  and one  $\text{P}-\text{OH}$  bond
  - four  $\text{P}=\text{O}$  and one  $\text{P}-\text{OH}$  bond
- iii. Which of the following equation shows the reducing property of  $\text{H}_3\text{PO}_2$
- $4\text{H}_3\text{PO}_3 \longrightarrow 3\text{H}_3\text{PO}_4 + \text{PH}_3$
  - $2\text{Ag} + \text{PCl}_5 \longrightarrow 2\text{AgCl} + \text{PCl}_3$
  - $\text{Sn} + 2\text{PCl}_5 \longrightarrow \text{SnCl} + 2\text{PCl}_3$
  - $4\text{AgNO}_3 + 2\text{H}_2\text{O} + \text{H}_3\text{PO}_2 \longrightarrow 4\text{Ag} + 4\text{HNO}_3 + \text{H}_3\text{PO}_4$
- iv. In solid-state  $\text{PCl}_5$  exists as an ionic solid because
- it contain  $[\text{PCl}_4]^+ [\text{PCl}_6]^-$
  - $[\text{PCl}_4]^+$  is cation
  - $[\text{PCl}_6]^-$  is anion
  - all of these
- v. Which of the following structure is of orthophosphoric acid





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:

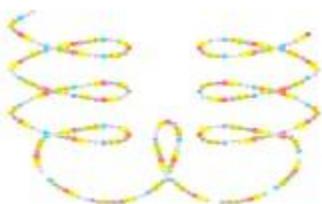
- a. Quaternary salt
- b. Primary amines
- c. Tertiary amine
- d. Secondary amine

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 → RX

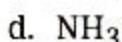
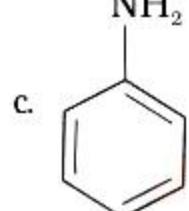
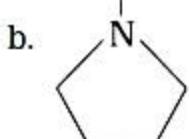
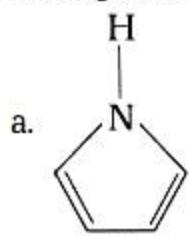
is:

- a. HF > HBr > HI > HCl
- b. HI > HBr > HCl > HF
- c. HF > HCl > HBr > HI
- d. HCl > 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 \_\_\_\_\_.



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

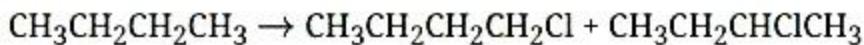
Which of the following compound would exhibit coordination isomerism?

- 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 than ferrous sulphate because:

- a. Its reactions 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?



- 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  $1.984\text{ g/cm}^3$  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  $[\text{Ni}(\text{en})_3]\text{Cl}_2$  (en = ethylenediamine) has lower stability than  $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$ .

**Reason:** In  $[\text{Ni}(\text{en})_3]\text{Cl}_2$  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

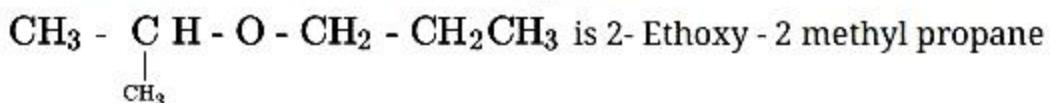
**Assertion:** The sum of mole fractions of all components of a solution is unity.

**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



**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 HCl 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  $[\text{Ag}(\text{NH}_3)_2]\text{Cl}$ ,  $[\text{Ni}(\text{CN})_4]^{2-}$  and  $[\text{CuCl}_4]^{2-}$  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  $[\text{CoCl}_4]^{2-}$

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.  $k = 2.3 \times 10^{-5} \text{ L mol}^{-1} \text{ s}^{-1}$

2.  $k = 3.1 \times 10^{-4} \text{ s}^{-1}$

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  $\text{O}_2$  and  $\text{F}_2$  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  $\text{PCl}_5$  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.  $\text{PbO}_2$  is stronger oxidizing agent than  $\text{SnO}_2$

OR

Draw the structure of  $\text{H}_2\text{SO}_3$ .

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



28. A metal (atomic mass = 50) has a body centred cubic lattice. The density of the metal is  $5.91 \text{ g cm}^{-3}$ . 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( $\text{C}_6\text{H}_6\text{O}$ ) gives a characteristic colour with aq.  $\text{FeCl}_3$  solution. (A) On reacting with  $\text{CO}_2$  and  $\text{NaOH}$  at  $400\text{k}$  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

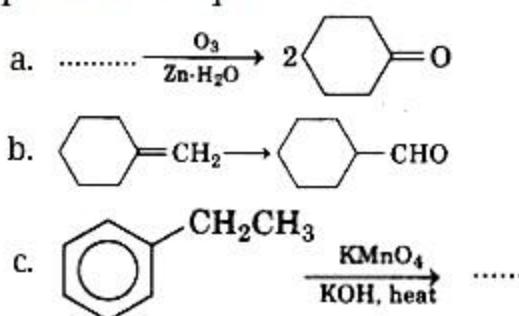
31. a. Write one difference between transition elements and p-block elements with reference to variability of oxidation states.  
b. Why do transition metals exhibit higher enthalpies of atomization?  
c. Name an element of lanthanoid series which is well known to show +4 oxidation state. Is it a strong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



ii. Describe the following reactions:

- Cannizzaro reaction
- Cross aldol condensation

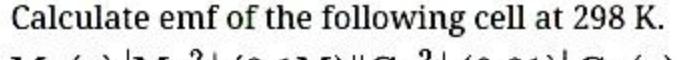
OR

Account for the following :

- $\text{CH}_3\text{CHO}$  is more reactive than  $\text{CH}_3\text{COCH}_3$  towards reaction with HCN.
  - There are two  $-\text{NH}_2$  groups in semicarbazide ( $\text{H}_2\text{NNHCONH}_2$ ). However, only one is involved in the formation of semicarbazone.
33. Explain with an example how weak and strong electrolytes can be distinguished.

OR

- State Faraday's first law of electrolysis. How much charge in terms of Faraday's is required for the reduction of 1 mole of  $\text{Cu}^{2+}$  to Cu.
- Calculate emf of the following cell at 298 K.



Given,  $E_{\text{cell}}^{\circ} = +2.71 \text{ V}$ ,

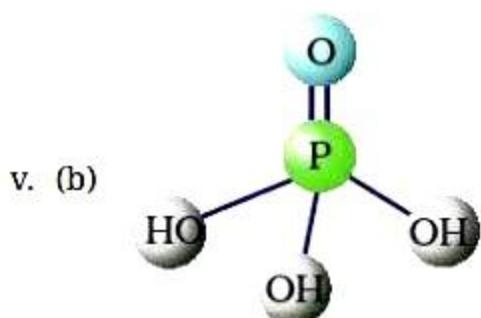
$1\text{F} = 96500 \text{ C mol}^{-1}$ .

**CBSE Class 12 Chemistry**  
**Sample paper 05 (2020-21)**

**Solution**

**Section A**

1. i. (b) phosphorus pentachloride
- ii. (d) all of these
- iii. (d)  $4\text{AgNO}_3 + 2\text{H}_2\text{O} + \text{H}_3\text{PO}_2 \longrightarrow 4\text{Ag} + 4\text{HNO}_3 + \text{H}_3\text{PO}_4$
- iv. (a) one P=O and one P–OH bond

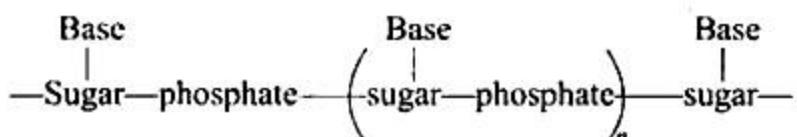


2. i. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion
  - ii. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion
  - iii. (d) Assertion is wrong statement but Reason is correct statement
  - iv. (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*-alkylphthalimide for producing primary amines. This is because of the reaction of sodium or potassium salt of phthalimide with alkyl halide impure  $\text{S}\text{N}_2$  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. ( $\pi=cRT$ )

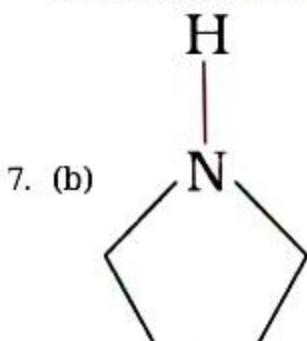
6. (b) HI > HBr > HCl > HF

**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:  $2R-X + 2Na \rightarrow R-R + 2NaX$ .



**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



8. (a)  $\text{K}_3[\text{Fe}(\text{CN})_6]$

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

OR

(b)  $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$

**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  $\text{CN}^-$  and  $\text{NH}_3$  ligands is possible between Cr and Co to give  $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$ . 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  $\text{FeSO}_4$ .

10. (d)  $\text{Cl}_2/\text{UV light}$

**Explanation:** Production of alkyl chlorides from alkanes can be carried out by chlorination under the presence of UV light. Chlorine molecule( $\text{Cl}_2$ ) 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:**  $M = \frac{dN_A a^3}{Z}$

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

$$= 74.65 \text{ g mol}^{-1}$$

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

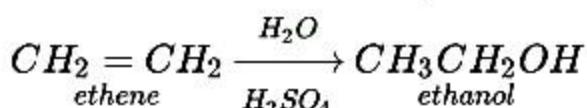
**Explanation:** IUPAC name of the compound is 2-propoxypropane

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

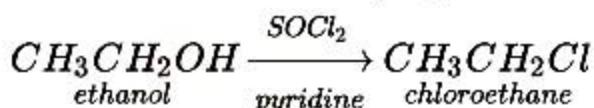
**Explanation:** Assertion is INCORRECT but, reason is CORRECT.

### Section B

17. Treat ethene with water in presence of conc.  $\text{H}_2\text{SO}_4$  to give ethanol



Treat ethanol with  $\text{SOCl}_2$  in presence of pyridine to give chloroethane

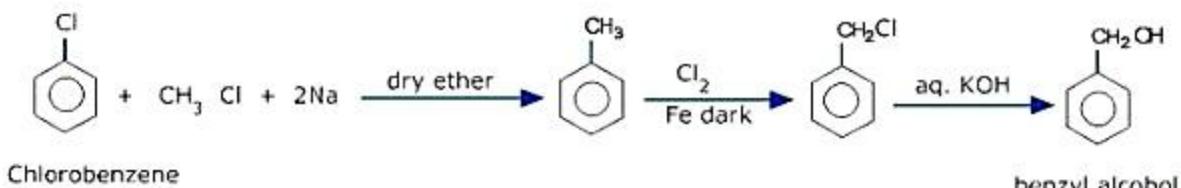


OR

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  $\text{Cl}_2$ , Fe in dark gives benzyl chloride

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

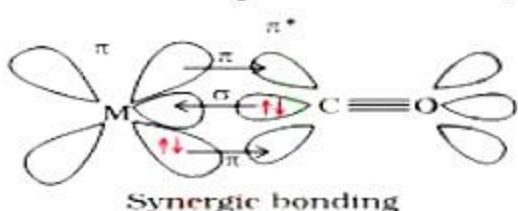
19. i.  $Ag(CN)_4^{2-}$  has square planar geometry.

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

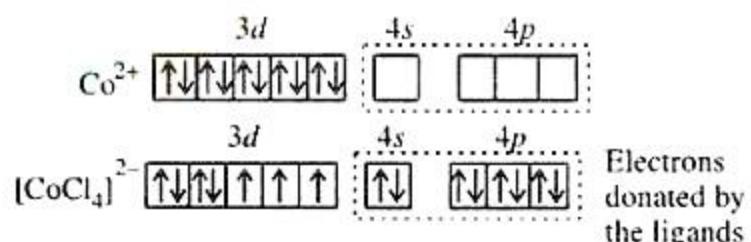
Electronic configuration of Co: [Ar]4s<sup>2</sup>3d<sup>7</sup>

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



$\text{Cl}^-$  does not cause pairing of electrons because it is weak field ligand.

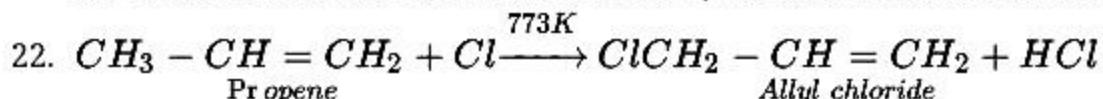
Hence,



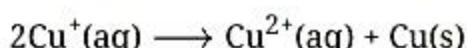
20. Rate constant of a reaction is nearly doubled with rise in temperature by  $10^{\circ}$ . The exact

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 ( $J \text{ mol}^{-1}$ ).

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

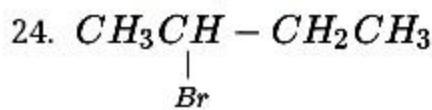


23. i. In aqueous solution  $\text{Cu}^+$  undergoes disproportionation to form a more stable  $\text{Cu}^{2+}$  ion.



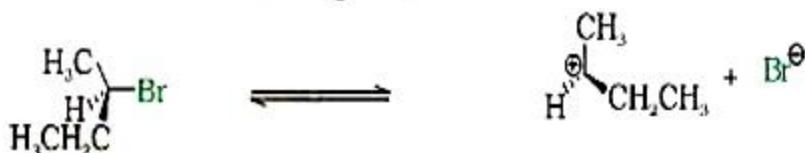
The higher stability of  $\text{Cu}^{2+}$  in aqueous solution may be attributed to its greater negative  $\Delta_{hyd} H^\circ$  than that of  $\text{Cu}^+$ . It compensates for the second ionization enthalpy of Cu involved in the formation of  $\text{Cu}^{2+}$  ions.

- ii. Both  $\text{O}_2$  and  $\text{F}_2$  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  $\text{MnF}_4$  whereas, the highest oxide is  $\text{Mn}_2\text{O}_7$ . This is due to the tendency of oxygen to form multiple bonds.

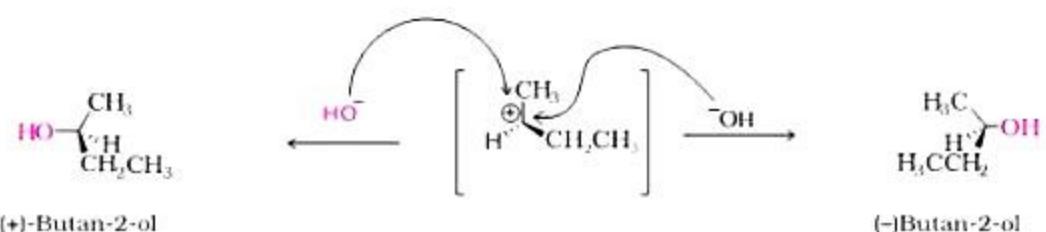


2 - Bromo butane

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



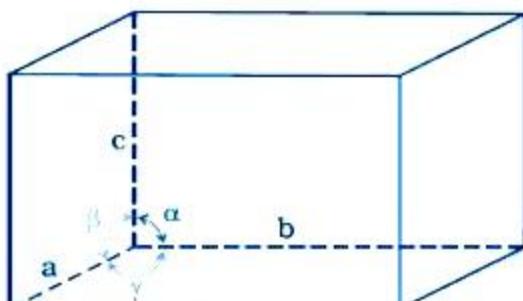
The attack of nucleophile can result in product which is a mixture of compounds both with same configuration and inverted configuration.



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

25. A unit cell is characterized by

- Its dimensions along the three edges  $a$ ,  $b$  and  $c$ . These edges may or may not be mutually perpendicular.
- Angles between the edges,  $\alpha$  (between  $b$  and  $c$ ),  $\beta$  (between  $a$  and  $b$ ) and  $\gamma$  (between  $a$  and  $c$ ). Thus, a unit cell is characterized by six parameters  $a$ ,  $b$ ,  $c$ ,  $\alpha$ ,  $\beta$  and  $\gamma$ .



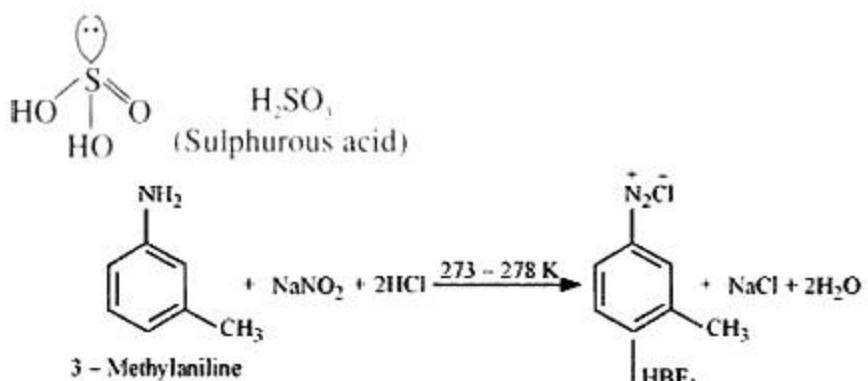
parameters of a unit cell

### Section C

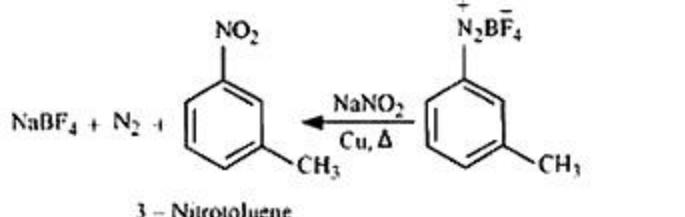
26. i. As a result of  $sp^3d$  hybridization, there are two axial bonds and three equatorial bonds in  $PCl_5$  molecule. As the axial bond pairs suffer more repulsive interactions from the equatorial bond pairs, therefore, the axial bonds are slightly elongated and slightly weaker than equatorial bonds.
- ii. In vapour state, sulphur partly exists as  $S_2$  molecule and  $S_2$  molecule has two unpaired electrons in antibonding  $\pi$  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

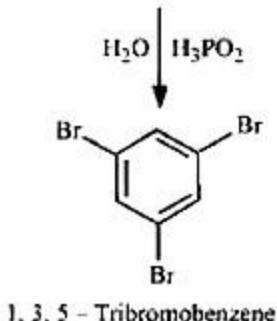
The structure of  $H_2SO_3$  is given below:



27. i.



ii.



OR

i. the order of basicity of amines in gaseous phase is as follows:  $3^\circ > 2^\circ > 1^\circ > \text{NH}_3$

Therefore the order will be



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



**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:

$$3^\circ > 2^\circ > 1^\circ$$

- 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  $2^\circ > 3^\circ > 1^\circ$ .

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

Z = 2

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

$$V = a^3$$

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

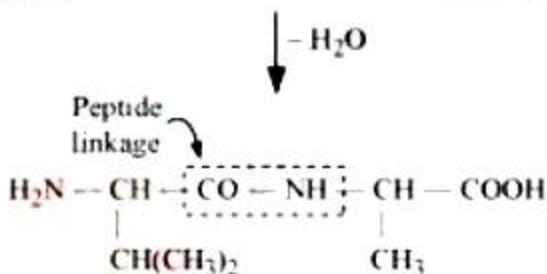
$$a^3 = \frac{Z \times M}{N_A \times d}$$

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

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

29. i Peptide linkage:

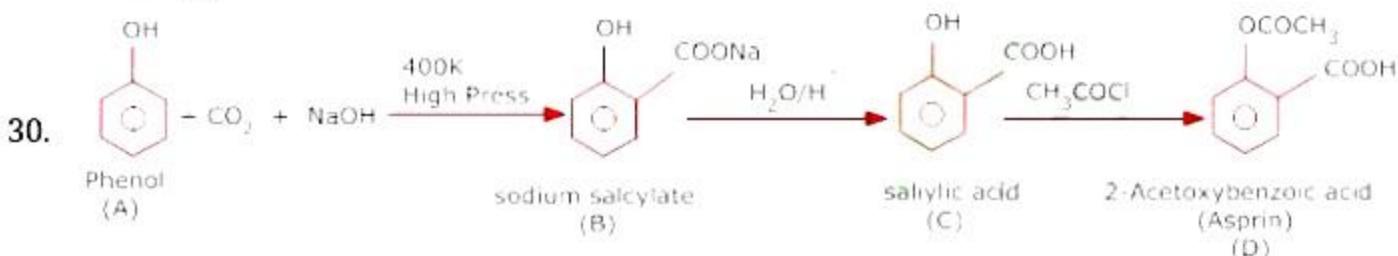
The amide formed between -COOH group of one molecule of an amino acid and  $-NH_2$  group of another molecule of the amino acid by the elimination of a water molecule is called a peptide linkage.



#### Valylalanine (Val - Ala)

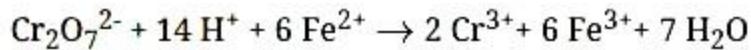
- ii. Primary structure: The primary structure of protein refers to the specific sequence in which various amino acids are present in it, i.e., the sequence of linkages between amino acids in a polypeptide chain. The sequence in which amino acids are arranged is different in each protein. A change in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



### Section D

- 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.
- Transition metals exhibit higher enthalpies of atomization because of strong interatomic interactions and strong metallic bonding between atoms.
- Element: Cerium or Terbium.  
It is a strong oxidizing agent.
- 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.
- Ionic equation:



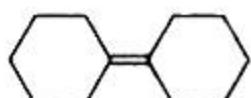
OR

- 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.

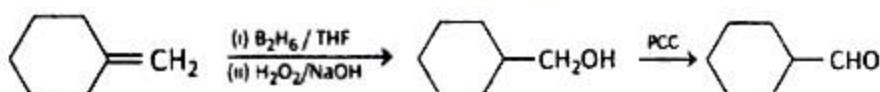
- ii. All the metals except scandium form MO oxides which are ionic. The highest oxidation number in the oxides, coincide with the group number and is attained in  $\text{Sc}_2\text{O}_3$  to  $\text{Mn}_2\text{O}_7$ . Beyond group 7, no higher oxides of iron above  $\text{Fe}_2\text{O}_3$  are known. Besides the oxides, the oxocations stabilise V<sup>V</sup> as  $\text{VO}_2^+$ , V<sup>IV</sup>, as  $\text{VO}^{2+}$  and Ti as  $\text{TiO}^{2+}$ . As the oxidation number of a metal increases, ionic character decreases. In case of Mn,  $\text{MnO}_7$  is a covalent green oil. Even  $\text{CrO}_3$  and  $\text{V}_2\text{O}_5$  have low melting points. In their higher oxides, the acidic character is predominant. Thus,  $\text{Mn}_2\text{O}_7$  gives  $\text{H}_2\text{MnO}_4$  and  $\text{CrO}_3$  gives  $\text{H}_2\text{CrO}_4$  and  $\text{H}_2\text{Cr}_2\text{O}_7$ .  $\text{V}_2\text{O}_5$  is however, amphoteric though mainly acidic and it gives  $\text{VO}_4^{3-}$  as well as  $\text{VO}_2^+$  salt.

32. i. a.

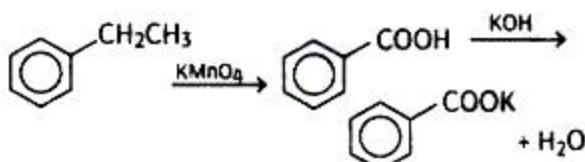


Cyclohexylidene cyclohexane

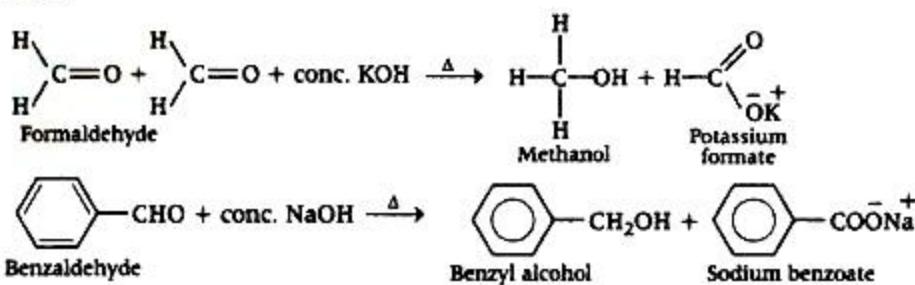
- b.  $\text{B}_2\text{H}_6/\text{THF}$  polarised by  $\text{H}_2\text{O}_2/\text{NaOH}$  and PCC.



c.

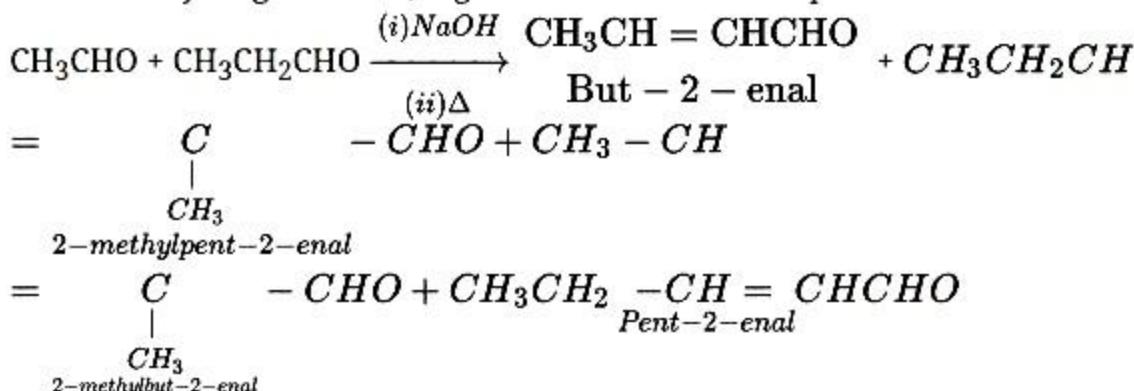


- ii. a. **Cannizzaro reaction:** Aldehydes which do not have  $\alpha$ -H atoms undergo self oxidation and reduction reaction on treatment with conc. alkali, this reaction is known as Cannizzaro reaction. In this reaction, one molecule of aldehyde is reduced to alcohol while another molecule is oxidised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



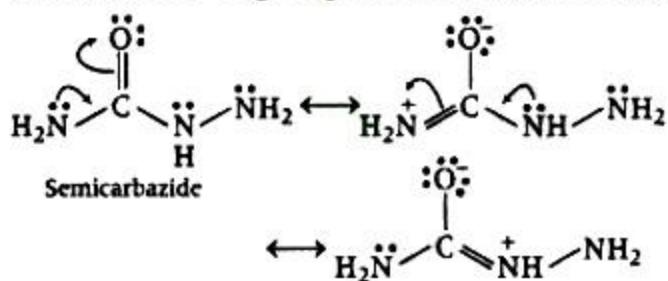
- b. **Cross aldol condensation:** When aldol condensation is carried out between two

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



OR

- i. This is because of the fact that due to smaller +I-effect of one alkyl group (- CH<sub>3</sub>) in CH<sub>3</sub>CHO as compared to larger +I-effect of two alkyl (- CH<sub>3</sub>)<sub>2</sub> groups in CH<sub>3</sub>COCH<sub>3</sub> the magnitude of positive charge on the carbonyl carbon is more in CH<sub>3</sub>CHO than in CH<sub>3</sub>COCH<sub>3</sub>. Also, the steric effect is more pronounced in case of CH<sub>3</sub>COCH<sub>3</sub>.
  - ii. Although semicarbazide has two -NH<sub>2</sub> 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  $\text{-NH}_2$  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  $\text{-NH}_2$  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<sub>2</sub>SO<sub>4</sub>

**Weak electrolytes:** Those electrolytes which do not dissociate into ions completely into aqueous solution are weak electrolytes. for example:  $\text{CH}_3\text{COOH}$ ,  $\text{NH}_4\text{Cl}$

OR

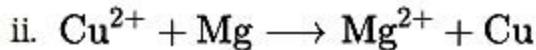
- i. **Faraday's first law of electrolysis** The amount of substance deposited during electrolysis is directly proportional to the quantity of electricity passed.

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

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 1 coulomb of charge is passed. Its Unit is  $\text{g C}^{-1}$ .

Charge required for the reduction of 1 mole of  $\text{Cu}^{2+}$  to Cu = 2F



Given,  $E_{\text{Cell}}^{\circ} = +2.71\text{V}$

By using the Nernst equation,

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

Here, n = 2 and  $E_{\text{cell}}^{\circ} = +2.71\text{ V}$

$$\begin{aligned}\therefore E_{\text{cell}} &= 2.71 - \frac{0.059}{2} \log \frac{(0.1)}{(0.01)} \\ &= 2.71 - \frac{0.059}{2} \log 10 \\ &= 2.71 - 0.0295 [\because \log 10 = 1] \\ &= 2.68\text{ V}\end{aligned}$$

**CBSE Class 12 - Chemistry**  
**Sample Paper 06 (2020-21)**

**Maximum Marks: 70**

**Time Allowed: 3 hours**

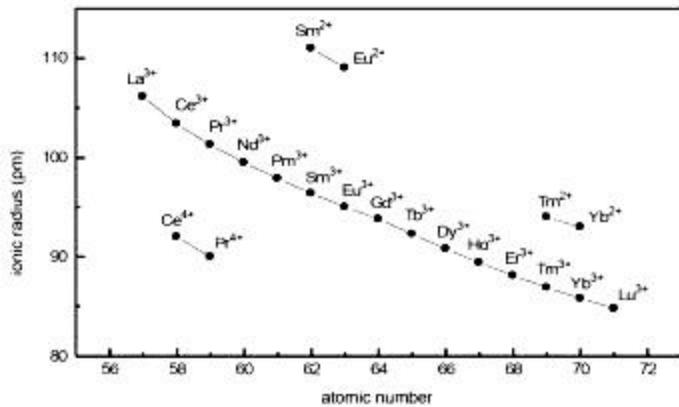
**General Instructions:**

- 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:**

The f-block consists of the two series, lanthanoids (the fourteen elements following lanthanum) and actinoids (the fourteen elements following actinium). Because lanthanum closely resembles the lanthanoids. The chemistry of the actinoids is much more complicated. The complication arises partly owing to the occurrence of a wide range of oxidation states in these elements and partly because their radioactivity creates special problems in their study. The overall decrease in atomic and ionic radii from lanthanum to lutetium (the lanthanoid contraction) is a unique feature in the chemistry of the lanthanoids. In the lanthanoids, La(II) and Ln(III) compounds are predominant species.



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

- Which of the following lanthanoids show +2 oxidation state besides the characteristic oxidation state +3 of lanthanoids?
  - Ce
  - Eu
  - Zn
  - Ho
- Why there is a fairly regular decrease in the sizes of lanthanoid with increasing atomic number?
  - Due to shielding of one 4f electron by another
  - Due to increasing nuclear charge along with the series
  - Both (a) and (b)
  - None of these
- Which of the following have almost identical radii?
  - Hf and Zr
  - La and Ce
  - Sm and Dy
  - Ho and Tb
- The  $E^\circ$  value for  $\text{Ce}^{4+}/\text{Ce}^{3+}$  is:
  - +1.74V
  - +6.78V
  - +3.45V
  - +6.22V
- Which of the following exhibit +4 state in oxides,  $\text{MO}_2$ ?
  - Pr

- b. Nd
  - c. Tb
  - d. all of these
2. **Read the passage and answer any four out of the following questions:**
- The coordination compounds are of great importance. These compounds are widely present in the mineral, plant and animal worlds and are known to play many important functions in the area of analytical chemistry, metallurgy, biological systems, industry and medicine. The selective estimation of these ions can be done due to the difference in the stability constants of calcium and magnesium complexes. Coordination compounds are of great importance in biological systems. The pigment responsible for photosynthesis, chlorophyll, is a coordination compound of magnesium. Among the other compounds of biological importance with coordinated metal ions are enzymes like carboxypeptidase and carbonic anhydrase (catalysts of biological systems). Coordination compounds are used as catalysts for many industrial processes. Articles can be electroplated with silver and gold much more smoothly and evenly from solutions of the complexes,  $[\text{Ag}(\text{CN})_2]^-$  and  $[\text{Au}(\text{CN})_2]^-$  than from a solution of simple metal ions.
- 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:** Hardness of water is estimated by simple titration with  $\text{Na}_2\text{EDTA}$ .
- Reason:** The  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions form stable complexes with EDTA.
- ii. **Assertion:** Gold combines with cyanide in the presence of oxygen and water to form the coordination entity  $[\text{Au}(\text{CN})_2]^-$  in aqueous solution.
- Reason:** Gold can be separated in metallic form from this solution by the addition of zinc.
- iii. **Assertion:** Impure nickel is converted to  $[\text{Ni}(\text{CO})_4]$ , which is decomposed to yield pure nickel.

**Reason:** Purification of metals can be achieved through the formation and subsequent decomposition of their coordination compounds.

- iv. **Assertion:** Haemoglobin, the red pigment of blood which acts as an oxygen carrier is the coordination compound of iron.

**Reason:** Vitamin B<sub>12</sub>, cyanocobalamin, the anti-pernicious anaemia factor, is a coordination compound of mercury.

- v. **Assertion:** EDTA is not effective in the treatment of lead poisoning.

**Reason:** Coordination compounds of platinum effectively inhibit the growth of tumours.

3. Which of the following is an example of secondary amine?

- a. N,N – dimethylaniline
- b. 3 – pentanamine
- c. methylamine
- d. N – ethyl – 1 – propanamine

4. Glucose does not give Schiff's test because of the formation of cyclic \_\_\_\_\_.

- a.  $\beta$  – D – (-) – Glucose
- b. forms of  $\alpha$  – and  $\beta$  – D – (+) – Glucose
- c.  $\beta$  – L – (-) – Glucose
- d.  $\alpha$  – D – (-) – Glucose

OR

Amino acid is.

- a.  $\text{H}_2\text{N}.\text{CH}_2.\text{COOH}$
- b.  $\text{Cl} - \text{CH}_2.\text{COOH}$
- c.  $\text{HO}.\text{CH}_2\text{COOH}$
- d.  $\text{CH}_3\text{COONH}_4$

5. Which of the following does not show a positive deviation from Raoult's law?

- a. benzene + CCl<sub>4</sub>
- b. benzene + acetone
- c. benzene + ethanol
- d. benzene + chloroform

6. IUPAC name of neo-Pentylbromide is:

- a. 1-Bromo-3-methylbutane
- b. 1-Bromo-2,2-dimethylpropane.
- c. 1-Bromo-1,2-dimethylpropane
- d. 1-Bromo-2-methylbutane

OR

Which of the following compounds has the highest boiling points?

- a.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$
  - b.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$
  - c.  $(\text{CH}_3)_3\text{Cl}$
  - d.  $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{Cl}$
7. The nitration reaction of amines can be controlled in order to obtain the desired para nitro derivative as the major product by:
- a. Reacting with a desired nitro compound
  - b. By acetylation reaction
  - c. By using aliphatic amines
  - d. By treating with acetic acid

OR

Amines are soluble in:

- a. only slightly soluble in water
  - b. water
  - c. organic solvents
  - d. only slightly soluble in organic solvents
8. Which of the following process does not occur at the interface of phases?
- a. Corrosion
  - b. Homogeneous catalysis
  - c. Crystallization
  - d. Heterogeneous catalysis

OR

Micelles are:

- a. Ideal solution
  - b. Associated colloids
  - c. Adsorbed solution
  - d. Emulsion cum gel
9. Which is correct in case of Van der waal adsorption?
- a. High temperature, high pressure
  - b. Low temperature, high pressure
  - c. Low temperature, low pressure
  - d. High temperature, low pressure
10. The order of reactivity of following alcohols with halogen acids is \_\_\_\_\_.
- A.  $\text{CH}_3\text{CH}_2-\text{CH}_2-\text{OH}$
  - B.  $\text{CH}_3\text{CH}_2-\underset{\substack{\text{CH}_3 \\ | \\ \text{CH}_3}}{\text{CH}}-\text{OH}$
  - C.  $\text{CH}_3\text{CH}_2-\underset{\substack{| \\ \text{CH}_3}}{\text{C}}-\text{OH}$
- a. (A) > (C) > (B)
  - b. (C) > (B) > (A)
  - c. (B) > (A) > (C)
  - d. (A) > (B) > (C)
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:** The ligands  $-\text{NO}_2^-$  and  $\text{ONO}^-$  are ambient in nature.
- Reason:** They form linkage isomers.
- 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:** 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:** Camphor is usually used in molecular mass determination.

**Reason:** Camphor has low cryoscopic constant and therefore, causes greater depression in freezing point.

- 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:** When methyl alcohol is added to water, the boiling point of water increases.

**Reason:** When a volatile solute is added to a volatile solvent elevation in the boiling point is observed.

- a. Assertion and reason both are correct statements and reason is the correct explanation for the 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.

15. **Assertion:** o-Nitrophenol is less soluble in water than the m- and p-isomers.

**Reason:** m- and p-Nitrophenols exist as associated molecules.

- 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. Both assertion and reason are correct statements but the reason is not the correct explanation of assertion.

16. **Assertion:** Aryl halogen undergoes nucleophilic substitution reactions with ease.

**Reason:** The carbon halogen bond in aryl halides has partial double bond character.

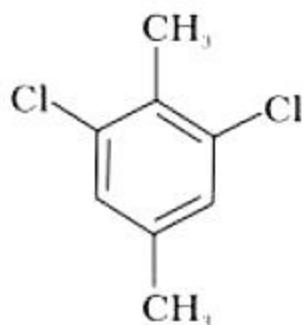
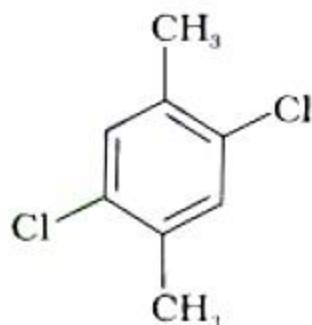
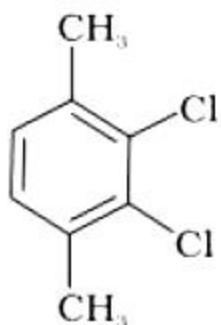
- a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
- b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
- c. Assertion is CORRECT but, reason is INCORRECT.
- d. Assertion is INCORRECT but, reason is CORRECT.

### Section B

17. Differentiate between geminal and vicinal halides.

OR

Which of the following compounds will have the highest melting point and why?



(I)

(II)

(III)

18. State Henry's law and mention its two important applications.

19. Why does bleeding stop by rubbing moist alum?

OR

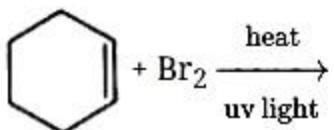
Explain the term dialysis with a suitable example.

20. Define activation energy of a reaction.

21. A reaction is of second order with respect to a reactant. How is the rate of reaction affected, if the concentration of the reactant is reduced to half? What is the unit of rate

constant for such a reaction?

22. What happens when ethanol is heated with concentrated sulphuric acid at 453 K? Explain the mechanism of this reaction.
23. What is lanthanoid contraction? What is its effect on the chemistry of the elements which follow the lanthanoids?
24. Draw the structure of the major monohalo product in the following reaction:



25. The window panes of the old buildings are thick at the bottom. Why?

### Section C

26. Why is H<sub>2</sub>O a liquid and H<sub>2</sub>S a gas?

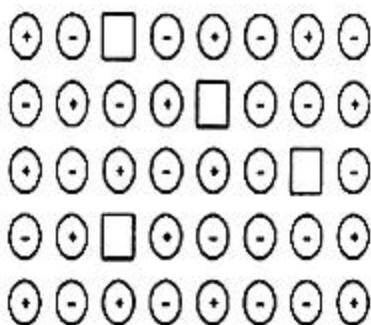
OR

- i. Draw the structures of the following molecules.
    - a. XeOF<sub>4</sub>
    - b. H<sub>2</sub>SO<sub>4</sub>
  - ii. Write the structural difference between white phosphorus and red phosphorus.
27. Write equations for
- i. Gabriel phthalimide reaction
  - ii. Hofmann bromamide reaction

OR

A compound 'A' of molecular formula C<sub>3</sub>H<sub>7</sub>O<sub>2</sub>N on reaction with Fe and conc. HCl gives a compound 'B' of molecular formula C<sub>3</sub>H<sub>9</sub>N. Compound 'B' on treatment with NaNO<sub>2</sub> and HCl gives another compound 'C' of molecular formula C<sub>3</sub>H<sub>8</sub>O. The compound 'C' gives effervescence with Na. On oxidation with CrO<sub>3</sub>, the compound 'C' gives a saturated aldehyde containing three carbon atoms. Deduce the structures of A, B and C and write the equations for the reactions involved.

28. Examine the illustration of a portion of the defective crystal given below and answer the following questions:



- What are the type of vacancy defect called?
  - How is the density of a crystal affected by these defects?
  - Name one ionic compound which can show this type of defect in the crystalline state.
  - How is the stoichiometry defect of the compound affected?
29. Define the following terms with a suitable example of each :
- Anomers
  - Denaturation of protein
  - Essential amino acids
30. Phenol is acidic in nature.

#### **Section D**

31. i. Account for the following:
- Ozone is thermodynamically unstable.
  - Solid  $\text{PCl}_5$  is ionic in nature.
  - Fluorine forms only one oxoacid  $\text{HOF}$ .
- ii. Draw the structures of
- $\text{BrF}_5$
  - $\text{XeF}_4$

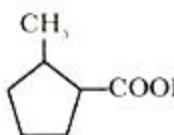
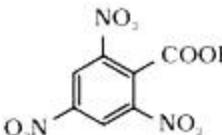
OR

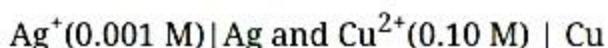
- Assign reasons for the following:
- When a moist blue litmus paper is dipped in a solution of  $\text{HOCl}$ , it first turns red and then later gets decolourised. Explain.
  - Iodine is liberated when  $\text{KI}$  is added to the solution of  $\text{Cu}^{2+}$  ions but  $\text{Cu}^{2+}$  is not liberated when  $\text{KCl}$  is added to a solution of  $\text{Cu}^{2+}$  ions. Why?
  - Name a compound of fluorine which shows +1 oxidation state. How is this compound prepared? Is this a disproportionation reaction?
32. i. Write the products of the following reactions:

- a.  + H<sub>2</sub>N—OH  $\xrightarrow{H^+}$
- b. 2C<sub>6</sub>H<sub>5</sub>CHO + conc. NaOH  $\longrightarrow$
- Cl<sub>2</sub>/P*
- c. CH<sub>3</sub>COOH  $\longrightarrow$
- ii. Give simple chemical tests to distinguish between the following pairs of compounds:
- Benzaldehyde and benzoic acid
  - Propanal and propanone

OR

Give the IUPAC names of the following compounds:

- i. Ph CH<sub>2</sub>CH<sub>2</sub>COOH
- ii. (CH<sub>3</sub>)<sub>2</sub>C = CHCOOH
- iii. 
- iv. 
33. a. Define molar conductivity of a substance and describe how for weak and strong electrolytes, molar conductivity changes with concentration of solute. How is such change explained?
- b. A voltaic cell is set up at 25°C with the following half cells:



What would be the voltage of this cell? ( $E_{cell}^0 = 0.46V$ )

OR

- a. State two advantages of H<sub>2</sub>O fuel cell over ordinary cell.
- b. Silver is electro deposited on a metallic vessel of total surface area 900 cm<sup>2</sup> by passing a current of 0.5 amp for two hours.
- Calculate the thickness of silver deposited.

[Given: Density of silver = 10.9 g cm<sup>-3</sup> Atomic mass of silver = 108 u 1F = 96500 C mol<sup>-1</sup>]

**CBSE Class 12 - Chemistry**  
**Sample Paper 06 (2020-21)**

**Solution**

**Section A**

1. i. (b) Eu  
ii. (c) Both (a) and (b)  
iii. (a) Hf and Zr  
iv. (a) +1.74V  
v. (d) all of these
2. i. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion  
ii. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion  
iii. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion  
iv. (c) Assertion is correct statement but reason is wrong statement  
v. (d) Assertion is wrong statement but reason is correct statement
3. (d) N – ethyl – 1 – propanamine

**Explanation:** N of N – ethyl – 1 – propanamine is bonded to two carbon atoms, therefore it is a secondary amine.

4. (b) forms of  $\alpha$  – and  $\beta$  – D – (+) – Glucose

**Explanation:** Schiff's test is given by aldehydes. Despite having the aldehyde group, glucose does not give Schiff's test as aldehydic group is not free here. It was proposed that one of the —OH groups may add to the —CHO group and form a cyclic hemiacetal structure. It was found that glucose forms a six-membered ring in which —OH at C-5 is involved in ring formation. This explains the absence of —CHO group and also existence of glucose in two cyclic hemiacetal forms  $\alpha$ -D-(+)-Glucose and  $\beta$ -D-(+)-Glucose.

OR

- (a)  $\text{H}_2\text{N}.\text{CH}_2.\text{COOH}$

**Explanation:** Amino acids contain amino ( $-\text{NH}_2$ ) and carboxyl ( $-\text{COOH}$ ) functional

groups.

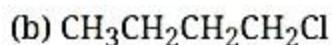
5. (d) benzene + chloroform

**Explanation:** benzene + chloroform

6. (b) 1-Bromo-2,2-dimethylpropane.

**Explanation:** neo-Pentyl bromide is  $(CH_3)_3CCH_2Br$ . C attached to Br is given position 1, so 2 - $CH_3$  groups are placed on 2nd C of the propane (parent chain). So, its IUPAC name will be 1-Bromo-2,2-dimethylpropane.

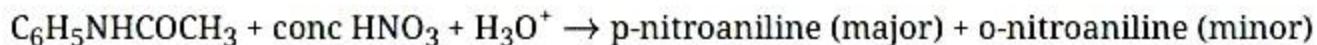
OR



**Explanation:** The forces of attraction between the molecules of a compound get stronger as they get bigger in size and have more electrons. Also, for a straight-chain compound, the points of interaction between the molecules are more than for a branched compound having the same molecular formula. Thus  $CH_3CH_2CH_2CH_2Cl$  has the highest melting point since it is the longest chain compound among the given options.

7. (b) By acetylation reaction

**Explanation:** The activating power of aniline can be controlled by acetylation of - $NH_2$  group by acetic anhydride or acetyl chloride to protect the - $NH_2$  group. This will give the para nitro product as the major product, instead of o,m,p mixture that we get if we do direct nitration of aniline.



OR



**Explanation:** Amines are soluble in water due to hydrogen bonding with water.

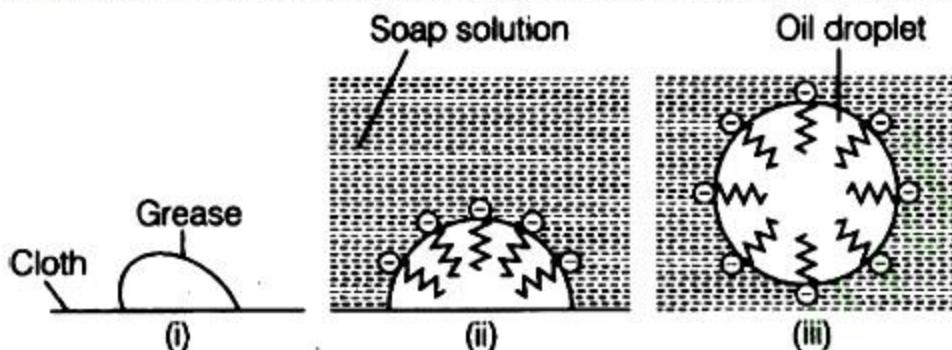
8. (b) Homogeneous catalysis

**Explanation:** Homogeneous catalysis is the process in which reactants, products, and catalysts are in the same phase.

OR

(b) Associated colloids

**Explanation:** Micelles are chemical structures formed with both hydrophilic (they'll mix into water) and hydrophobic (they don't mix into water). Also called as Associated colloids. In the general case, micelles are formed when there is an ideal temperature in the medium (called the Kraft temperature) and a certain concentration of electrolytes (called the CMC: Critical Micelle Concentration) in the medium.



- i. Grease or oil on surface of cloth.
- ii. Stearate ions arranged around the grease or oil droplet.
- iii. Grease or oil droplet surrounded by stearate ions (ionic micelle formed).

9. (b) Low temperature, high pressure

**Explanation:** Physisorption is favoured only at low temperature and high pressure.

10. (b) (C) > (B) > (A)

**Explanation:** Haloalkanes are prepared from alcohol and halogen acids where the hydroxyl group of the alcohol is replaced by the halogen. Options (A) (B) and (C) are primary, secondary, tertiary alcohols respectively. Tertiary alcohols are more reactive than secondary and primary alcohol, the secondary halide is more reactive than primary halide and they form haloalkanes from haloacids at room temperature without catalysts. The order of reactivity of alcohols is  $3^\circ > 2^\circ > 1^\circ$ .

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

**Explanation:** Assertion is CORRECT but, reason is INCORRECT.

14. (c) Assertion is CORRECT but, reason is INCORRECT.

**Explanation:** Assertion is CORRECT but, reason is INCORRECT.

OR

- (d) Assertion and reason both are incorrect statements.

**Explanation:** When methyl alcohol (volatile) is added to water, the boiling point of water decreases because vapour pressure increases when a volatile solute is added to a volatile solvent.

15. (d) Both assertion and reason are correct statements but the reason is not the correct explanation of assertion.

**Explanation:** In o-nitrophenol, there is an intramolecular H-bonding, and due to this its surface area decreases and becomes less polar.

Thus, o-nitrophenol does not form H-bond with  $H_2O$  with but m-nitrophenol and p-nitrophenol form H-bonds with  $H_2O$ . Also, due to intermolecular H-bonding m-nitrophenol and p-nitrophenol exist as associated molecules.

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

**Explanation:** Assertion is INCORRECT but, reason is CORRECT.

### Section B

17. The dihalo-compounds having same type of halogen atoms are classified as geminal halides (halogen atoms are present on the same carbon atom) and vicinal halides (halogen atoms are present on the adjacent carbon atoms).

OR

Compound (II) has both methyl groups, as well as chlorine atoms, are placed symmetrically at para-positions, due to this, these molecules fit in the crystal lattice better than others i.e (I) and (III) isomers, hence compound (II) it has the highest melting point.

18. Henry's law states that the partial pressure (P) of the gas in the vapour phase is directly

proportional to the mole fraction ( $m$ ) of the gas in the solution.

Mathematically,

$m = KP$  where  $K$  is the proportionality constant known as Henry's constant.

### **Applications of Henry's Law**

- i. To increase the solubility of  $\text{CO}_2$  in soft drinks and soda water, the bottle is sealed under high pressure.
  - ii. To minimise the painful effects of bends or decompression sickness in deep-sea divers, oxygen diluted with less soluble helium gas is used as breathing gas.
19. Blood is a colloidal sol. This contains charged protein molecules. Moist alum has highly charged  $\text{Al}^{3+}$  and  $\text{SO}_4^{2-}$  ions which neutralize the charged protein molecules present in the blood. This results in the coagulation of different blood proteins and bleeding stops while rubbing the injured part with moist alum.

OR

Dialysis is the process of removing a dissolved substance from a colloid solution by means of diffusion through a suitable membrane. For example, if egg albumin sol is mixed with sodium chloride solution,  $\text{Na}^+$  and  $\text{Cl}^-$  ions will pass through semipermeable membrane whereas pure colloidal solution will be obtained.

20. The minimum extra energy over and above the average potential energy of the reactants which must be supplied to the reactants to enable them to cross over the energy barrier between reactants and products is called activation energy.
21. When the concentration is reduced to half

$$R^* = \frac{R}{2}$$

$$\text{New rate, } r'' \propto [R']^2 \propto \left[\frac{R}{2}\right]^2 = \frac{1}{4}[R]^2 \dots\dots \text{(iii)}$$

From Eqs. (i) and (iii),

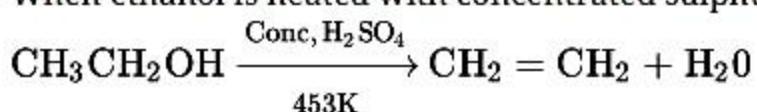
$$\frac{r}{r''} = \frac{[R]^2}{\frac{1}{4}[R]^2} = 4$$

$$\text{Or } r'' = \frac{r}{4}$$

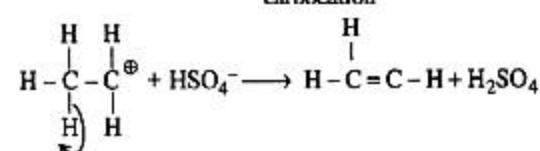
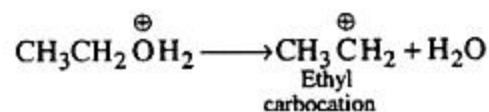
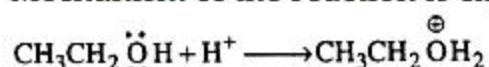
Hence, the rate becomes one fourth of the initial rate when concentration of the reactant is reduced to half.

The unit of rate constant is  $\text{L mol}^{-1} \text{ s}^{-1}$   
(second order reaction).

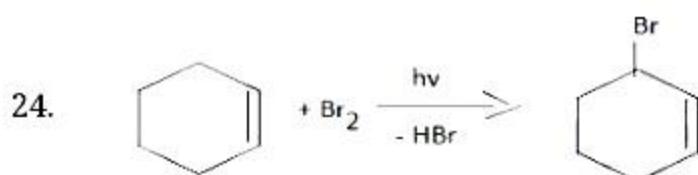
22. When ethanol is heated with concentrated sulphuric acid at 453 K, ethane is formed.



Mechanism of the reaction is explained as under:



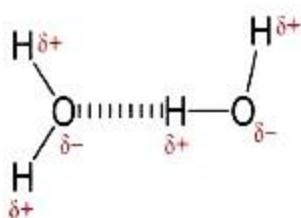
23. The decrease in atomic and ionic size with increase in atomic number among lanthanoids is called lanthanoid contraction. The elements after lanthanoids closely resemble with the elements exactly above them due to similar ionic size for example Zr and Hf have similar sizes.



25. Glass panes of old buildings are not true solid but a supercooled liquid of high viscosity, called as Pseudo solids and has the property to flow. They flow down very slowly and makes the bottom portion thicker.

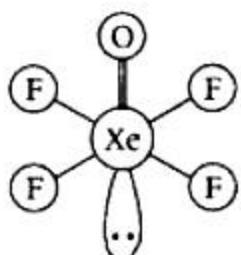
### Section C

26. Due to greater electronegativity of O than S,  $\text{H}_2\text{O}$  undergoes extensive intermolecular H-bonding. As a result,  $\text{H}_2\text{O}$  is a liquid at room temperature. In contrast,  $\text{H}_2\text{S}$  does not undergo H-bonding. It exists as discrete molecules which are held together by weak Vander Waals forces of attraction. To break these forces of attraction, only a small amount of energy is required. Therefore,  $\text{H}_2\text{S}$  is a gas at room temperature.

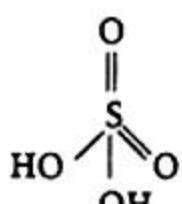


OR

- i. a. Structure of  $\text{XeOF}_4$  is given below:

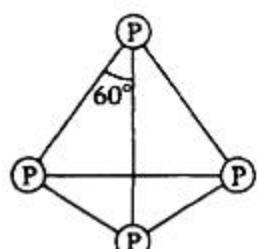


- b. The structure of  $\text{H}_2\text{SO}_4$



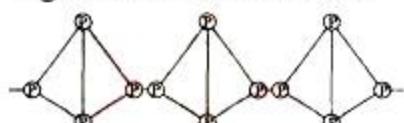
Sulphuric acid  
( $\text{H}_2\text{SO}_4$ )

- ii. **White phosphorus** It consists of discrete tetrahedral  $\text{P}_4$  molecules as shown below:

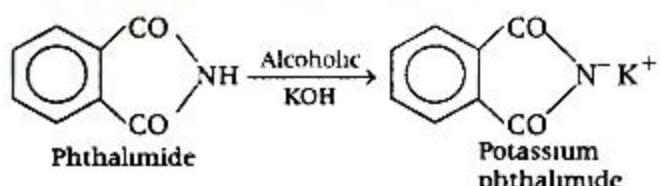


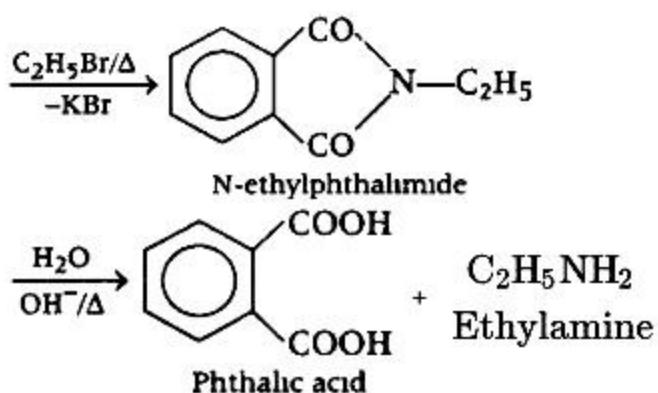
There is angular strain in the  $\text{P}_4$  molecule where the angles are only  $60^\circ$ .

**Red phosphorus** It is a polymeric structure having chain of  $\text{P}_4$  tetrahedra linked together in the manner.

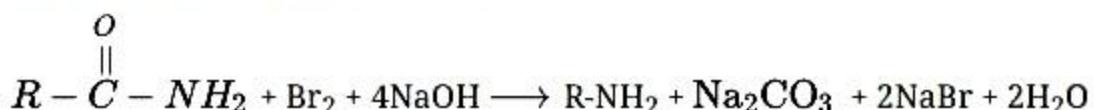


27. i. **Gabriel Phthalimide Reaction**



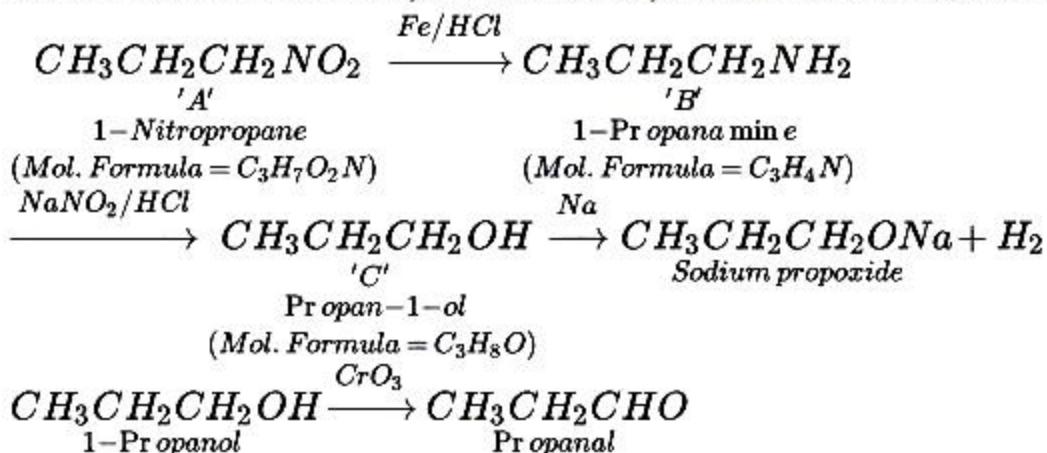


ii. **Hofmann Bromamide Reaction**



OR

Based on the observations, structures of A, B and C are deduced as under:



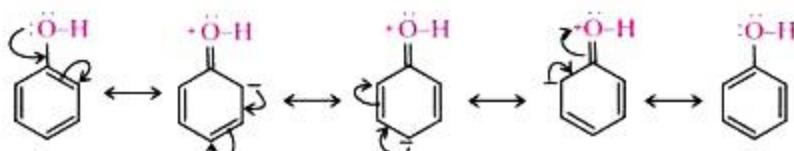
28. i. Schottky defect  
 ii. Density decreases as equal number of cations and anions are missing from crystal.  
 iii.  $\text{Na}^+\text{Cl}^-$   
 iv. Stoichiometry of crystal does not affected.
29. a. **Anomers:** These are the hemi-acetal forms of glucose which differ in the configuration at  $\text{C}_1$  of hydroxyl group.  
 e.g.-  $\alpha$ -glucose and  $\beta$ -glucose.
- b. **Denaturation of proteins:** When native protein is subjected to change in temperature and pH, then it loses its biological activity.  
 e.g.- Curdling of milk.
- c. **Essential amino acids:** The amino acid which do not get synthesised by our body are

called essential amino acid.

e.g.-Valine.

30. Phenol is acidic in nature because

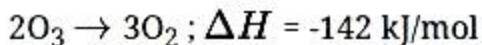
- phenol, due to resonance, the positive charge rests on oxygen making the shared pair of electrons more towards oxygen and hydrogen as  $\text{H}^+$



- The carbon attached to OH is  $\text{SP}^2$  hybridized and is more electronegative, this decreases the electron density on oxygen, increasing the polarity of O-H bond and ionization of phenol. The phenoxide ion formed by loss of  $\text{H}^+$  is more resonance stabilized than phenol itself.

### Section D

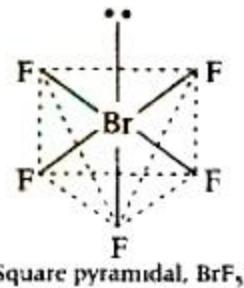
31. i. a. Ozone is thermodynamically unstable because of its decomposition into oxygen results in the liberation of heat ( $\Delta H$  is negative) and increase in entropy ( $\Delta S$  is positive). These two effects reinforce each other resulting in large negative Gibbs energy change ( $\Delta G$ ) for its conversion into oxygen.



b. Gaseous and molten  $\text{PCl}_5$  is a neutral molecule with trigonal bipyramidal. This trigonal bipyramidal structure persists in non-polar solvents, such as  $\text{CS}_2$  and  $\text{CCl}_4$ . While in the solid-state,  $\text{PCl}_5$  exist as  $[\text{PCl}_4]^+$ ,  $[\text{PCl}_6]^-$ , therefore is ionic in nature.

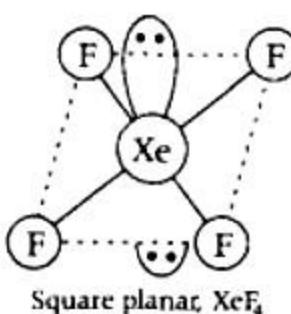
c. Due to high electronegativity and small size, fluorine forms only one oxoacid,  $\text{HOF}$  known as fluoric (I) acid or hyperfluorous acid.

ii. a. Structure of  $\text{BrF}_5$  is square pyramidal.



Square pyramidal,  $\text{BrF}_5$ ,

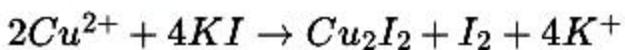
b. Structure of  $\text{XeF}_4$  is square planar.



OR

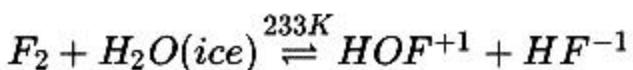
- i. HOCl acts as an acid and, hence, turns blue litmus red.  $\text{HOCl} \rightarrow \text{H}^+ + \text{OCl}^-$  It also works as a bleaching agent, and thus decolourised red litmus by nascent oxygen.  
 $\text{HOCl} \rightarrow \text{HCl} + [\text{O}]$

- ii. The I- ion being a strong reducing agent reduces  $\text{Cu}^{2+}$  to  $\text{Cu}^+$  and itself gets oxidised to  $\text{I}_2$



Since  $\text{Cl}^-$  ion does not act as reducing agent, therefore,  $\text{Cl}_2$  is not liberated when KCl is added to a solution of  $\text{Cu}^{2+}$  ions.

- iii. The compound of F which shows an oxidation state +1 is HOF. It is prepared by passing  $\text{F}_2$  over ice at 233 K.

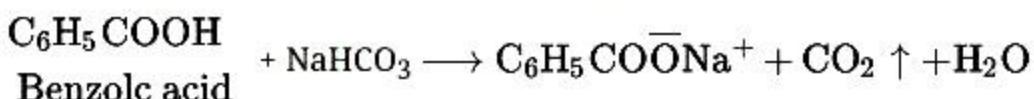


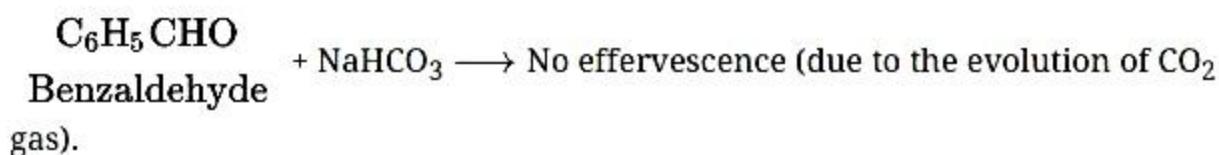
This is a disproportionation reaction since the oxidation state of F decreases from zero in  $\text{F}_2$  to -1 in HF and increased to +1 in HOF.

32. i. a. 
$$\text{Cyclohexanone} + \text{H}_2\text{N}-\text{OH} \xrightarrow{\text{H}^+} \text{cyclohexanamine} + \text{H}_2\text{O}$$
  
 b.  $2\text{C}_6\text{H}_5\text{CHO} + \text{conc. NaOH} \rightarrow \text{C}_6\text{H}_5\text{CH}_2\text{OH} + \text{C}_6\text{H}_5\text{COO}^- \text{Na}^+$   
 Benzyl alcohol      Sodium benzoate
   
 c.  $\text{CH}_3\text{COOH} \xrightarrow{\text{Cl}_2/\text{P}} \text{ClCH}_2\text{COOH}$   
 Monochloroacetic acid

- ii. a. **Benzaldehyde and benzoic acid:**

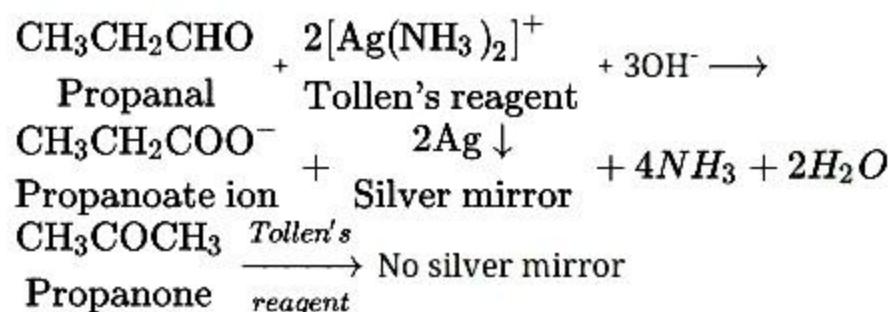
Both can be distinguished by using sodium bicarbonate ( $\text{NaHCO}_3$ ) test. Benzoic acid being an acid reacts with  $\text{NaHCO}_3$  solution to produce brisk effervescence due to evolution of  $\text{CO}_2$  gas while benzaldehyde does not.





b. **Propanal and propanone:**

These compounds can be distinguished by using Tollen's test. Propanal being an aldehyde reduces Tollen's reagent to shining silver mirror and propanone being a ketone does not.



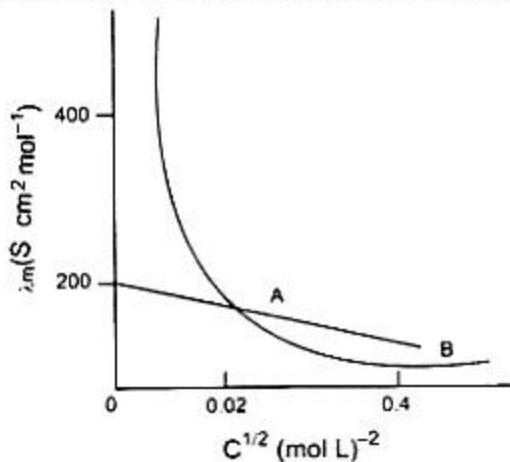
OR

- The compound contains carboxylic acid -COOH as the functional group and Ph means a phenyl group. The longest chain contains 3 carbon (prop) atom with a phenyl group at carbon 3 position so the IUPAC name of the compound is 3-phenylpropanoic acid.
  - The longest chain of the compound contains 4 carbon atom (but) with a methyl group as a substituent and a carboxylic acid as a functional group. The no. of the chain starts from the carbon atom of the -COOH group with a double bond on carbon 2 so the IUPAC name of the compound is 3-Methylbut-2-enoic acid.
  - The longest chain of the compound has 5 carbon atom (all are saturated (pent)) which are cyclic with the carboxylic group attached and a methyl group as a substituent. The no. of the chain starts from the carbon atom of the -COOH group (carboxylic acid) so the IUPAC name of the compound is 2-Methylcyclopentanoic acid.
  - The longest chain of the compound is a derivative of benzene with the carboxylic group attached and 3 nitro groups. The no. of the chain starts from the carbon atom of the -COOH group so the IUPAC name of the compound is 2,4,6-Trinitrobenzoic acid.
33. a. **Molar conductivity:** Molar conductivity of a solution is defined as the conductance of the solution which contains one mole of the electrolyte such that the entire solution is placed between the two electrodes kept one centimeter apart. It is denoted by  $\lambda_m$
- $$\text{Molar conductivity } \lambda_m = \frac{k(\text{kappa})}{C}$$
- Its unit is  $\text{S cm}^2 \text{ mol}^{-1}$

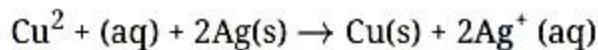
**Weak electrolytes:** When the concentration of weak electrolyte becomes very low, its degree of ionization rises sharply. There is sharp increase in the number of ions in the solution.

Hence the molar conductivity of a weak electrolyte rises steeply at low concentration.

**Strong electrolyte:** The molar conductivity of a strong electrolyte decreases slightly with the increase in concentration.



- b. The reaction takes place in cell is



Here n = 2

$$E_{cell}^0 = 0.46V$$

$$\begin{aligned} E_{cell} &= E_{cell}^0 - \frac{0.059}{n} \log \frac{[\text{Ag}^+]^2}{[\text{Cu}^{2+}]} \\ &= 0.46 - \frac{0.059}{2} \log \frac{[0.001]^2}{0.10} \\ &= 0.46 - \frac{0.059}{2} \log 10^{-5} \\ &= 0.46 - \frac{0.059}{2} \times 5 \log 10 \\ &= 0.046 \frac{0.059}{2} 5 \log 10 \\ &= 0.046 + 1.46 [\because \log 10 = 1] [\because \log 10 = 1] \end{aligned}$$

OR

- a. i. It is highly efficient and do not produce pollution.  
ii. The H<sub>2</sub>O produced can be used by astronauts for drinking purpose.
- b. We have, mass(m) deposited is

$$m = Z \times I \times t$$

$$\begin{aligned} m &= \frac{108}{96500} \times 0.5 \times 2 \times 60 \times 60 \\ &= \frac{108 \times 5}{965 \times 10} \times 2 \times 6 \times 6 = 4.03 \text{ g} \end{aligned}$$

$$4.03g = V \times d$$

$$4.03g = V \times 10.5gcm^{-3}$$

V = Area × Thickness

$$V = \frac{4.03}{10.5}$$

$$\frac{4.03}{10.5} = 900cm^2 \times \text{thickness}$$

$$\text{Thickness} = \frac{0.338cm^3}{900cm^2}$$

$$= 4.26 \times 10^{-4}cm$$

**CBSE Class 12 - Chemistry  
Sample Paper 07 (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:**

The actinoids include the fourteen elements from Th to Lr. The actinoids are radioactive elements and the earlier members have relatively long half-lives, the latter ones have half-life values ranging from a day to 3 minutes for lawrencium. The latter members could be prepared only in nanogram quantities. Actinoids show a greater range of oxidation states. The elements, in the first half of the series frequently exhibit higher oxidation states. The actinoids resemble the lanthanoids in having more compounds in +3 state than in the +4 state. All the actinoids are believed to have the electronic configuration of  $7s^2$  and variable occupancy of the 5f and 6d subshells. The magnetic properties of the actinoids are more complex than those of the lanthanoids. The variation in the magnetic susceptibility of the actinoids with the number of unpaired 5f electrons is roughly parallel to the corresponding results for the lanthanoid.

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

- i. The electronic configurations of Am is
  - a. [Rn] 5f<sup>8</sup>7s<sup>2</sup>
  - b. [Rn] 5f<sup>7</sup>7s<sup>2</sup>
  - c. [Rn] 5f<sup>9</sup>7s<sup>2</sup>
  - d. [Rn] 5f<sup>10</sup>7s<sup>2</sup>
- ii. The actinoids show in general oxidation state of
  - a. +4
  - b. +3
  - c. +5
  - d. +6
- iii. A member of the lanthanoid series which is well known to exhibit +4 oxidation state is
  - a. Cerium (Z=58)
  - b. Neodymium (Z=60)
  - c. Terbium (Z=65)
  - d. Holmium (Z=67)
- iv. The 5f electrons of actinoid are more effectively shielded from the nuclear charge than the 4f electrons of the corresponding lanthanoid because
  - a. the outer electrons are less firmly held
  - b. outer electrons are available for bonding in the actinoids
  - c. the outer electron is tightly held
  - d. both (a) and (b)
- v. Hydrochloric acid attacks all metals but most are slightly affected by
  - a. hydrochloric acid
  - b. sulphuric acid
  - c. nitric acid
  - d. none of these

**2. Read the passage and answer the following questions:**

The crystal field theory (CFT) is an electrostatic model which considers the metal-ligand bond to be ionically arising purely from electrostatic interactions between the metal ion and the ligand. Ligands are treated as point charges in case of anions or point dipoles in case of neutral molecules. The five d orbitals in an isolated gaseous metal atom/ion have the same energy, i.e., they are degenerate. In an octahedral coordination entity with six

ligands surrounding the metal atom/ion, there will be repulsion between the electrons in metal d orbitals and the electrons (or negative charges) of the ligands. This splitting of the degenerate levels due to the presence of ligands in a definite geometry is termed as crystal field splitting and the energy separation is denoted by  $\Delta_0$ . The colour in the coordination compounds can be readily explained in terms of the crystal field theory.

**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:** The  $d_{x^2-y^2}$  and  $d_{z^2}$  orbitals which point towards the axes along the direction of the ligand will experience more repulsion.

**Reason:** The  $d_{xy}$ ,  $d_{yz}$  and  $d_{xz}$  orbitals which are directed between the axes will be lowered in energy.

ii. **Assertion:** The complex  $[Ti(H_2O)_6]^{3+}$ , which is red in colour.

**Reason:** The crystal field theory attributes the colour of the coordination compounds to d-d transition of the electron.

iii. **Assertion:** Ligands for which  $\Delta_0 < P$  are known as weak field ligands and form high spin complexes.

**Reason:** If  $\Delta_0 > P$ , than the fourth electron enters one of the  $e_g$  orbitals giving the configuration  $t_{2g}^3 e_g^1$ .

iv. **Assertion:** In tetrahedral coordination entity formation, the d orbital splitting is inverted and is smaller as compared to the octahedral field splitting.

**Reason:** Spectrochemical series is based on the absorption of light by complexes with different ligands.

v. **Assertion:** The crystal field model is successful in explaining the formation, structures, colour and magnetic properties of coordination compounds.

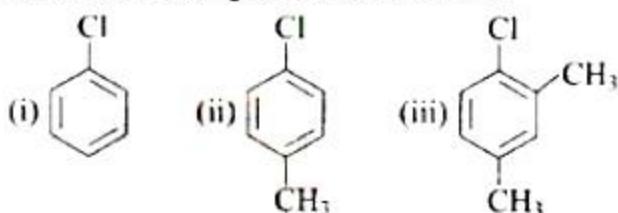
**Reason:** The anionic ligands are found at the low end of the spectrochemical series.

3. The geometry of amines is\_\_\_\_\_.

- a. trigonal
  - b. pentagonal
  - c. pyramidal
  - d. tetragonal
4. Hydrolysis of proteins in the presence of enzymes produces:
- a. Amino acids
  - b. Dicarboxylic acids
  - c. Hydroxy acids
  - d. Aromatic acids

OR

- Adenosine is
- a. Nucleic acid
  - b. Nucleoside
  - c. Base
  - d. Nucleotide
5. The depression in freezing point for 1M urea, 1 M glucose and 1 M NaCl are in the ratio of
- a. 1:1:2
  - b. 3:2:2
  - c. 1:1:1
  - d. 1:2:3
6. In the given question, arrange the compounds in increasing order of rate of reaction towards nucleophilic substitution.



- a. (iii) < (ii) < (i)
- b. (i) < (iii) < (ii)
- c. (i) < (ii) < (iii)
- d. (ii) < (i) < (iii)

OR

The compound formed on heating chlorobenzene with nitric acid in the presence of concentrated sulphuric acid is:

- a. DDT
  - b. Gammexene
  - c. Freon
  - d. Hexachloroethane
7. Which one of the following is used to increase blood pressure?
- a. None of these
  - b. Ephedrine
  - c. Benadryl
  - d. Novocain

OR

Hinsberg's reagent reacts with primary and secondary amines to form sulphonamides. This reagent is also known as

- a. p – toluenesulphonyl chloride
  - b. None of these
  - c. N Methylbenzamide
  - d. Benzenesulphonyl chloride
8. Whipped cream is an example of
- a. Solid emulsion
  - b. Suspension
  - c. Foam
  - d. Lyophilic sol

OR

Which of the following processes does not involve a catalyst?

- a. Thermite process
  - b. Haber process
  - c. Oswald process
  - d. Contact process
9. Which of the following will show Tyndall effect?
- a. Aqueous solution of soap above critical micelle concentration

- b. Aqueous solution of sugar
  - c. Aqueous solution of soap below critical micelle concentration
  - d. Aqueous solution of sodium chloride
10. A halogen used in potential blood substitutes in surgery is:
- a. Fluorine
  - b. Bromine
  - c. Iodine
  - d. Chlorine
11. A compound formed by elements A and B crystallizes in the cubic structure where A atoms are at the corners of a cube and B atoms are the face centre. The formula of the compound is:
- a.  $A_2B$
  - b.  $A_2B_3$
  - c.  $AB_2$
  - d.  $AB_3$
12. **Assertion:**  $[Fe(CN)_6]^{3-}$  ion shows a magnetic moment corresponding to two unpaired electrons.
- Reason:** Because it has  $d^2sp^3$  type hybridization.
- a. Assertion and reason both are true, the reason is the correct explanation of assertion.
  - b. Assertion and reason both are true but the reason is not the correct explanation of assertion.
  - c. The assertion is true, the reason is false.
  - d. The assertion is false, the reason is true.
13. **Assertion:** All naturally occurring  $\alpha$ -amino acids except glycine are optically active.
- Reason:** Most naturally occurring amino acids have L-configuration.
- a. Both assertion and reason are wrong statements.
  - b. The assertion is the correct statement and reason is the wrong statement.
  - c. The assertion is the wrong statement and reason is the correct statement.
  - d. Assertion and reason both are correct statements but reason does not explain assertion.
14. **Assertion:** Osmotic pressure of 0.1 M urea solution is less than that of 0.1 M NaCl solution.

**Reason:** Osmotic pressure is not a colligative property.

- 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:** Increasing pressure on water decreases its freezing point.

**Reason:** Density of water is maximum at 273 K.

- 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:** The acidity of alcohols follows the order  $1^\circ > 2^\circ > 3^\circ$ .

**Reason:** The +I effect of alkyl groups ( $3^\circ > 2^\circ > 1^\circ$ ) favours the dissociation of -OH group.

- 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.

16. **Assertion:** The nucleophilic substitution of vinyl chloride is difficult than ethyl chloride.

**Reason:** Vinyl group is electron donating group.

- 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.

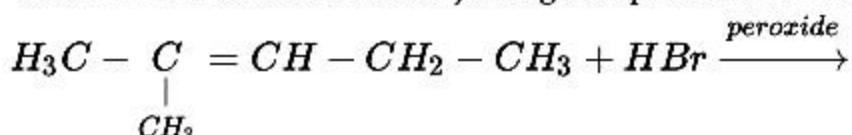
### Section B

17. How will you bring the following conversion?

Propene to 1-nitropropane

OR

Write the structure of the major organic product in the following reaction:



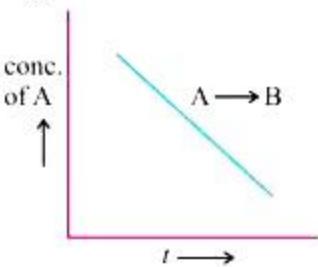
18. What happens when blood cells are placed in pure water?

19. How is dialysis carried out? Mention its one application.

OR

On the basis of Hardy-Schulze rule explain why the coagulating power of phosphate is higher than chloride.

20.



i. What is the order of the reaction?

ii. What is the slope of the curve?

21. In a reaction,  $2A \rightarrow \text{Products}$ , the concentration of A decreases from  $0.5\text{ mol L}^{-1}$  to  $0.4\text{ mol L}^{-1}$  in 10 minutes. Calculate the rate during this interval?

22. Write structural formula and give IUPAC name:-

Benzyl Alcohol

23. Predict which of the following will be coloured in aqueous solutions?  $\text{Ti}^{3+}$ ,  $\text{V}^{3+}$ ,  $\text{Cu}^+$ ,  $\text{Sc}^{3+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Fe}^{3+}$  and  $\text{Co}^{2+}$  give reason for each.

24. Write the IUPAC names of the following compounds:

i.  $\text{CH}_2 = \text{CHCH}_2\text{Br}$

ii.  $(\text{CCl}_3)_3\text{CCl}$

25. The compound  $\text{CuCl}$  has  $\text{ZnS}$  structure and the edge length of the unit cell in 500 pm.

Calculate the density. (Atomic masses: Cu = 63, Cl = 35.5, Avogadro no. =  $6.022 \times 10^{23} \text{ mol}^{-1}$ )

### Section C

26. Account for the following:

- All the bonds in  $\text{PCl}_5$  are not equivalent.
- Sulphur in vapour state exhibits paramagnetism
- Fluorine is the strongest oxidant amongst the halogens.
- Among the noble gases, only xenon is known to form true chemical compounds.
- $\text{PbO}_2$  is stronger oxidizing agent than  $\text{SnO}_2$

OR

Draw the structures of the following:

- Peroxodisulphuric acid
- Bromine trifluoride.

27. Write the reactions involved in obtaining p - aminoazobenzene using nitrobenzene as an organic reagent to start with.

OR

Complete the following reactions:

- $\text{C}_6\text{H}_5\text{N}_2\text{Cl} + \text{C}_6\text{H}_5\text{NH}_2 \longrightarrow$
  - $\text{C}_6\text{H}_5\text{N}_2\text{Cl} + \text{CH}_3\text{CH}_2\text{OH} \longrightarrow$
  - $\text{RNH}_2 + \text{CHCl}_3 + \text{KOH} \longrightarrow$
28. Iron(II) oxide has a cubic structure and each side of the unit cell is  $5 \text{ } \overset{\circ}{\text{A}}$ . If density of the oxide is  $4 \text{ g/cm}^3$ , calculate the number of  $\text{Fe}^{2+}$  and  $\text{O}^{2-}$  ions present in each unit cell.  
(Atomic mass Fe = 56 u, O = 16 u, Avogadro's number =  $6.023 \times 10^{23} \text{ atoms mol}^{-1}$ )

29. What are the common types of secondary structure of proteins?

30. Write the mechanism of acid dehydration of ethanol to yield ethane.

### Section D

31. i. How is ammonia prepared on a large scale? Name the process and mention the optimum conditions for the production of ammonia by this process.
- ii. a.  $\text{H}_2\text{S}$  is more acidic than  $\text{H}_2\text{O}$ . Give reason.

- b. Sulphur has a greater tendency for catenation than oxygen. Give reason.  
c. What happens when sulphur dioxide reacts with chlorine in the presence of charcoal?

OR

- a. i. Write the disproportionation reaction of  $H_3PO_3$ .  
ii. Draw the structure of  $XeF_4$ .
- b. Account for the following :  
i. Although Fluorine has less negative electron gain enthalpy yet  $F_2$  is strong oxidizing agent.  
ii. Acidic character decreases from  $N_2O_3$  to  $Bi_2O_3$  in group 15.
- c. Write a chemical reaction to test sulphur dioxide gas. Write chemical equation involved.
32. Give chemical tests to distinguish between the following pairs of compounds:  
i. Propanal and propanone.  
ii. Benzaldehyde and benzoic acid.

OR

Write the IUPAC names of the following ketones and aldehydes. Wherever possible, give also common names.

- i.  $CH_3CO(CH_2)_4CH_3$   
ii.  $CH_3CH_2CHBrCH_2(CH_3)CHO$   
iii.  $CH_3(CH_2)_5CHO$   
iv.  $Ph - CH = CH - CHO$



- vi.  $PhCOPh$

33. State the products of electrolysis obtained on the cathode and the anode in the following cases:  
i. A dilute solution of  $H_2SO_4$  with platinum electrodes.  
ii. An aqueous solution of  $AgNO_3$  with silver electrodes.

OR

A voltaic cell is set up at 25°C with the half cells, Al|Al<sup>3+</sup> (0.001 M) and Ni|Ni<sup>+</sup> (0.50 M).

Write the equation for the reaction that occurs when the cell generates an electric current and determine the cell potential.

Given:  $E_{(Ni^{2+}/Ni)}^0 = -0.25V$   $E_{(Al^{3+}/Al)}^0 = -1.66V$

**CBSE Class 12 - Chemistry  
Sample Paper 07 (2020-21)**

**Solution**

**Section A**

1. i. (b) [Rn]  $5f^77s^2$   
ii. (b) +3  
iii. (a) Cerium ( $Z = 58$ )  
iv. (d) both (a) and (b)  
v. (c) nitric acid
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. (c) Assertion is correct statement but reason is wrong 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. (c) pyramidal

**Explanation:** An amine molecule has the shape of a somewhat flattened triangular pyramid, with the nitrogen atom at the apex. An unshared electron pair is localized above the nitrogen atom.

4. (a) Amino acids

**Explanation:** Only  $\alpha$ -amino acids are obtained on hydrolysis of proteins.

OR

- (b) Nucleoside

**Explanation:** A unit formed by the attachment of a base to 1' position of sugar is known as nucleoside. Adenosine is nucleoside composed of adenine attached a ribose sugar molecule.

5. (a) 1:1:2

**Explanation:** NaCl has  $i=2$  while urea and glucose will have  $i=1$

6. (a) (iii) < (ii) < (i)

**Explanation:** Electron releasing group increase the reactivity of aryl halides, less is the number of electrons releasing group, the less is rate towards nucleophilic substitution reaction.

OR

- (a) DDT

**Explanation:** **Dichloro diphenyl trichloroethane** (DDT), non-water soluble chlorinated hydrocarbon in use since the Second World War (1939-1945) as an insecticide for the control of lice (that spread typhus) and mosquitoes (that spread malaria and yellow fever).

7. (b) Ephedrine

**Explanation:** Ephedrine is a stimulant used to prevent low blood pressure during spinal anaesthesia. It increases heart rate and blood pressure, expands bronchial tube, and increases body heat.

OR

- (d) Benzenesulphonyl chloride

**Explanation:**  $C_6H_5SO_2Cl_2$ . This is benzene sulphonyl chloride known as hinsberg reagent. It is used to distinguish between primary, secondary, and tertiary amine.

8. (c) Foam

**Explanation:** Whipped cream is example of foam. It is formed by combination of gas (dispersed phase) and liquid (dispersion medium).

OR

- (a) Thermite process

**Explanation:** Thermite process doesn't require a catalyst. It can easily proceed without the help of a catalyst.

9. (a) Aqueous solution of soap above critical micelle concentration

**Explanation:** At high concentration, soap solution behaves as associated colloid and form micelles. But micelles formation occurs only above Kraft temperature( $T_K$ ) and above a particular concentration called critical micelle concentration (CMC). Colloidal particles can only show the Tyndall effect.

10. (a) Fluorine

**Explanation:** Certain fully fluorinated compounds are being considered as potential blood substitutes in surgery. So fluorine is the element used in these blood substitutes.

11. (d)  $AB_3$

**Explanation:** No. of elements of A in 1 unit cell =  $\frac{1}{8} \times 8 = 1$

No. of elements of B in face centre =  $\frac{1}{2} \times 6 = 3$

So, formula of the compound is:  $AB_3$

12. (d) The assertion is false, the reason is true.

**Explanation:**  $[Fe(CN)_6]^{3-}$  ion shows a magnetic moment corresponding to one unpaired electron.

13. (d) Assertion and reason both are correct statements but reason does not explain assertion.

**Explanation:** All  $\alpha$ -amino acids except glycine contain at least one chiral carbon.

14. (c) Assertion is CORRECT but, reason is INCORRECT.

**Explanation:** Assertion is CORRECT but, reason is INCORRECT.

OR

- (c) Assertion is CORRECT but, reason is INCORRECT.

**Explanation:** Assertion is CORRECT but, reason is INCORRECT.

15. (c) Assertion is CORRECT but, reason is INCORRECT.

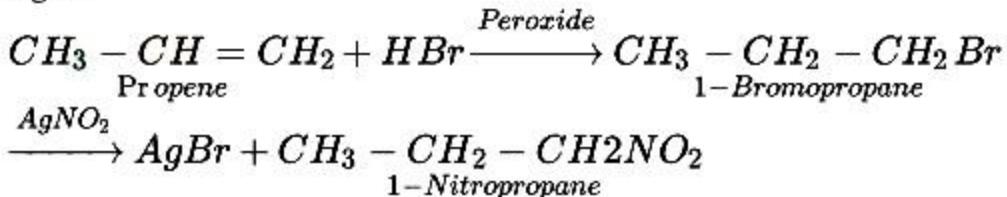
**Explanation:** Assertion is CORRECT but, reason is INCORRECT.

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

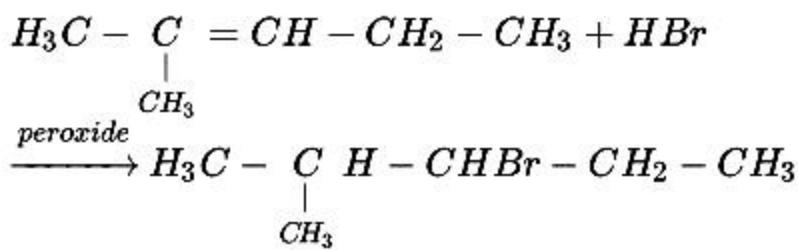
**Explanation:** Assertion is CORRECT but, reason is INCORRECT.

### Section B

17. Propene on treatment with HBr in presence of peroxide gives anti-markownikov's product 1-bromopropane which on treatment with  $AgNO_2$  gives 1-nitropropane and  $AgBr$ .



OR



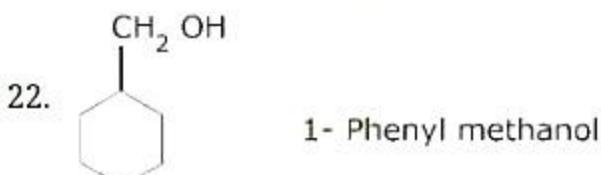
18. Due to osmosis, water molecules move into blood cells through the cell walls. As a result, blood cells swell and may even burst. As osmosis is the process of movement of molecules from lower concentration to higher concentration.
19. Dialysis is used for purification of colloidal solution. It is carried out by putting impure colloidal solution in parchment paper bag and then dipping it in distilled water.

OR

According to the Hardy-Schulze rule, the coagulation property of an electrolyte depends upon the valency of the coagulation ion. Higher the charge on flocculating ion added, the greater is its power to cause precipitation. Phosphate ion has -3 charge while chloride ion carries only -1 charge. So the coagulating power of phosphate is higher than chloride.

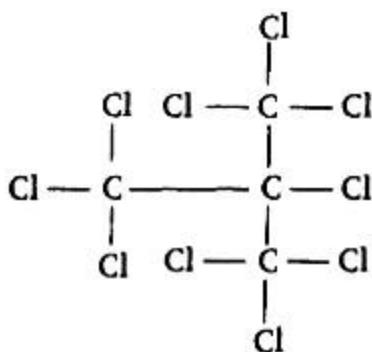
20. i. Zero order reaction.  
ii.  $[R] = [R_0] - kt \therefore \text{Slope} = -k$

$$\begin{aligned}
 21. \text{Average rate} &= -\frac{1}{2} \frac{\Delta[A]}{\Delta t} \\
 &= -\frac{1}{2} \frac{[A]_2 - [A]_1}{t_2 - t_1} \\
 &= -\frac{1}{2} \frac{0.4 - 0.5}{10} \\
 &= -\frac{1}{2} \frac{-0.1}{10} \\
 &= 0.005 \text{ mol L}^{-1} \text{ min}^{-1}
 \end{aligned}$$



23.  $Ti^{3+}$ ,  $V^{3+}$ ,  $Mn^{2+}$ ,  $Fe^{3+}$  and  $Co^{2+}$  are coloured due to the presence of unpaired electrons, they can undergo d-d transitions.  $Cu^+$ ,  $Sc^{3+}$  are colourless due to the absence of unpaired electrons in them.

24. i.  $\overset{1}{C}H_2 = \overset{2}{C}\overset{3}{H}CH_2Br$   
 $3-\text{bromoprop}-1-\text{ene}$
- ii.  $(CCl_3)_3CCl$  The structure can be drawn as



tris-(trichloromethyl) chloromethane

25. Since ZnS has fcc structure, therefore, CuCl also has fcc structure.

Here,  $Z=4$ ,  $M = 1 \times \text{Cu} + 1 \times \text{Cl} = 1 \times 63 + 1 \times 35.5 = 98.5 \text{ g/mol}$

$$N_A = 6.022 \times 10^{23} \text{ mol}^{-1};$$

$$a = 500 \text{ pm} = 5 \times 10^{-8} \text{ cm}; a^3 = 125 \times 10^{-24} \text{ cm}^3$$

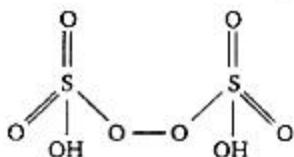
$$\text{Now, } d = \frac{ZM}{N_A a^3} = \frac{4 \times (98.5 \text{ g/mol})}{(6.022 \times 10^{23} \text{ mol}^{-1}) \times (125 \times 10^{-24} \text{ cm}^3)} = \frac{394 \times 10}{6.022 \times 125} = 5.23 \text{ g/cm}^3$$

### Section C

26. i. As a result of  $\text{sp}^3\text{d}$  hybridization, there are two axial bonds and three equatorial bonds in  $\text{PCl}_5$  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  $\text{S}_2$  molecule and  $\text{S}_2$  molecule has two unpaired electrons in antibonding  $\pi$  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  $\text{PbO}_2$  is stronger oxidizing agent than  $\text{SnO}_2$ .

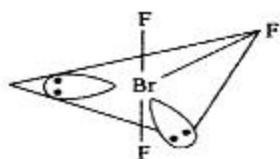
OR

- i. The structure of  $\text{H}_2\text{S}_2\text{O}_8$  peroxydisulphuric acid is shown below:



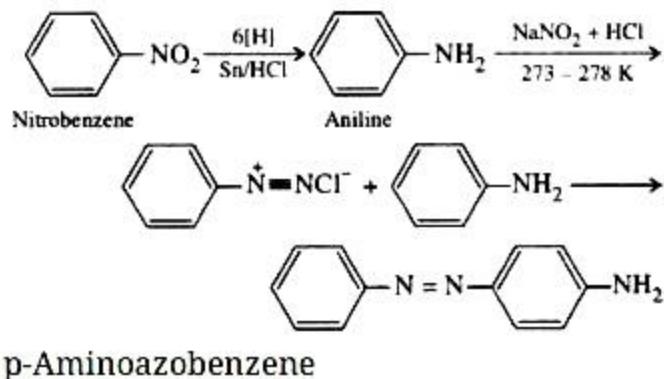
Peroxydisulphuric acid ( $\text{H}_2\text{S}_2\text{O}_8$ )

ii. The structure of  $\text{BrF}_3$  is shown below:

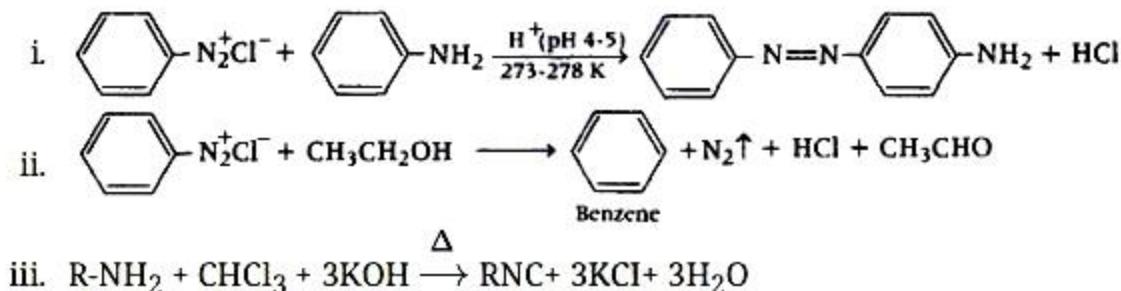


Bromine trifluoride ( $\text{BrF}_3$ )

27. p-aminodiazobenzene can be obtained from nitrobenzene as under:



OR



28. Given,

$$a = 5 \text{ } \overset{\circ}{\text{A}} = 5 \times 10^{-8} \text{ cm}$$

$$d = 4 \text{ g/cm}^3; M = 72 \text{ g/mol}$$

$$Z = \frac{dN_A a^3}{M} = \frac{(4 \text{ g/cm}^3) \times (6.023 \times 10^{23} \text{ atom mol}^{-1}) (5 \times 10^{-8} \text{ cm})^3}{(72 \text{ g/mol})}$$

$$Z = 4.18 \simeq 4.$$

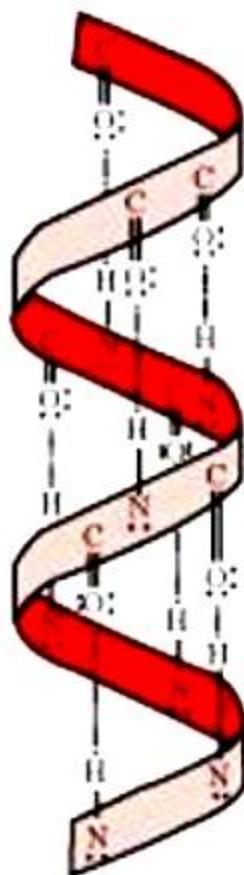
29. There are two common types of secondary structure of proteins:

- i.  $\alpha$ -helix structure
- ii.  $\beta$  pleated sheet structure

$\alpha$ -Helix structure

In this structure, the  $-\text{NH}-\text{NH}$  group of an amino acid residue forms H-bond with the

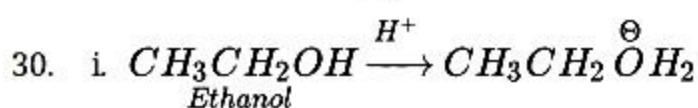
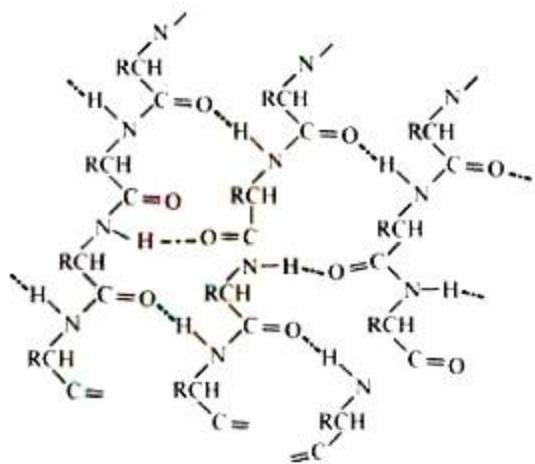
$\text{C=O}$  group of the adjacent turn of the right-handed screw ( $\alpha$ -helix).

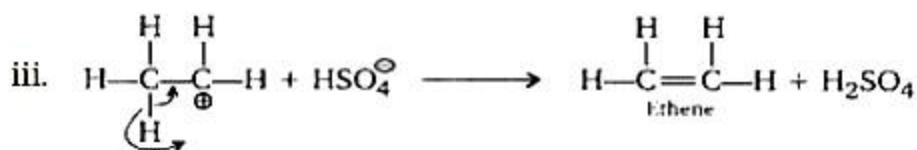
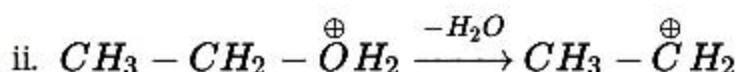


### $\beta$ pleated sheet structure:

#### $\beta$ pleated sheet structure:

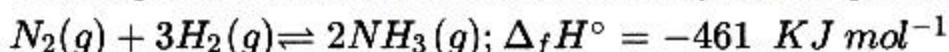
This structure is called so because it looks like the pleated folds of drapery. In this structure, all the peptide chains are stretched out to nearly the maximum extension and then laid side by side. These peptide chains are held together by intermolecular hydrogen bonds.





### Section D

31. i. On a large scale, ammonia is manufactured by Haber's process.



In accordance with the Le-Chatelier's principle, high pressure and constant temperature would favour the formation of ammonia.

Use of a catalyst such as iron oxide with small amounts of  $K_2O$  and  $Al_2O_3$  increases the rate of attainment of equilibrium.

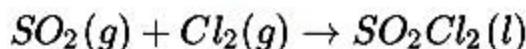
- ii. a. Due to the decrease in bond dissociation enthalpy down the group, the acidic character increases.

Thus,  $H_2S$  is more acidic than  $H_2O$ .

- b. The bond energy of S-S bond ( $213 \text{ KJ mol}^{-1}$ ) is greater than O-O bond ( $138 \text{ KJ mol}^{-1}$ ).

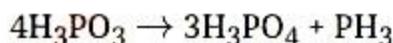
Due to the small size of an oxygen atom, there is greater Ip-bp repulsion in O-O, resulting in weakening of O-O bond more than in S-S bond.

- c. When sulphur dioxide reacts with chlorine in the presence of charcoal sulphuryl chloride is formed.

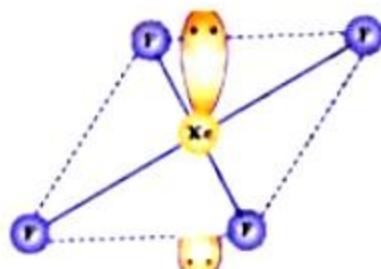


OR

- a. i. Disproportionation reaction of  $H_3PO_3$ :



- ii. Structure of  $XeF_4$ :

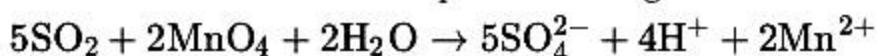


- b. i. Fluorine ( $F_2$ ) is strong oxidizing agent due to small size and low bond dissociation

enthalpy.

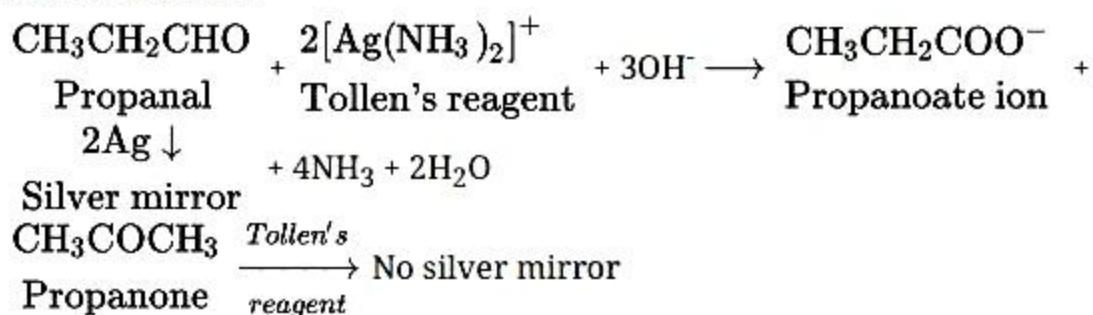
- ii. As the size increases, electronegativity decreases and non-metallic character also decreases. So, acidic character decreases from  $\text{N}_2\text{O}_3$  to  $\text{Bi}_2\text{O}_3$  in group 15.

- c. Chemical reaction to test sulphur dioxide gas:

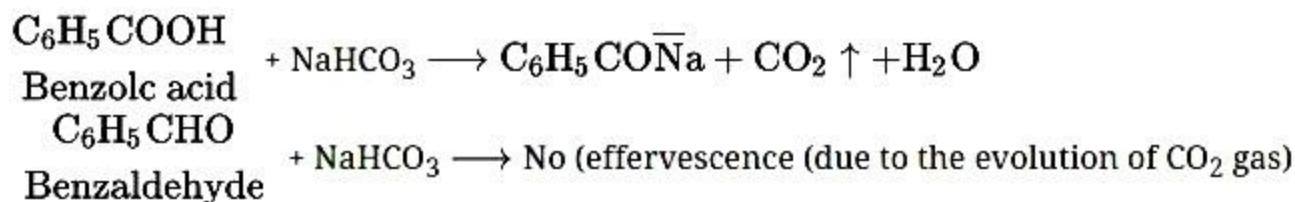


32. i. **Propanal and propanone**

These compounds can be distinguished by using Tollen's test. Propanal being an aldehyde reduces Tollen's reagent to shining silver mirror and propanone being a ketone does not.

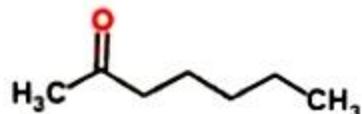


- ii. Benzaldehyde and benzoic acid Both can be distinguished by using sodium bicarbonate ( $\text{NaHCO}_3$ ) test. Benzoic acid being an acid reacts with  $\text{NaHCO}_3$  solution to produce brisk effervescence due to evolution of  $\text{CO}_2$  gas while benzaldehyde does not.



OR

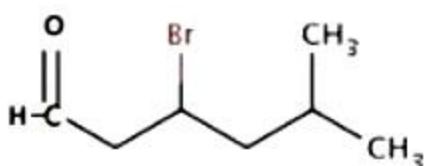
- i.  $\text{CH}_3\text{CO}(\text{CH}_2)_4\text{CH}_3$



IUPAC name of compound: Heptan-2-one

Common name: Methyl n-propyl ketone

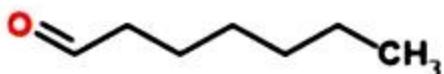
- ii.  $\text{CH}_3\text{CH}_2\text{CHBrCH}_2(\text{CH}_3)\text{CHO}$



IUPAC name of compound: 4-Bromo-2-methylhexanal

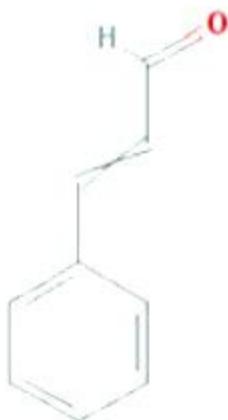
Common name: ( $\gamma$ -Bromo- $\alpha$ -methyl-caproaldehyde)

iii.  $\text{CH}_3(\text{CH}_2)_5\text{CHO}$



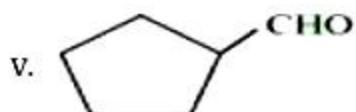
IUPAC name of compound: Heptanal

iv.  $\text{Ph} - \text{CH} = \text{CH} - \text{CHO}$



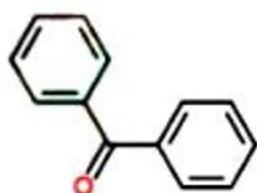
IUPAC name of compound: 3-phenylprop-2-enal

Common name:  $\beta$ -Pheynolacrolein



IUPAC name: Cyclopentanecarbaldehyde

vi.  $\text{PhCOPh}$



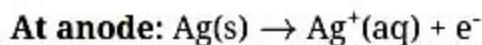
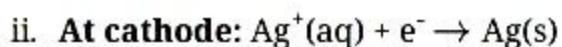
IUPAC name: Diphenylmethanone

Common name: Benzophenone

33. i. At cathode:  $2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$

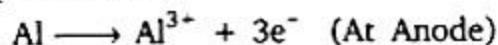


$\text{H}_2(\text{g})$  is evolved at cathode and  $\text{O}_2(\text{g})$  is evolved at anode.

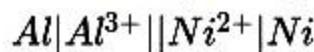


OR

Half cell equation are:



The cell may be represented as:



$$E_{\text{cell}}^0 = E_{\text{right}}^0 - E_{\text{left}}^0$$

$$= (-0.25) - (-1.66)$$

$$= -0.25 + 1.66$$

$$= 1.41 \text{ V}$$

Applying Nernst equation to the above cell reaction.

$$\begin{aligned} E_{\text{cell}} &= 1.41 \text{ V} - \frac{0.0591}{6} \log \frac{(10^{-3})^2}{(0.5)^3} = 1.41 \text{ V} - \frac{0.0591}{6} \log(8 \times 10^{-6}) \\ &= 1.41 \text{ V} - \frac{0.0591}{6} (\log 2^3 + \log 10^{-6}) \\ &= 1.41 \text{ V} - \frac{0.0591}{6} [3 \times \log 2 + (-67) \log 10] \\ &= 1.41 \text{ V} - \frac{0.0591}{6} [3 \times 0.3010 - 6] \\ &= 1.41 \text{ V} + 0.050 \text{ V} \end{aligned}$$

$$E_{\text{cell}} = 1.46 \text{ V}$$

**CBSE Class 12 - Chemistry**  
**Sample Paper 08 (2020-21)**

**Maximum Marks: 70**

**Time Allowed: 3 hours**

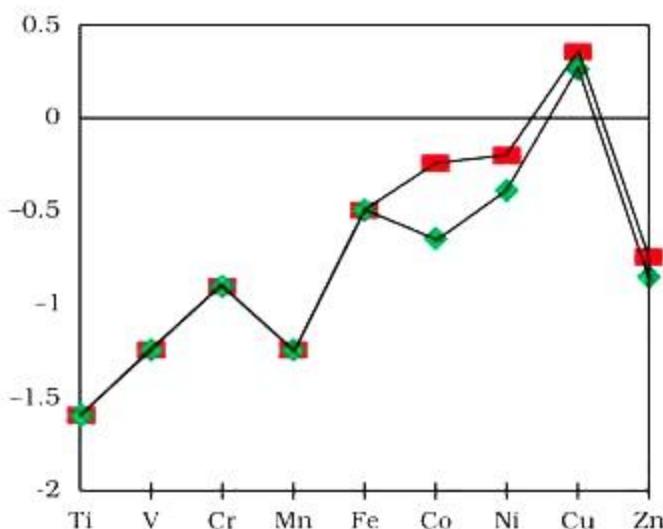
**General Instructions:**

- 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:**

The unique behaviour of Cu, having a positive  $E^\circ$  accounts for its inability to liberate  $H_2$  from acids. Only oxidising acids (nitric and hot concentrated sulphuric) react with Cu, the acids being reduced. The stability of the half-filled d sub-shell in  $Mn^{2+}$  and the completely filled d<sup>10</sup> configuration in  $Zn^{2+}$  are related to their  $E^\circ$  values, whereas  $E^\circ$  for Ni is related to the highest negative  $\Delta_{hyd}H^\circ$ . An examination of the  $E^\circ (M^{3+}/M^{2+})$  values the low value for Sc reflects the stability of  $Sc^{3+}$  which has a noble gas configuration. The comparatively high value for Mn shows that  $Mn^{2+}(d^5)$  is particularly stable, whereas a comparatively low value for Fe shows the extra stability of  $Fe^{3+}(d^5)$ . The comparatively low value for V is related to the stability of  $V^{2+}$  (half-filled t<sub>2g</sub> level).



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

- Ionisation enthalpy along with each series of the transition elements from left to right
  - increase
  - decrease
  - remain the same
  - none of these
- The stability of  $\text{Cu}^{2+}$  (aq) rather than  $\text{Cu}^+$ (aq) is due to
  - more negative  $\Delta_{hyd} H^\circ$  of  $\text{Cu}^{2+}$  (aq)
  - less negative  $\Delta_{hyd} H^\circ$  of  $\text{Cu}^{2+}$  (aq)
  - more positive  $\Delta_{hyd} H^\circ$  of  $\text{Cu}^{2+}$  (aq)
  - less positive  $\Delta_{hyd} H^\circ$  of  $\text{Cu}^{2+}$  (aq)
- Why is  $\text{Cr}^{2+}$  reducing and  $\text{Mn}^{3+}$  oxidising?
  - $\text{Cr}^{2+}$  is reducing as its configuration changes from  $d^4$  to  $d^3$
  - the latter having a half-filled  $t_{2g}$  level
  - the change from  $\text{Mn}^{3+}$  to  $\text{Mn}^{2+}$  results in the half-filled ( $d^5$ ) configuration
  - all of these
- Zn has high value for  $\text{M}^{3+}/\text{M}^{2+}$  Standard Electrode Potentials
  - due to large size
  - due to the removal of an electron from the stable  $d^{10}$  configuration of  $\text{Zn}^{2+}$ .
  - both (a) and (b)

- d. none of these
- v. Transition metals, despite high  $E^\circ$  oxidation, are poor reducing agents. The incorrect reason is
  - a. high heat of vaporization
  - b. high ionization energies
  - c. low heats of hydration
  - d. complex forming nature

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

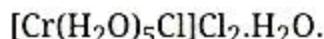
Isomers are two or more compounds that have the same chemical formula but a different arrangement of atoms. Due to the different arrangements of atoms, they differ in one or more physical or chemical properties. Two principal types of isomerism are known among coordination compounds. Stereoisomerism includes geometrical isomerism, optical isomerism while Structural isomerism consists of linkage isomerism, coordination isomerism, Ionisation isomerism and Solvate isomerism. Isomerism arises in heteroleptic complexes due to different possible geometric arrangements of the ligands. In a square planar complex of formula  $[MX_2L_2]$  X and L are unidentate, the two ligands X may be arranged adjacent to each other in a cis isomer, or opposite to each other in a trans isomer. Solvate form of isomerism is known as 'hydrate isomerism' in the case where water is involved as a solvent. This is similar to ionisation isomerism.

**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:** Optical isomers are mirror images that cannot be superimposed on one another.

**Reason:** The molecules or ions that cannot be superimposed are called chiral.

- ii. **Assertion:**  $[Cr(H_2O)_6]Cl_3$  is an aqua complex and its solvate isomer is



**Reason:** Solvate isomer is also known as linkage isomers.

- iii. **Assertion:** Thiocyanate is an ambidentate ligand.

**Reason:** Thiocyanate ligand,  $\text{NCS}^-$  is present which can bind through the nitrogen to give M-NCS or through sulphur to give M-SCN.

- iv. **Assertion:**  $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$  and  $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$  are coordination isomer.

**Reason:** Ionisation isomers are formed when the counter ion in a complex salt is itself a potential ligand and can displace a ligand which can then become the counter ion.

- v. **Assertion:** Square planar complex shows three isomers-two cis and one trans.

**Reason:** Stereoisomers have the same chemical formula and chemical bonds but they have different spatial arrangements.

3. Aniline upon heating with conc.  $\text{HNO}_3$  and conc.  $\text{H}_2\text{SO}_4$  mixture gives:

- a. The mixture of o, p, and m nitroaniline:
- b. No reaction
- c. o-and p-nitroaniline
- d. o-nitroaniline

4. Peptide linkage is present in:

- a. Carbohydrates
- b. Proteins
- c. Vitamins
- d. Rubber

OR

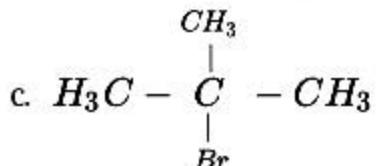
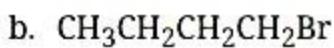
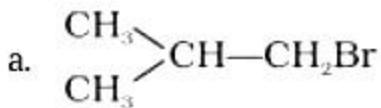
Commercially glucose is obtained by

- a. hydrolysis of sucrose
- b. boiling sucrose with dilute  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$  in alcoholic solution
- c. hydrolysis of starch by boiling it with dilute  $\text{H}_2\text{SO}_4$  at 393 K under pressure.
- d. crushing ripe grapes

5. Which of the following has highest boiling point?

- a. 0.1 molal urea solution
- b. 0.1 molal  $\text{NaCl}$  solution

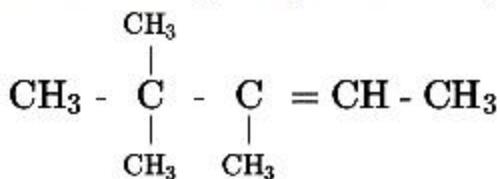
- c. 0.1 molal  $\text{BaCl}_2$  solution  
 d. 0.1 molal sugar solution  
 6. Arrange the following compounds in increasing order of their boiling points.



- a. (c) < (a) < (b)  
 b. (c) < (b) < (a)  
 c. (a) < (b) < (c)  
 d. (b) < (a) < (c)

OR

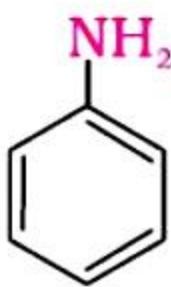
The following compound is ,as per the IUPAC system



- a. 3, 4, 4 - triethyl pent - 2 - ene  
 b. 2 diethyl, 3 - ethyl pentene  
 c. None of these  
 d. 2, 2, 3 - triethyl pent - 4 - ene  
 7. Secondary amines react with the nitrosonium ion to generate:  
 a. N – nitrosoamines  
 b. anilines  
 c. imines  
 d. oximes

OR

The following amine is called as



- a. Nitrobenzene
  - b. Aniline and phenylamine
  - c. Aniline and o-toluidine
  - d. O - Toluidine
8. Which among the following is adsorbed greatly by activated charcoal?
- a.  $\text{H}_2$
  - b.  $\text{CH}_4$
  - c. CO
  - d.  $\text{SO}_2$
- OR
- At high concentration of soap in water, soap behaves as \_\_\_\_\_.
- a. macromolecular colloid
  - b. molecular colloid
  - c. associated colloid
  - d. lyophilic colloid
9. Rate of physisorption increases with:
- a. decrease in pressure
  - b. increase in temperature
  - c. decrease in surface area
  - d. decrease in temperature
10. In the reaction,  $\text{R} - \text{X} + \text{NaOR}' \rightarrow \text{ROR}' + \text{X}^-$  ( - ve ion). The main product formed is:
- a. Ether
  - b. Alcohol
  - c. Ester
  - d. Amine

11. In cubic close packing(ccp) arrangement, the pattern of the successive layers will be designated as
- ABC, ABC, ABC
  - AB, ABC, AB, ABC....
  - None of these
  - AB, AB, AB....

12. **Assertion:**  $\text{NF}_3$  is weaker ligand than  $\text{N}(\text{CH}_3)_3$ .

**Reason:**  $\text{NF}_3$  ionises to give  $\text{F}^-$  ions in aqueous solution.

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

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

14. **Assertion:** When  $\text{NaCl}$  is added to water a depression in freezing point is observed.

**Reason:** The lowering of the vapour pressure of a solution causes depression in the freezing point.

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

OR

**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

15. **Assertion:** Glycerol does not react with HI.

**Reason:** 2 - Iodopropane can be produced by treatment of glycerol with HI.

- 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.

16. **Assertion:** In monohaloarenes, further electrophilic substitution occurs at ortho and para positions.

**Reason:** Halogen atom is a ring deactivator.

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

### Section B

17. Why are haloarenes more stable than haloalkanes and undergo electrophilic substitution reaction at ortho and para positions?

OR

p - dichlorobenzene has higher melting point than meta - dichlorobenzene because

18. Define molal elevation constant or ebullioscopic constant.
19. What causes Brownian movement in a colloidal solution?

OR

Explain the following:

- a. Same substance can act as both as colloids and crystalloids.
- b. Artificial rain is caused by spraying salt over clouds.
- c. When a beam of light is passed through a colloidal sol, the path of the beam gets illuminated.
20. Three-fourth of a reaction is completed in 32 minutes. What is the half life period of this reaction?
21. Distinguish between rate expression and rate constant of a reaction.
22. Explain why low molecular mass alcohols are soluble in water.
23. Why is the third ionization energy of manganese (Atomic Number = 25) unexpected high?
24. Convert: 1-chloropropane to 2-iodopropane.
25. What is meant by co-ordination number in an ionic crystal?

### Section C

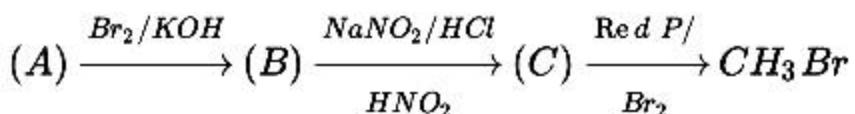
26. How are the following compounds prepared from  $\text{XeF}_6$ ?

- i.  $\text{XeOF}_4$
- ii.  $\text{XeO}_3$

OR

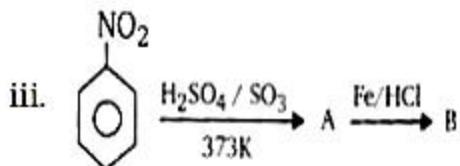
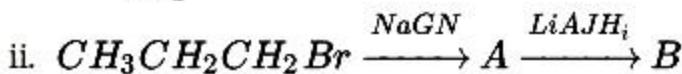
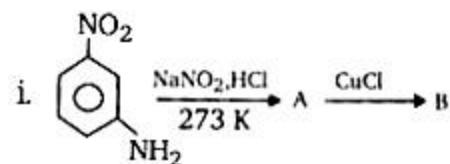
Give reasons:

- i.  $\text{SO}_2$  is reducing while  $\text{TeO}_2$  is an oxidising agent.
- ii. Nitrogen does not form pentahalides.
- iii.  $\text{ICl}$  is more reactive than  $\text{I}_2$ .
27. Identify the compounds A, B and C in the following compounds:



OR

Identify A and B in the following reactions:



28. Copper crystallizes into a fcc lattice with edge length  $3.6 \times 10^{-8} \text{ cm}$ . Show that the calculated density is in agreement with its measured value of  $8.92 \text{ g cm}^{-3}$ .
29. Which sugar is called invert sugar? Why is it called so?
30. How can phenol be converted to aspirin?

#### Section D

31. Explain each of the following:

- Nitrogen is much less reactive than phosphorus.
- The stability of +5 oxidation state decreases down the group 15.
- The bond angles (O-N-O) are not of the same value in  $NO_2^-$  and  $NO_2^+$ .

OR

  - Which allotrope of phosphorus is more reactive and why?
  - How the supersonic jet aeroplanes are responsible for the depletion of ozone layers?
  - $F_2$  has lower bond dissociation enthalpy than  $Cl_2$ . why?

  - Which noble gas is used in filling balloons for meteorological observations?
  - Complete the equation:  $XeF_2 + PF_5$

32. Give simple chemical tests to distinguish between the following pairs of compounds:
- Ethanal and propanal.
  - Benzoic acid and phenol.

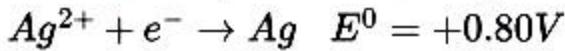
OR

Write the structures of the following compounds.

- i. 2-Methoxypropionaldehyde
  - ii. 3-Hydroxybutanal
  - iii. 2-Hydroxycyclopentanecarbaldehyde
  - iv. 4-Oxopentanal
  - v. Di-sec-butyl ketone
33. a. Explain why electrolysis of aqueous solution of NaCl gives H<sub>2</sub> at cathode and Cl<sub>2</sub> at anode. Write overall reaction.
- $$E^0_{(Na^+/Na)} = -2.71V; E^0_{(H_2O/H_2)} = -0.83V$$
- $$E^0_{(Cl_2/2Cl^-)} = 1.36V; E^0_{(H^+, O_3/H_2O)} = 1.23V$$
- b. Calculate the emf of the cell Zn | Zn<sup>2+</sup>(0.1 M) || Cd<sup>2+</sup> (0.01 M) | Cd at 298 K
- Given  $E^0_{(Zn^{2+}/Zn)} = -0.75V; E^0_{(Cd^+/Cd)} = -0.40V$

OR

1. Account for the following:
  - i. Alkaline medium inhibits the rusting of iron.
  - ii. Iron does not react even if the zinc coating is broken in a galvanized iron pipe.
2. Construct the galvanic cell using the following data:-



For what concentration Ag<sup>+</sup> ions will the emf of the cell be zero at 25°C if the concentration of Cu<sup>2+</sup> is 0.01 M? [log 3.919 = 0.593]

**CBSE Class 12 - Chemistry**  
**Sample Paper 08 (2020-21)**

**Solution**

**Section A**

1. i. (a) increase  
ii. (a) more negative  $\Delta_{hyd} H^\circ$  of  $Cu^{2+}$  (aq)  
iii. (d) all of these  
iv. (b) due to the removal of an electron from the stable  $d^{10}$  configuration of  $Zn^{2+}$   
v. (d) complex forming nature
2. i. (b) Assertion and reason both are correct statements but 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. (d) Assertion is wrong statement but reason is correct statement  
v. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion
3. (a) The mixture of o, p, and m nitroaniline:

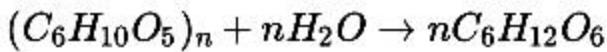
**Explanation:** Mixture of ortho, meta, and para nitroaniline is formed because of the formation of anilinium ion which is formed by direct nitration of aniline.

4. (b) Proteins
- Explanation:** Peptide linkage is present in proteins. It is a chemical bond formed between two molecules when the carboxyl group of one molecule reacts with the amino group of other molecules, releasing a molecule of water.

OR

- (c) hydrolysis of starch by boiling it with dilute  $H_2SO_4$  at 393 K under pressure.

**Explanation:** Commercially glucose is obtained by hydrolysis of starch by boiling it with dilute  $H_2SO_4$  at 393 K under pressure (2-3 atm).



5. (c) 0.1 molal BaCl<sub>2</sub> solution

**Explanation:** i=3 so  $\Delta T_b$  will be maximum and hence Tb will be maximum.

6. (a) (c) < (a) < (b)

**Explanation:** The boiling points of isomeric haloalkanes decrease with an increase in branching as with an increase in branching surface area decreases which leads to a decrease in intermolecular forces. Hence, the increasing order of their boiling points is c < a < b.

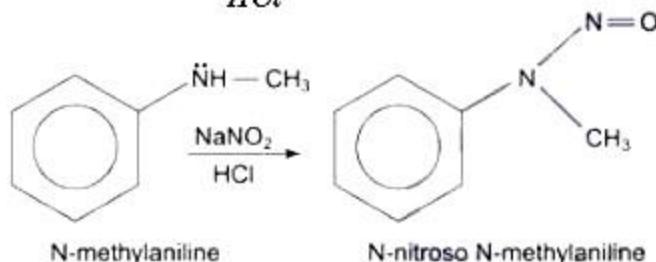
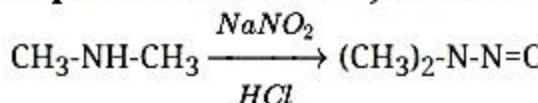
OR

- (a) 3, 4, 4 - triethyl pent - 2 - ene

**Explanation:** Longest chain contains double bond.

7. (a) N – nitrosoamines

**Explanation:** Secondary amines react with nitrosonium ion to form N-nitrosoamine.



OR

- (b) Aniline and phenylamine

**Explanation:** C<sub>6</sub>H<sub>5</sub>NH<sub>2</sub> is known as aniline. Here, the amino group is directly attached to phenyl ring so it is also known as phenylamine. This is an aromatic primary amine.

8. (d) SO<sub>2</sub>

**Explanation:** SO<sub>2</sub> due to high polarity and surface area is adsorbed maximum.

OR

- (c) associated colloid

**Explanation:** At low concentration, the soap solution behaves like a normal strong electrolyte. But at high concentration, soap molecules aggregate to form micelles. These

are known as associated colloids.

9. (d) decrease in temperature

**Explanation:** decrease in temperature

10. (a) Ether

**Explanation:** The given reaction is an example of the substitution reaction.

11. (a) ABC, ABC, ABC

**Explanation:** First layer and fourth layer are same.

12. (c) Assertion is CORRECT but, reason is INCORRECT.

**Explanation:** Assertion is CORRECT but, reason is INCORRECT.

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

**Explanation:** When a non-volatile solute is added to water, freezing point lowers due to lowering of vapor pressure.

OR

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

**Explanation:** Assertion is INCORRECT but, reason is CORRECT

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

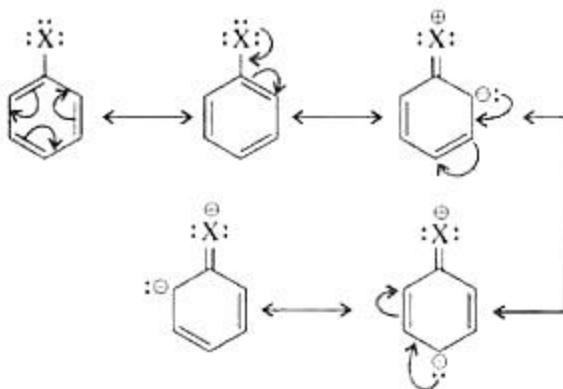
**Explanation:** Assertion is INCORRECT but, reason is CORRECT.

16. (a) Assertion and reason both are correct statements but the reason is not the correct explanation of assertion.

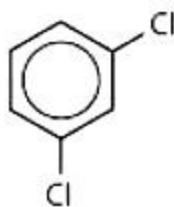
**Explanation:** Further electrophilic substitution occurs at ortho and para positions because halogen atoms are ortho and para directing, not because they are ring deactivators.

### Section B

17. Haloarenes are resonance hybrid of following five structures. The electron density gets concentrated more at ortho and para positions. Thus they are stable and undergo electrophilic substitution at ortho and para positions.



OR



1,3-dichlorobenzene  
*m*-dichlorobenzene



1,4-dichlorobenzene  
*p*-dichlorobenzene

*p*- dichlorebenzene have symmetrical structure therefore it can fit better into the crystal lattice which increases its melting point.

18. Molal elevation constant is defined as increase in boiling point of the solvent, when one mole of solute is dissolved in 1000g of solvent. The elevation is proportional to the number of particles dissolved and given by  $\Delta T_b = K_b m$ , where  $m$  is the molal concentration of solute. The constant  $K_b$  is the ebullioscopic constant of the solvent.
19. The Brownian movement arises due to the unbalanced bombardment of particles by the molecules of the dispersion medium. The Brownian movement has a stirring effect which does not permit the particles to settle and thus, is responsible for stability of sols.

OR

- a. The same substance can act as both colloid and crystalloid. It depends on the size of the particles, when the size of the particles lies between 1 to 1000 nm, it behaves as a colloid. If particles size is less than 1 nm, it exists as a true solution and behaves like a crystalloid.
- b. Artificial rain is caused by spraying salt over clouds. The colloidal water particles of the clouds get neutralized by oppositely charged ions of the salt and coagulated to

bigger water drop cause artificial rain.

- c. When a beam of light is passed through a colloidal solution, the path of beam gets illuminated with visible light. This is due to scattering of light by colloidal particles.

20. Step. 1. Calculation of the rate constant (k) for the reaction

$$k = \frac{2.303}{t} \frac{\log a}{a-x}$$

$$a=100, x=75, (a-x) = 100-75, t=32 \text{ minutes}$$

$$k = \frac{2.303}{32\text{min}} \frac{\log 100}{25} = \frac{2.303}{32\text{min}} \log 4 = \frac{2.303 \times 0.6021}{32\text{min}}$$
$$= 0.0433 \text{ min}^{-1}$$

Step II) Calculation of the half-life period ( $t_{1/2}$ )

$$t_1/2 = \frac{0.693}{k} = \frac{0.693}{0.0433 \text{ min}^{-1}} = 16 \text{ min}$$

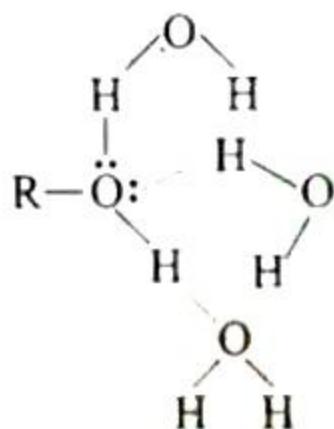
21. Rate expression is the way to express rate of reaction in terms of concentration of reactants.

For a chemical reaction  $aA + bB \rightarrow cC + dD$

$$\text{Rate} = k[A]^x[B]^y$$

Rate constant (k) is defined as the rate of reaction when the concentration of reactants are taken unity.

22. The lower members of alcohol are highly soluble in water but the solubility decreases with an increase in molecular weight. The solubility of lower alcohols in water is due to hydrogen bonds between alcohols and water molecules.



23. Mn (25) has electronic configuration = [Ar] 3d<sup>5</sup>4s<sup>2</sup>

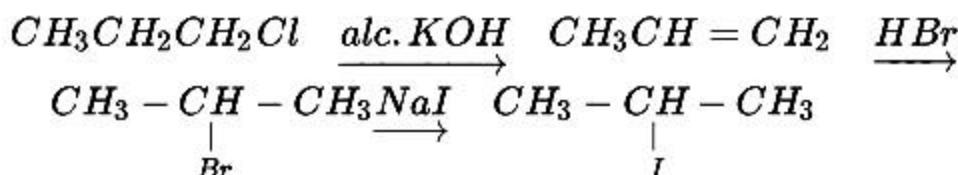
Mn<sup>2+</sup> has electronic configuration = [Ar] 3d<sup>5</sup>4s<sup>0</sup>

After losing 2 electrons, it has half filled d-orbital, which is more stable than why Mn<sup>2+</sup> has exceptionally high third ionization energy.

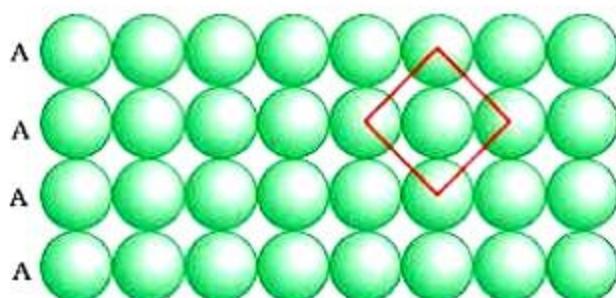
24. Step 1: Treat chloropropane with alc. KOH to give propene

Step 2: Treat propene with HBr to give 2-bromopropane

Step 3: Treat 2-bromopropane with NaI to give 2-iodopropane



25. **Coordination number:** The number of closest neighbours of any constituent particle is called its coordination number. e.g. Co-ordination number in square close packing is 4.



### Section C

26. Hydrolysis of  $\text{XeF}_6$  with water gives  $\text{XeOF}_4$  and  $\text{XeO}_3$

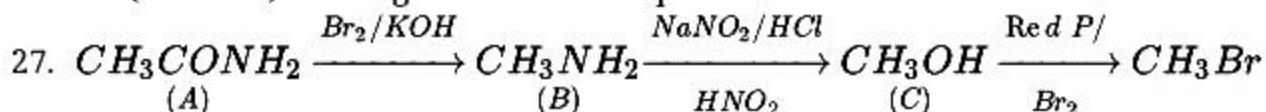
- Partial hydrolysis of  $\text{XeF}_6$  gives  $\text{XeOF}_4$ :  $\text{XeF}_6 + \text{H}_2\text{O} \rightarrow \text{XeOF}_4 + 2\text{HF}$
- Complete hydrolysis of  $\text{XeF}_6$  gives  $\text{XeO}_3$ :  $\text{XeF}_6 + 3\text{H}_2\text{O} \rightarrow \text{XeO}_3 + 6\text{HF}$

OR

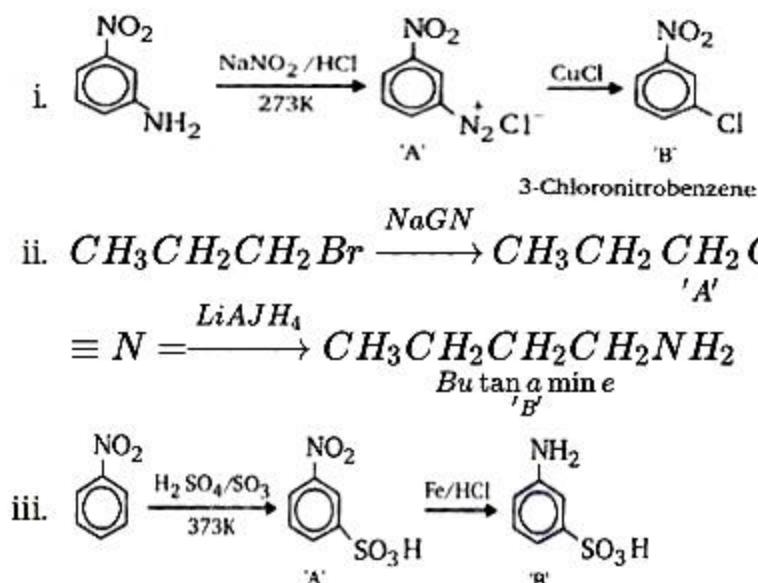
- The dioxide molecules contain  $p\pi-p\pi$  bonds which become weaker with increase in atomic number because, increase in atomic no. increases size along a group and hence there occurs an increase in the bond length and so the reducing character decreases down the group. Due to presence of d-orbitals (vacant), sulphur can extend its covalency and show oxidation states till +6, which is stable in sulphur (eg:  $\text{SF}_6$ ). Hence it acts as a reducing agent, and now the character decreases down the group because of decrease in strength of the  $p\pi-p\pi$  bonds while, unlike sulphur, Te cannot show +6 oxidation state as it is highly unstable due to inert pair effect. Therefore there can only be a decrease in its oxidation state (it can decrease to -2, +2 etc). Hence,  $\text{TeO}_2$  acts as oxidizing agent.
- Nitrogen does not form pentahalide due to the absence of d-orbitals. While all the elements of its group have vacant d-orbitals that helps them in making pentahalides

such as  $\text{PCl}_5$ .

- iii. Interhalogen compounds are more reactive than halogens (except fluorine) because  $X-X'$  bond ( $\text{I}-\text{Cl}$  bond in halogens) in interhalogen compounds is weaker than  $X-X$  bond ( $\text{I}-\text{I}$  bond) in halogens due to their polar nature.



OR



28. We know that,

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

No. of atoms in fcc lattice,  $z = 4$

$$= \frac{4 \times 63.5 \text{ mol}^{-1}}{(3.61 \times 10^{-8} \text{ cm})^3 \times (6.02 \times 10^{23} \text{ mol}^{-1})}$$

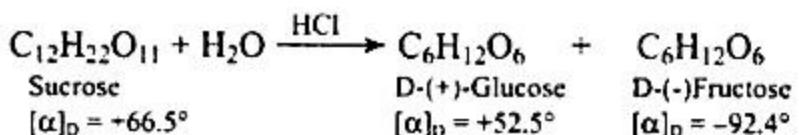
$$\text{Atomic mass of unit cell} = \frac{4 \times 63.5}{6.02 \times 10^{23}} = 4.22 \times 10^{-22} \text{ g}$$

Now, Density =  $\frac{\text{Mass of unit cell}}{\text{Vol. of unit cell}}$

$$= \frac{4.22 \times 10^{-22}}{47.4 \times 10^{-24} \text{ cm}^2} = 8.9 \text{ g cm}^{-3}$$

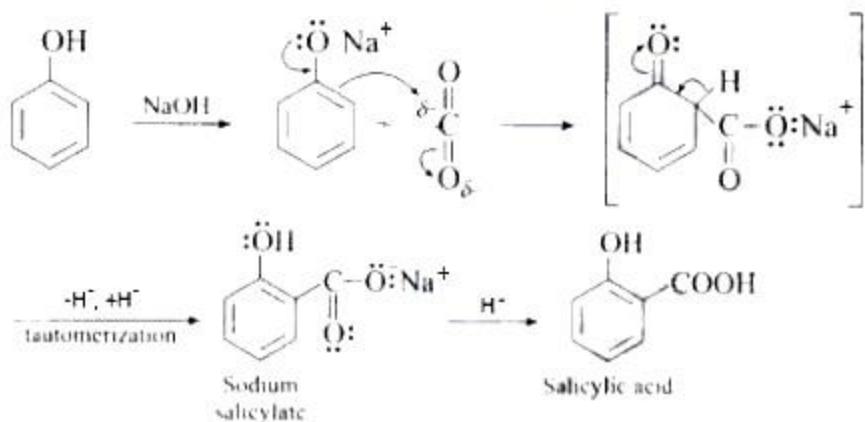
which is in close agreement with the measured value.

29. Sucrose is called invert sugar. The sugar obtained from sugar beet is a colourless, crystalline and sweet substance. It is very soluble in water and its aqueous solution is dextrorotatory having  $[\alpha]_D = +66.5^\circ$ . On hydrolysis with dilute acids or enzyme invertase, cane sugar gives an equimolar mixture of D - (+)-glucose and D-(-)-fructose.

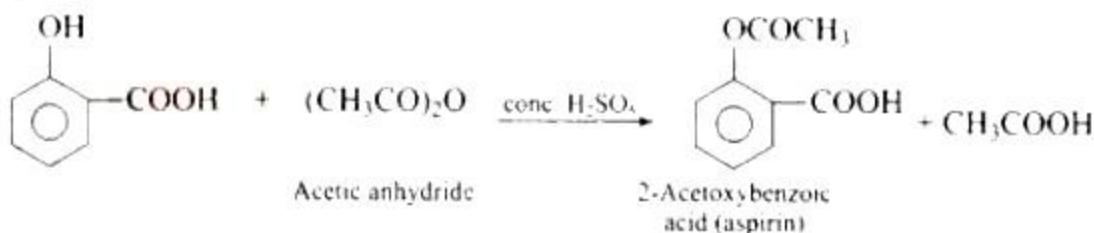
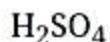


So, sucrose is dextrorotatory but after hydrolysis gives dextrorotatory glucose and laevorotatory fructose. D-(-)-fructose has a greater specific rotation than D-(+)-glucose. Therefore, the resultant solution upon hydrolysis is laevorotatory in nature. Since the laevorotation of fructose ( $-92.4^\circ$ ) is more than dextrorotation of glucose ( $+52.5^\circ$ ). Thus, hydrolysis brings change in the sign of rotation from dextro before hydrolysis to laevo after hydrolysis, the reaction is called inversion reaction and the mixture (glucose and fructose) is called invert sugar.

30. Phenol is converted into salicylic acid. The reaction is usually carried out by allowing sodium phenoxide to absorb carbon dioxide and then heating the product to 400 K and 4–7 atm pressure. The first unstable intermediate is formed which undergoes a proton shift to form sodium salicylate. The subsequent acidification of sodium salicylate gives.



Then aspirin is obtained by acetylating salicylic acid with acetic anhydride and conc.



The preparation of Aspirin from salicylic acid is an example of an electrophilic substitution reaction in which carbon dioxide is an electrophile.

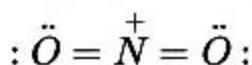
### Section D

31. i. Nitrogen is chemically less reactive. This is due to the presence of a more stable triple bond in  $\text{N}_2$  molecule (high bond enthalpy of  $\text{N} \equiv \text{N}$  bond).

Whereas, phosphorus forms only P-P single bond. Therefore, phosphorus is more reactive than nitrogen.

- ii. Due to inert pair effect, nuclear attraction increases on s-electrons as a result they does not participate. The lower oxidation state (+3) gets stable whereas, the higher oxidation state gets unstable down the group. Hence, the stability of +5 oxidation state decreases down the group.
- iii. The difference in bond angle is due to the fact that  $NO_2^+$  does not have lone pair of electrons on N-atom but  $NO_2^-$  has a lone pair of electrons on the N-atom.

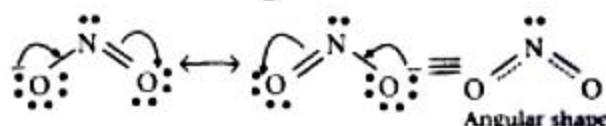
Structure of  $NO_2^+$



$NO_2^+$  = Linear shape

Bond angle =  $180^\circ$

Structure of  $NO_2^-$



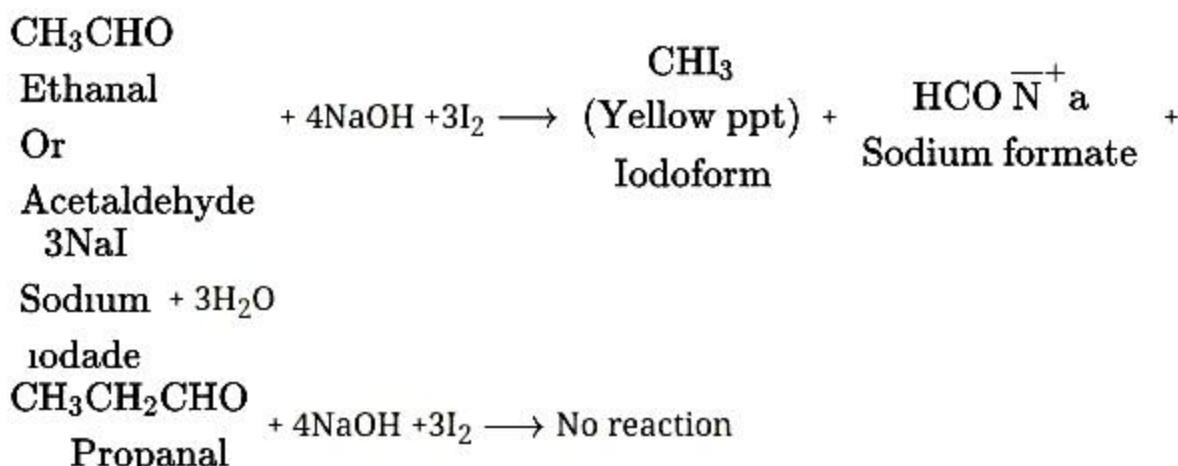
Bond angle =  $120^\circ$

OR

- a. i. White phosphorus because it is monomeric and has low bond dissociation enthalpy due to angle of strain (bond angle of strain (bond angle  $60^\circ$ )).  
ii. Supersonic jet aeroplanes release NO which is responsible for the depletion of ozone layer.  $NO + O_3 \rightarrow NO_2 + O_2$   
iii. it is due to more interelectronic repulsion between lone pair of electrons.
- b. i. Helium.  
ii.  $XeF_2 + PF_5 \rightarrow [XeF] + [PF]^-$

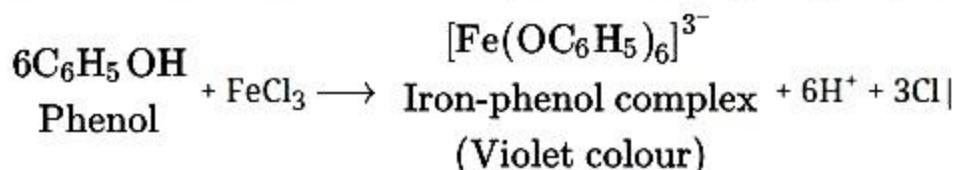
32. i. **Distinguishing test between ethanal and propanal**

Iodoform test Ethanal because of the presence of  $CH_3CO-$  skeleton gives positive iodoform test whereas propanal due to the absence of such a skeleton does not give such test.

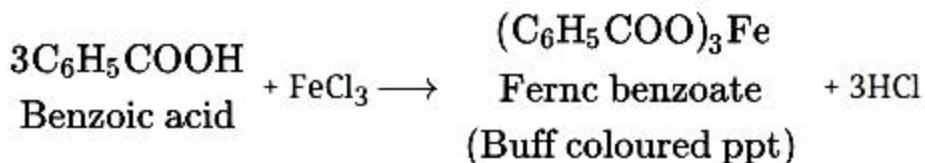


**ii. Distinguishing test between benzoic acid and phenol**

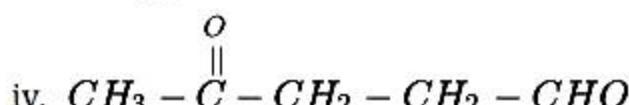
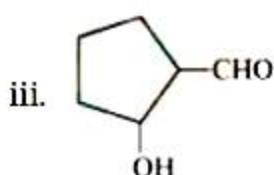
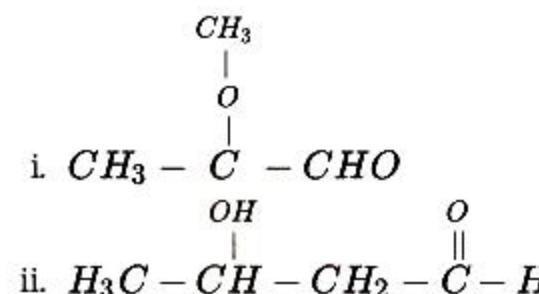
Phenol and benzoic acid can be distinguished by ferric chloride test. Phenol reacts with neutral FeCl<sub>3</sub> to form ferric phenoxide complex giving violet colouration.

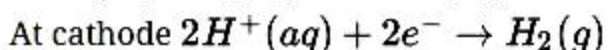
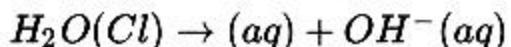
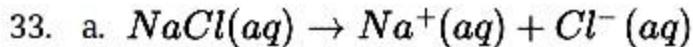
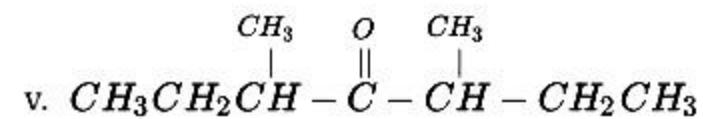


But benzoic acid reacts with neutral FeCl<sub>3</sub> to give a buff coloured precipitate of ferric benzoate.

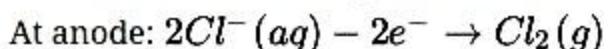


OR



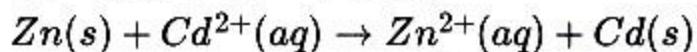
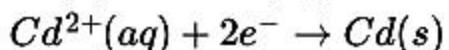
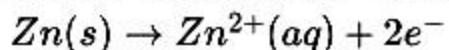
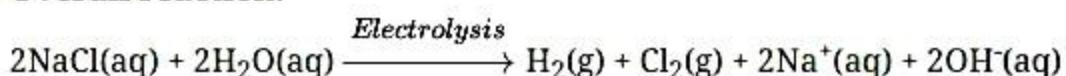


It is because reduction potential value of  $E^0(H^+/H_2)$  is more than that of  $E^0(H^+/H)$



It is because of over voltage i.e. energy required to liberate  $O_2$  is more than that of  $Cl_2$

**Overall reaction:**



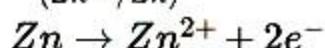
$$\begin{aligned} E_{cell} &= E^0_{cell} - \frac{0.0591}{2} \log \frac{[Zn^{2+}]}{[Cd^{2+}]} \\ &= E^0_{(Cd^{2+}/Cd)} - E^0_{(Zn^{2+}/Zn)} - \frac{0.0591}{2} \log \frac{0.1}{0.01} \\ &= -0.40V - (-0.76V) - \frac{0.0591}{2} \log 10 \\ &= +0.36V - 0.0295 \\ &= 0.3305V \end{aligned}$$

OR

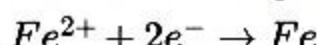
1. (i)  $H^+$  ions are required for rusting to take place. Alkaline medium will react with  $H^+$ , therefore inhibit rusting.

(ii) It is because zinc acts as anode because it is more reactive. (

$$E^\ominus_{(Zn^{2+}/Zn)} = -0.76V \text{ and } E^\ominus_{(Fe^{2+}/Fe)} = -0.44V$$

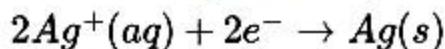


Even if any  $Fe^{2+}$  is formed it will gain electrons and change into Fe and thus corrosion will be prevented.

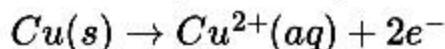


2. From the data, it is found that standard emf of the Copper is less than Silver, therefore Copper is oxidized and Silver is reduced.

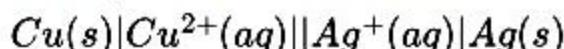
**At Cathode (Reduction) :**



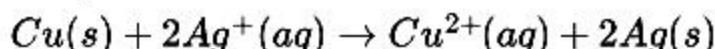
**At Anode (Oxidation):**



Cell representation of the cell is:



Complete cell reaction is the summation of these two half cell reactions.



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

Now standard emf of the cell is

$$E_{cell}^\ominus = E_{(Ag^+/Ag)}^\ominus - E_{(Cu^{2+}/Cu)}^\ominus$$

$$= + 0.80 \text{ V} - 0.34 \text{ V}$$

$$= + 0.46 \text{ V}$$

Nernst equation is

$$E_{cell} = E_{cell}^\ominus - \frac{2.303RT}{nF} \log \frac{[Cu^{2+}]}{[Ag^+]}$$

For this reaction, n = 2, F = 96500 Cmol<sup>-1</sup>, T = 298 K

$$E_{cell} = E_{cell}^\ominus - \frac{0.0591}{2} \log \frac{[Cu^{2+}]}{[Ag^+]^2}$$

$$0 = 0.46 \text{ V} - \frac{0.0591}{2} \log \frac{[Cu^{2+}]}{[Ag^+]^2} \quad (\text{Given } E_{cell} = 0)$$

$$\log \frac{0.01}{[Ag^+]^2} = \frac{0.46V \times 2}{0.0591} = \frac{0.92}{0.0591}$$

$$= 15.567$$

$$\log \frac{0.01}{[Ag^+]^2} = 15.567$$

$$\frac{0.01}{[Ag^+]^2} = \text{antilog}(15.567)$$

$$= 3.690 \times 10^{15}$$

$$[Ag^+]^2 = \frac{0.01}{3.688 \times 10^{15}} = 2.71 \times 10^{-18}$$

$$\therefore [Ag^+] = 1.65 \times 10^{-9} \text{ mol L}^{-1}$$

**CBSE Class 12 - Chemistry  
Sample Paper 09 (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 and answer any four out of the following questions:**

The f-block consists of elements in which 4f and 5f orbitals are progressively filled. They are placed in a separate panel at the bottom of the periodic table. The names transition metals and inner transition metals are often used to refer to the elements of d-and f-blocks respectively. The d-block occupies the large middle section of the periodic table flanked between s and p blocks in the periodic table. In general, the electronic configuration of the outer orbitals of these elements is  $(n-1)d^{1-10}ns^{1-2}$ . The electronic configurations of outer orbitals of Zn, Cd, Hg and Cn are represented by the general formula  $(n-1)d^{10}ns^2$ . The transition metals and their compounds also exhibit catalytic property and paramagnetic behaviour. Transition metal also forms an alloy. An alloy is a blend of metals prepared by mixing the components. Alloys may be homogeneous solid solutions in which the atoms of one metal are distributed randomly among the atoms of the other.

**The following questions are multiple-choice questions. Choose the most appropriate**

**answer.**

- i. Which of the following has a magnetic moment value of 5.9?
  - a.  $\text{Fe}^{2+}$
  - b.  $\text{Fe}^{3+}$
  - c.  $\text{Ni}^{2+}$
  - d.  $\text{Cu}^{2+}$
- ii. Which of the following are d-block elements but not regarded as transition elements?
  - a. Cu, Ag, Au
  - b. Zn, Cd, Hg
  - c. Fe, Co, Ni
  - d. Ru, Rh, Pd
- iii. Transition elements form alloys easily because they have
  - a. Same atomic number
  - b. Same electronic configuration
  - c. Nearly same atomic size
  - d. None of the above
- iv. Which one of the following characteristics of the transition metals is associated with higher catalytic activity?
  - a. High enthalpy of atomisation
  - b. Paramagnetic behaviour
  - c. Colour of hydrate ions
  - d. Variable oxidation states
- v. Which of the following has the maximum number of unpaired electrons?
  - a.  $\text{Mg}^{2+}$
  - b.  $\text{Ti}^{3+}$
  - c.  $\text{V}^{3+}$
  - d.  $\text{Fe}^{2+}$

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

Alfred Werner (1866-1919), a Swiss chemist was the first to formulate his ideas about the structures of coordination compounds. Werner proposed the concept of a primary valence and a secondary valence for a metal. The coordination entity constitutes a central metal atom or ion bonded to a fixed number of ions or molecules. In a coordination

entity, the atom/ion to which a fixed number of ions/groups are bound in a definite geometrical arrangement around it is called the central atom or ion. The ions or molecules bound to the central atom/ion in the coordination entity are called ligands. Ligands may be simple ions such as  $\text{Cl}^-$ , small molecules such as  $\text{H}_2\text{O}$  or  $\text{NH}_3$ , larger molecules such as  $\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$  or  $\text{N}(\text{CH}_2\text{CH}_2\text{NH}_2)_3$  or even macromolecules, such as protein. Ligands are unidentate, bidentate and polydentate. The coordination number (CN) of a metal ion in a complex is the number of ligand donor atoms to which the metal is directly bonded.

**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:** Binary compounds such as  $\text{CrCl}_3$ , have a primary valence of 3.

**Reason:** Coordinate compound metals show only one type of linkage that is primary linkage.

- ii. **Assertion:**  $\text{CoCl}_3(\text{NH}_3)_3$  is a coordination entity in which the cobalt ion is surrounded by three ammonia molecules and three chloride ion.

**Reason:** The central atom/ion in the coordination entities:  $[\text{NiCl}_2(\text{H}_2\text{O})_4]$  is  $\text{Ni}^{2+}$ .

- iii. **Assertion:**  $\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$  (ethane-1,2-diamine) ligand is said to be didentate.

**Reason:** Didentate ligands are bind through two donor atoms.

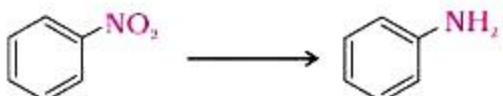
- iv. **Assertion:** The complex ions,  $[\text{PtCl}_6]^{2-}$  the coordination number of Pt is 6.

**Reason:** Ligand which can ligate through two different atoms is called ambidentate ligand.

- v. **Assertion:** EDTA can bind through two nitrogen and four oxygen atoms to a central metal ion.

**Reason:** The number of ligating groups attach to an atom is called the denticity of the ligand.

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



- a. None of these
  - b.  $\text{H}_2/\text{Pd}$
  - c.  $\text{NaOH}/\text{Pd}$
  - d.  $\text{HCl}/\text{Pd}$
4. Addison's disease is characterised by
- a. increased susceptibility to stress
  - b. All of these
  - c. hypoglycemia
  - d. weakness

OR

Which one of the following is not a globular protein?

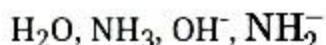
- a. Insulin
  - b. Enzyme
  - c. Haemoglobin
  - d. Myosin
5. Which among the following is an example of liquid in solid?
- a. Aerated drinks
  - b. Hydrated salts
  - c. Sugar solution
  - d. Alloys
6. Finkelstein reaction is:
- a.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl} + \text{NaI} \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{I} + \text{NaCl}$
  - b.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl} + \text{NaBr} \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{Br} + \text{NaCl}$
  - c.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{I} + \text{NaCl} \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2 - \text{Cl} + \text{NaI}$
  - d.  $\text{CH}_3 = \text{CH}_2 + \text{H} - \text{I} \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{I} + \text{CH}_3\text{CHICH}_3$

OR

Carbon – halogen bond of alkyl halides is responsible for their nucleophilic substitution,

elimination, and their reaction with metal atoms to form organometallic compounds because of its:

- a. Polarity
  - b. Kinetic properties
  - c. Chirality
  - d. Racemisation
7. The correct decreasing order of basic strength of the following species is \_\_\_\_\_.



- a.  $\text{H}_2\text{O} > \text{NH}_3 > \text{OH}^- > \text{NH}_2^-$
- b.  $\text{OH}^- > \text{NH}_2^- > \text{H}_2\text{O} > \text{NH}_3$
- c.  $\text{NH}_2^- > \text{OH}^- > \text{NH}_3 > \text{H}_2\text{O}$
- d.  $\text{NH}_3 > \text{H}_2\text{O} > \text{NH}_2^- > \text{OH}^-$

OR

If the starting amide has got four carbon atoms and the amine that is formed has got only 3 carbon atoms, then the reaction is called \_\_\_\_\_.

- a. Gabriel synthesis
  - b. Carbylaminates reaction
  - c. Hoffmann bromamide reaction
  - d. Clemmensen reduction
8. Liquid – liquid sols are known as
- a. Emulsions
  - b. Foam
  - c. Aerosols
  - d. Gels

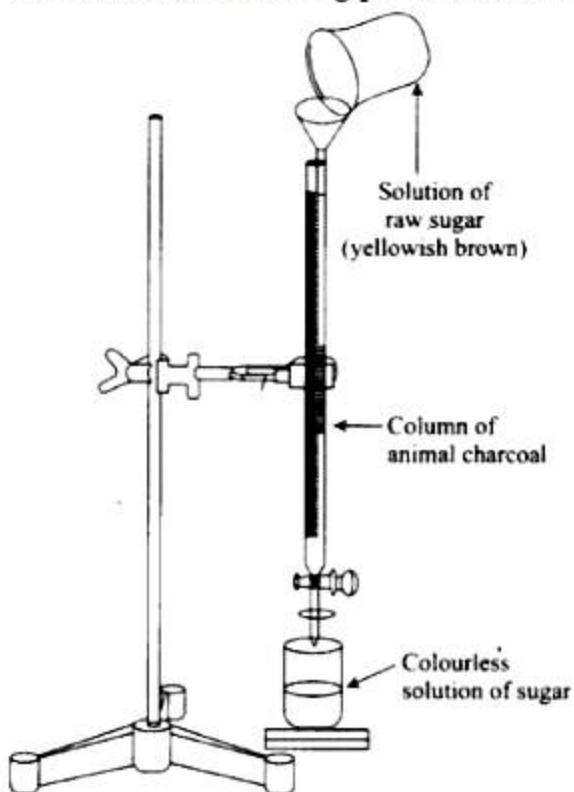
OR

Micelles are:

- a. Ideal solution
- b. Associated colloids
- c. Adsorbed solution

d. Emulsion cum gel

9. Which of the following phenomenon is applicable to the process shown in the Fig.?



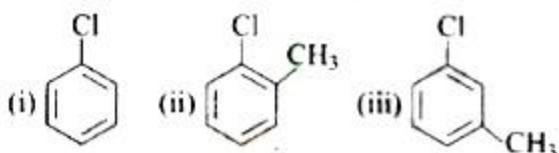
a. Emulsification

b. Absorption

c. Adsorption

d. Coagulation

10. Arrange the following compounds in increasing order of rate of reaction towards nucleophilic substitution.



a. (i) < (ii) < (iii)

b. (ii) < (iii) < (i)

c. (iii) < (ii) < (i)

d. (i) < (iii) < (ii)

11. The structure of CsCl crystal is:

a. Octahedral

b. None of these

c. Body centred cubic lattice

d. Face centred cubic lattice

12. **Assertion:** Tetrahedral complexes do not show geometrical isomerism.

**Reason:** Bond angle in tetrahedral geometry is  $109.5^\circ$ .

- 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:** Except glycine, all naturally occurring  $\alpha$ -amino acids are optically active.

**Reason:** All  $\alpha$ -amino acids occurring naturally except glycine has at least one asymmetric carbon.

- 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  $\text{KNO}_3$ .

**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:** Ether behaves as bases in the presence of mineral acids.

**Reason:** Due to the presence of lone pairs of electron on oxygen.

- 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.

16. **Assertion:** Addition of HBr to 1 - butene in the presence of peroxide gives 1-bromobutane.

**Reason:** It involves the formation of primary radical.

- 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. How will you bring this conversion?

Bromomethane to propanone

OR

How will you bring about the following conversion?

Toluene to benzyl alcohol

18. Based on solute-solvent interactions, arrange the following in order of increasing solubility in n-octane and explain. Cyclohexane, KCl,  $CH_3OH$ ,  $CH_3CN$ .
19. Explain the mechanism of adsorption.

OR

Why is adsorption always exothermic?

20. A reaction is second order with respect to a reactant. How will be the rate of reaction get affected if the concentration of the reactant is:
  - i. doubled
  - ii. reduced to half.
21. Define the terms -
  - i. Order of a reaction
  - ii. Molecularity of a reaction.
22. What happens when phenol is treated with  $H_2$  in presence of nickel?
23. While filling up of electrons in the atomic orbitals, the 4s orbital is filled before the 3d orbital but the reverse happens during the ionization of the atom. Explain why?
24. Give the structure of 2 - chloro - 1 - phenylpropane
25. Mention one property which is caused due to the presence of F-centres in a solid.

### **Section C**

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

OR

Oxygen molecule has the formula  $O_2$  while sulphur is  $S_8$ . (Give reason)

27. Write an equation of the reaction of aniline with benzoyl chloride and write the name of the product obtained.

OR

Why is  $NH_2$  group of aniline acetylated before carrying out nitration?

28. Copper crystallises into a fcc lattice with edge length  $3.61 \times 10^{-8}$  cm. Show that the calculated density is in agreement with its measured value of  $8.92\text{ g cm}^{-3}$ .
29. Differentiate between globular and fibrous proteins.
30. How may the following conversion be carried out:
  - i. Propene to propan-2-ol
  - ii. Anisole to phenol.

### **Section D**

31. Complete and balance:-

- i.  $PbS(s) + 4O_3(g) \rightarrow$
- ii.  $NO(g) + O_3(g) \rightarrow$
- iii.  $4FeS_2(s) + 11O_2(g) \rightarrow$
- iv.  $2NaOH + SO_2 \rightarrow$
- v.  $2Fe^{3+} + SO_2 + 2H_2O \rightarrow$

OR

Give reasons for the following:

- i.  $(CH_3)_3P=O$  exists but  $(CH_3)_3N=N=O$  does not.
  - ii. Oxygen has less electron gain enthalpy with negative sign than sulphur.
  - iii.  $H_3PO_2$  is a stronger reducing agent than  $H_3PO_3$ .
32. i. How would you account for the following?
- a. Aldehydes are more reactive than ketones toward nucleophiles.
  - b. The boiling points of aldehydes and ketones are lower than that of the corresponding acids.
  - c. The aldehydes and ketones undergo a number of addition reactions.
- ii. Give chemical tests to distinguish between
- a. acetaldehyde and benzaldehyde.
  - b. propanone and propanol

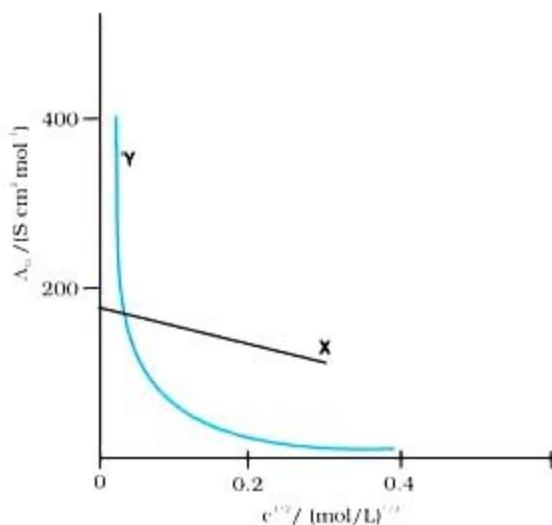
OR

Write structural formulas and names of four possible aldol condensation products from propanal and butanal. In each case, indicate which aldehyde acts as nucleophile and which as electrophile.

33. Write Nernst equation for a Daniel cell?

OR

The following curve is obtained when molar conductivity,  $\Lambda_m$  is plotted against the square root of concentration,  $C^{1/2}$  along y and x-axis respectively for the two electrolytes X and Y.



- i. What can you say about the nature of these two electrolytes?
- ii. How do you account for the increase in  $\Lambda_m$  for the electrolytes X and Y with dilution?
- iii. How can you determine  $\Lambda_m^\infty$  for these electrolytes?

**CBSE Class 12 - Chemistry**  
**Sample Paper 09 (2020-21)**

**Solution**

**Section A**

1. i. (b)  $\text{Fe}^{3+}$   
ii. (b) Zn, Cd, Hg  
iii. (c) Nearly same atomic size  
iv. (d) Variable oxidation state  
v. (d)  $\text{Fe}^{2+}$
2. i. (c) Assertion is correct statement but reason is wrong statement  
ii. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion  
iii. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion  
iv. (d) Assertion is wrong statement but reason is correct statement  
v. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion
3. (b)  $\text{H}_2/\text{Pd}$

**Explanation:**  $-\text{NO}_2$  group is reduced to  $-\text{NH}_2$  using  $\text{H}_2/\text{Pd}$ .

4. (b) All of these

**Explanation:** If adrenal cortex does not function properly then one of the results may be Addison's disease characterised by hypoglycemia, weakness and increased susceptibility to stress.

OR

- (d) Myosin

**Explanation:** Globular proteins are formed when the chains of polypeptides coil around to give a spherical shape. These are usually soluble in water. 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. Myosin (present in muscles), is a fibrous protein and not a globular protein.

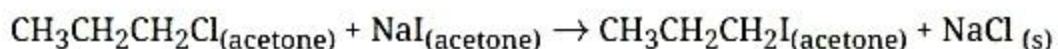
5. (b) Hydrated salts

**Explanation:** Hydrated salts have water molecule of hydration as solute.

6. (a)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl} + \text{NaI} \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{I} + \text{NaCl}$

**Explanation:** Halide exchange reaction is Finkelstein reaction in which alkyl chloride is converted to alkyl iodide.

The classic Finkelstein reaction entails the conversion of an alkyl chloride or an alkyl bromide to an alkyl iodide by treatment with a solution of sodium iodide in dry acetone. Sodium iodide is soluble in acetone and sodium chloride and sodium bromide are not. The reaction is driven toward products according to Le chatelier's principle due to the precipitation of the salt insoluble in acetone. For example, in this case, chloropropane can be converted to iodopropane:



OR

- (a) Polarity

**Explanation:** Since halogen atoms are more electronegative than carbon, the carbon-halogen bond of alkyl halide is polarised; the carbon atom bears a partial positive charge whereas the halogen atom bears a partial negative charge. This is responsible for nucleophilic substitution reactions, elimination reactions, and the reaction of alkyl halides with a metal to form organometallic compounds.

7. (c)  $\text{NH}_2^- > \text{OH}^- > \text{NH}_3 > \text{H}_2\text{O}$

**Explanation:**  $\text{NH}_2^- > \text{OH}^- > \text{NH}_3 > \text{H}_2\text{O}$ . Due to higher electronegativity of O than N atom, the O-H bond is more polar than the N-H bond. Hence, O-H is more acidic in nature than the N-H bond. Now,  $\text{NH}_2^-$  and  $\text{OH}^-$  have a negative charge due to which they are more basic than  $\text{NH}_3$  and  $\text{H}_2\text{O}$ .

OR

- (c) Hoffmann bromamide reaction

**Explanation:** In Hoffmann bromamide degradation reaction, the amine formed has one carbon less than the amide.



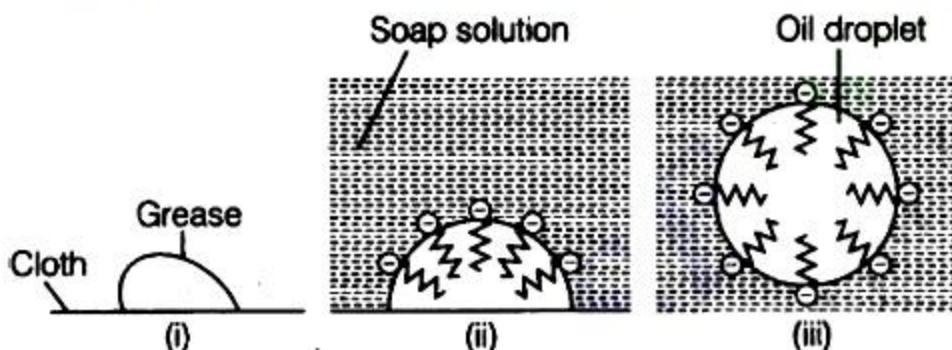
8. (a) Emulsions

**Explanation:** Liquid in liquid sols are emulsions. Examples are milk, hair cream.

OR

(b) Associated colloids

**Explanation:** Micelles are chemical structures formed with both hydrophilic (they'll mix into water) and hydrophobic (they don't mix into water). Also called as Associated colloids. In the general case, micelles are formed when there is an ideal temperature in the medium (called the Kraft temperature) and a certain concentration of electrolytes (called the CMC: Critical Micelle Concentration) in the medium.



- Grease or oil on surface of cloth.
- Stearate ions arranged around the grease or oil droplet.
- Grease or oil droplet surrounded by stearate ions (ionic micelle formed).

9. (c) Adsorption

**Explanation:** In this figure, impurities present in raw sugar indicating yellowish-brown colour get adsorbed by animal charcoal. So this clearly indicates an adsorption process.

10. (b) (ii) < (iii) < (i)

**Explanation:** Due to the presence of an electron releasing group at ortho or para positions, decreases the rate of nucleophilic substitution.

11. (c) Body centred cubic lattice

**Explanation:** A body-centred cubic (bcc) unit cell has an atom at each of its corners and also one atom at its body centre as in CsCl.

12. (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.

13. (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.

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.

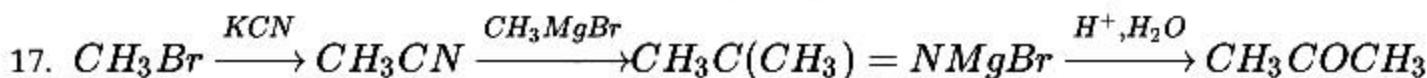
15. (a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

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

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

**Explanation:** Assertion is CORRECT but, reason is INCORRECT.

### Section B



OR

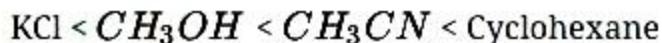


18. n-octane is a non-polar solvent. Therefore, the solubility of a non-polar solute is more than that of a polar solute in the n-octane.

The order of increasing polarity is:



Therefore, the order of increasing solubility is:



19. Adsorption arises due to presence of unbalanced forces or residual attractive forces on the surface of the particles. These forces are responsible for attracting the adsorbate particles on its surface and they cause the adsorption.

OR

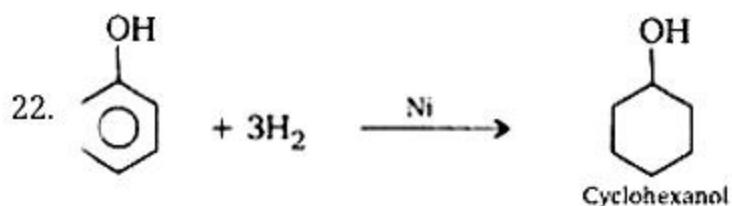
Adsorption is always exothermic. This statement can be explained in two ways:

- i. Adsorption leads to a decrease in the residual forces on the surface of the adsorbent.  
This causes a decrease in the surface energy of the adsorbent. Therefore, adsorption is always exothermic.
  - ii.  $\Delta H$  of adsorption is always negative. When a gas is adsorbed on a solid surface, its movement is restricted leading to a decrease in the entropy of the gas i.e.,  $\Delta S$  is negative. Now for a process to be spontaneous,  $\Delta G$  should be negative. Therefore,  $\Delta G = \Delta H - T\Delta S$ . Since  $\Delta S$  negative,  $\Delta H$  has to be negative to make  $\Delta G$  negative. Hence, adsorption is always exothermic.
20. For the reaction,  $A \rightarrow \text{Product}$
- $\text{Rate} = k[A]^2 \dots \dots \dots (i)$
- Let the concentration of the reactant be  $[A] = a$
- Rate of reaction,  $\text{Rate} = k[A]^2 = ka^2 \implies R = ka^2$
- i. If the concentration of the reactant is doubled, i.e.  $[A] = 2a$ , then the rate of the reaction (i) would be  
 $R' = k(2a)^2 = 4ka^2 = 4R \quad [\because R = ka^2]$   
Therefore, the rate of the reaction would become 4 times the original rate.
  - ii. If the concentration of the reactant is reduced to half, i.e.  $[A] = \frac{1}{2}a$ , then the rate of the reaction would be  
 $R'' = \frac{1}{2}a^2 = \frac{1}{4}Ka^2 = \frac{1}{4}R$   
Therefore, the rate of the reaction would be reduced to  $\frac{1}{4}$ th the original rate of reaction.

21. i. Order of a reaction: the sum of powers of the concentration of the reactants in the rate law expression is called order of that reaction. It can be zero, fraction or integer.  
For example:

$\text{Rate} = k [A]^x [B]^y$ , then order of reaction =  $x+y$

- ii. Molecularity of a reaction: The number of reacting species which must collide simultaneously in order to bring about a chemical reaction is called molecularity of a reaction. It is always an integer.

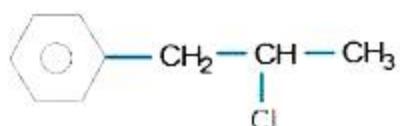


23. According to  $n + 1$  rule: For  $3d = n + 1 = 5$

$$4s = n + 1 = 4$$

Therefore, the electron will enter in  $4s$  orbital first and then in  $3d$  orbitals. Ionization enthalpy is responsible for the ionization of atom. The electrons present in  $4s$  orbital are loosely held by the nucleus. So electrons are removed from  $4s$  orbital prior to  $3d$  orbital.

24. As we can figure out the parent chain contains 3 C as it is a propane. Also at position 2, -Cl is attached and at position 1 -  $C_6H_5$  (phenyl) is attached. So the structure of the compound must be



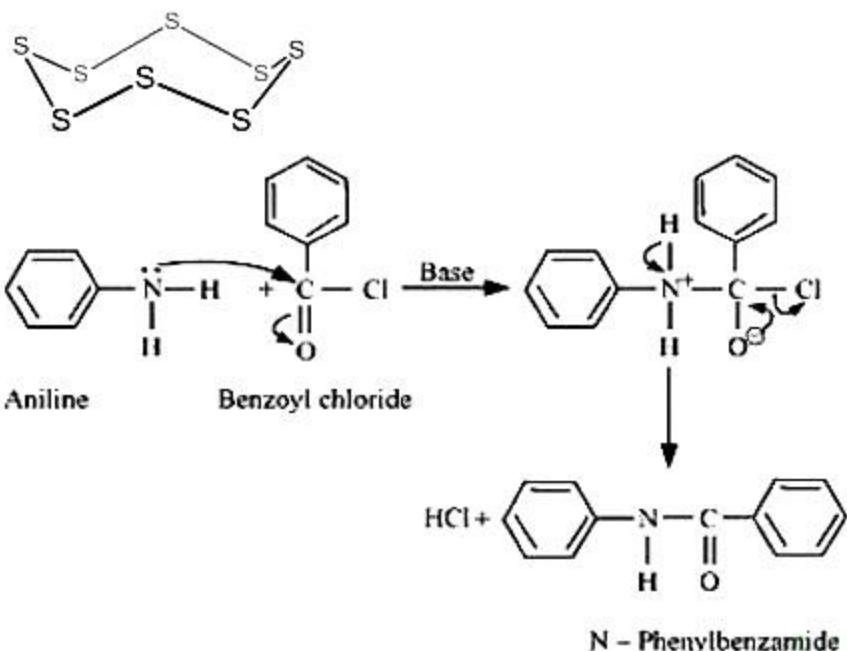
25. F-centre is responsible for the colour and paramagnetic behaviour of the solid.

### Section C

26.  $NH_3$  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.

OR

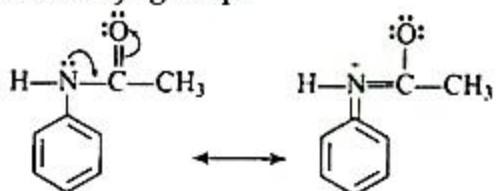
Due to the small size and high electronegativity oxygen forms  $p\pi - p\pi$  multiple bonds. As a result, oxygen exists as diatomic ( $O_2$ ) molecule. Due to its bigger size and lower electronegativity sulphur does not form  $p\pi - p\pi$  multiple bonds. Consequently, sulphur because of its high tendency of catenation and a lower tendency of  $p\pi - p\pi$  multiple bonds forms octa atomic ( $S_8$ ) molecules having an eight-membered puckered ring structure.



N - Phenylbenzamide

OR

Direct nitration of aniline is not possible on account of oxidation of the  $\text{NH}_2$  group to yield tarry oxidation products in addition to nitro derivatives. However, nitration can be carried after protecting the  $-\text{NH}_2$  group by acetylation to give acetanilide which is then nitrated and finally hydrolyzed to give o- and p-nitroanilines. The acetyl group being electron-withdrawing attracts the lone pair of electrons of the N-atom towards the carbonyl group.



As a result, the activating effect  $-\text{NH}_2$  group is reduced i.e., the lone pair of electrons on nitrogen is less available for donation to the benzene ring by resonance. Therefore, the activating effect of  $-\text{NHCOCH}_3$  group is less than that of  $-\text{NH}_2$  group.

28. Edge length,  $a = 3.61 \times 10^{-8} \text{ cm}$

As the lattice is fcc type, the number of atoms per unit cell,  $Z = 4$

Atomic mass,  $M = 63.5 \text{ g mol}^{-1}$

We also know that,  $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

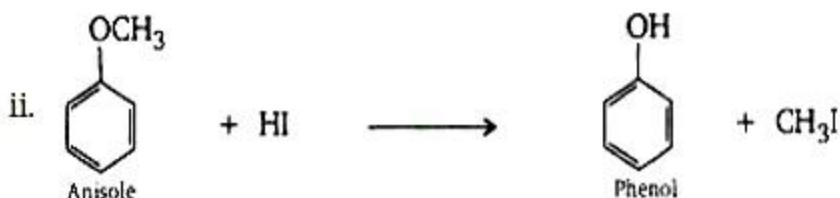
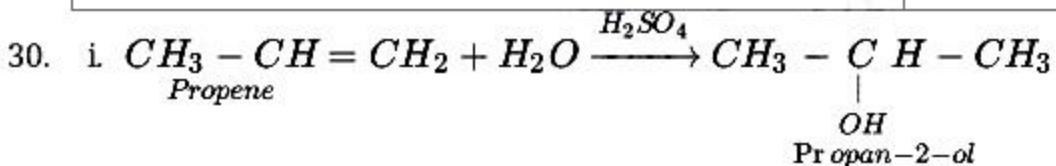
Applying the relation:

$$d = \frac{ZM}{a^3 N_a} = \frac{4 \times 63.5 \text{ g mol}^{-1}}{(3.61 \times 10^{-8} \text{ cm})^3 \times 6.022 \times 10^{23} \text{ mol}^{-1}} = 8.97 \text{ g cm}^{-3}$$

The measured value of density is given as  $8.92 \text{ g cm}^{-3}$ . Hence, the calculated density  $8.97 \text{ g cm}^{-3}$  is in agreement with its measured value.

29.

Fibrous protein	Globular protein
1. It is a fibre-like structure formed by the polypeptide chain. These proteins are held together by strong hydrogen and disulphide bonds.	1. The polypeptide chain in this protein is folded around itself, giving rise to a spherical structure.
2. It is usually insoluble in water.	2. It is usually soluble in water.
3. Fibrous proteins are usually used for structural purposes. For example, keratin is present in nails and hair; collagen in tendons; and myosin in muscles.	3. All enzymes are globular proteins. Some hormones such as insulin are also globular proteins.



### Section D

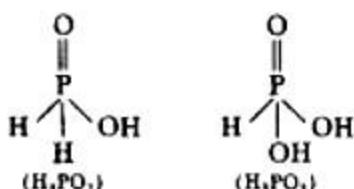
31. i.  $\text{PbS} (\text{s}) + 4\text{O}_3 (\text{g}) \rightarrow \text{PbSO}_4 (\text{s}) + 4\text{O}_2 (\text{g})$   
 ii.  $\text{NO} (\text{g}) + \text{O}_3 (\text{g}) \rightarrow \text{NO}_2 (\text{g}) + \text{O}_2 (\text{g})$   
 iii.  $4\text{FeS}_2 (\text{s}) + 11\text{O}_2 (\text{g}) \rightarrow 2\text{Fe}_2\text{O}_3 (\text{s}) + 8\text{SO}_2 (\text{g})$   
 iv.  $2\text{NaOH} + \text{SO}_2 \rightarrow \text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$   
 v.  $2\text{Fe}^{3+} + \text{SO}_2 + 2\text{H}_2\text{O} \rightarrow 2\text{Fe}^{2+} + \text{SO}_4^{2-} + 4\text{H}^+$

OR

- i. Due to the absence of d-orbitals, N cannot form  $p\pi - d\pi$  multiple bonds. As a result, N cannot expand its covalency more than four, therefore, the compound  $\text{R}_3\text{N}=\text{O}$  does

not exist. On the other hand, due to the presence of d-orbitals in P, it forms  $p\pi - d\pi$  multiple bonds, therefore can expand its covalency beyond 4. As a result, P can form  $R_3P=O$ . In this compound, the covalency of P is 5.

- ii. Because of the compact nature (small size) of oxygen atom, it has less negative electron gain enthalpy than sulphur.
- iii. The structures of  $H_3PO_2$  and  $H_3PO_3$  are as follows:



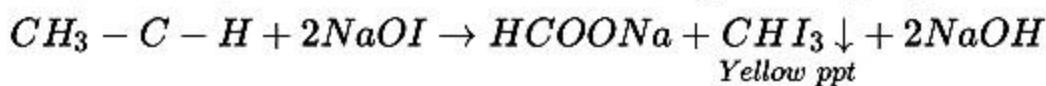
The acids which contain P-H bond, have strong reducing properties.

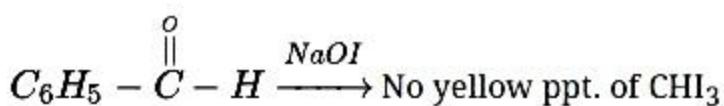
Hypophosphorous acid ( $H_3PO_2$ ) contains two P-H bonds, whereas orthophosphorous acid ( $H_3PO_3$ ) has one P-H bond. Hence,  $H_3PO_2$  is a stronger reducing agent than  $H_3PO_3$ .

32. i. a. Aldehydes are more reactive than ketones toward nucleophiles due to steric and electronic reasons. Sterically, the presence of two relatively large substituents in ketones hinders the approach of nucleophile to carbonyl carbon than in aldehyde having only one such substituent.
- b. This is because of the presence of intermolecular hydrogen bonding in carboxylic acids as they have polar-OH group due to which carboxylic acids exist as associated molecules and hence, high temperature is required to break H-bond, which leads to their high boiling points.
- c. Due to the present of polar carbonyl group  $\left[ \text{C}\overset{\delta+}{\underset{\delta-}{\text{O}}} \leftrightarrow \text{C}^{\delta+}-\text{O}^{\delta-} \right]$  the carbonyl carbon bears partial positive charge, and thus undergo nucleophilic addition reaction.

- ii. a. Due to the presence of  $CH_3 - \overset{\overset{\text{O}}{\parallel}}{C} -$  group in acetaldehyde it undergoes iodoform reaction by giving yellow ppt. with  $\text{NaOH}/I_2$ , while benzaldehyde does not show

this (iodoform) test due to the absence of  $CH_3 - \overset{\overset{\text{O}}{\parallel}}{C} -$  group.

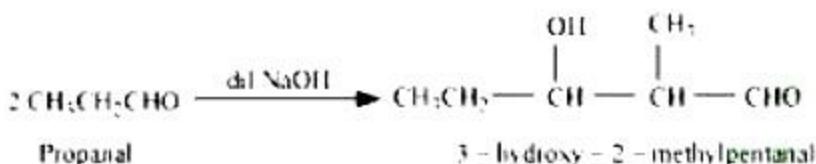




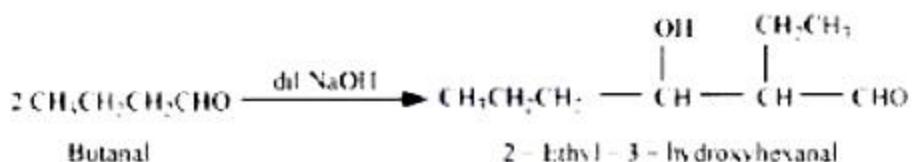
- b. Propanone gives iodoform test with NaOHI/I<sub>2</sub> and gives yellow ppt. of CHI<sub>3</sub> while propanol does not give this test.

OR

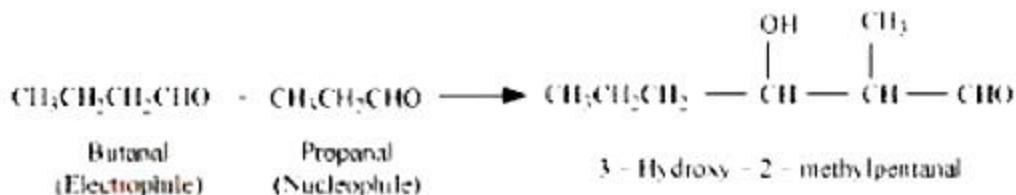
- i. Taking two molecules of propanal  $\text{CH}_3\text{CH}_2\text{CHO}$ , one which acts as a nucleophile and the other as an electrophile.



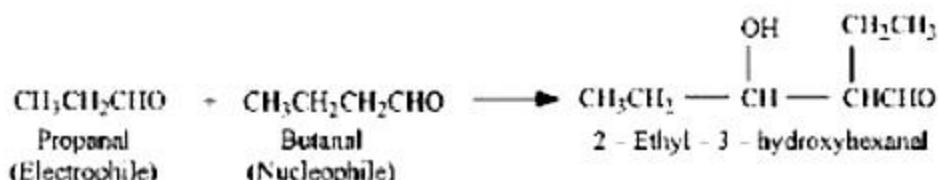
- ii. Taking two molecules of butanal  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ , one which acts as a nucleophile and the other as an electrophile.



- iii. Taking one molecule each of propanal  $\text{CH}_3\text{CH}_2\text{CHO}$  and butanal  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$  in which propanal acts as a nucleophile and butanal acts as an electrophile.



- iv. Taking one molecule each of propanal  $\text{CH}_3\text{CH}_2\text{CHO}$  and butanal  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$  in which propanal acts as an electrophile and butanal act as a nucleophile.



### 33. Nernst Equation for Daniel cell:

In Daniell cell, following redox reaction occurs:



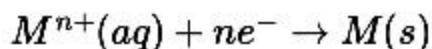
This reaction is a combination of two half reactions whose addition gives the overall cell reaction:

- i.  $Cu^{2+} + 2e^- \rightarrow Cu(s)$  (reduction half reaction)
- ii.  $Zn(s) \rightarrow Zn^{2+} + 2e^-$  (oxidation half reaction)

The cell is represented as:



**Nernst showed that for the electrode reaction:**



the electrode potential at any concentration measured with respect to standard hydrogen electrode can be represented by:

$$E_{(M^{n+}/M)} = E_{(M^{n+}/M)}^\ominus - \frac{RT}{nF} \ln \frac{[M]}{[M^{n+}]}$$

but concentration of solid M is unity, therefore we have

$$E_{(M^{n+}/M)} = E_{(M^{n+}/M)}^\ominus - \frac{RT}{nF} \ln \frac{1}{[M^{n+}]}$$

For Daniell cell, **n=2 moles of electrons**. With this information, we can proceed now.

In Daniell cell, the electrode potential for any given concentration of  $Cu^{2+}$  and  $Zn^{2+}$  ions are given by

**For Cathode:**

$$E_{(Cu^{2+}/Cu)} = E_{(Cu^{2+}/Cu)}^\ominus - \frac{RT}{2F} \ln \frac{1}{[Cu^{2+}(aq)]} \quad (A)$$

**For Anode:**

$$E_{(Zn^{2+}/Zn)} = E_{(Zn^{2+}/Zn)}^\ominus - \frac{RT}{2F} \ln \frac{1}{[Zn^{2+}(aq)]} \quad (B)$$

The cell potential is given by

$$E_{(cell)} = E_{(Cu^{2+}/Cu)} - E_{(Zn^{2+}/Zn)} \quad (C)$$

Using (A), (B) and (C), we get the Nernst Equation for Daniell cell.

$$E_{(cell)} = E_{(cell)}^\ominus - \frac{RT}{2F} \ln \frac{[Zn^{2+}]}{[Cu^{2+}]}$$

OR

- i. Electrolyte X is a strong electrolyte and Y is a weak electrolyte.
- ii. Molar conductivity,  $\Lambda_m$  of X (strong electrolysis) increases slowly with dilution. This is

because interionic forces of attraction decreases on dilution, although the number of ions remain the same. As a result ions move freely and hence  $\Lambda_m$  increases with dilution. On the other hand, for Y (weak electrolyte)  $\Lambda_m$  increases sharply with dilution. This is because degree of dissociation increases on dilution resulting in greater number of ions on dilution. Hence  $\Lambda_m$  increases.

- iii. For X,  $\Lambda_m^\infty$  can be obtained by extrapolation to zero concentration.

**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. copper
  - 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.  $\text{FeCr}_2\text{O}$
  - b.  $\text{FeCr}_2\text{O}_4$
  - c.  $\text{Na}_2\text{CrO}_4$
  - d.  $\text{Na}_2\text{Cr}_2\text{O}_7$
- v. The oxo cations stabilise  $\text{V}^{\text{IV}}$ 
  - a.  $\text{VO}$
  - b.  $\text{VO}^{4+}$
  - c.  $\text{VO}^{2+}$
  - 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:**  $[\text{Mn}(\text{CN})_6]^{3-}$  has a magnetic moment of two unpaired electrons.

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

ii. **Assertion:**  $[\text{CoF}_6]^{3-}$  is outer orbital complex involving  $\text{sp}^3\text{d}^2$  hybridisation.

**Reason:**  $[\text{CoF}_6]^{3-}$  are diamagnetic 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,  $[\text{Co}(\text{NH}_3)_6]^{3+}$  is called an inner orbital complex.

**Reason:** The paramagnetic octahedral complex,  $[\text{CoF}_6]^{3-}$  uses outer orbital (4d) in hybridisation ( $\text{sp}^3\text{d}^2$ ). It is thus called the outer orbital complex.

v. **Assertion:** In the diamagnetic octahedral complex,  $[\text{Co}(\text{NH}_3)_6]^{3+}$ , the cobalt ion is in +3 oxidation state and has the electronic configuration  $3\text{d}^6$ .

**Reason:** The octahedral complex has the hybridisation of  $\text{sp}^3$ .

3. The nitrogen's lone pair in pyrrolidine is best described as occupying what type of orbital?

  - s
  - $sp^2$
  - $sp^3$
  - sp

4. Three cyclic structures of monosaccharides are given below which of these are anomers.

The diagram shows three Haworth projections of monosaccharides:

  - (I)**: A five-membered ring with four carbon atoms. The top carbon has a vertical line pointing up with a CH<sub>2</sub>OH group below it. The right carbon has a horizontal line pointing right with an OH group above it. The bottom carbon has a horizontal line pointing left with an OH group above it. The left carbon has a vertical line pointing down with an OH group above it. The oxygen atom is at the top right, bonded to the right carbon.
  - (II)**: A five-membered ring with four carbon atoms. The top carbon has a horizontal line pointing right with an OH group above it. The right carbon has a vertical line pointing up with a CH<sub>2</sub>OH group below it. The bottom carbon has a horizontal line pointing left with an OH group above it. The left carbon has a vertical line pointing down with an OH group above it. The oxygen atom is at the top right, bonded to the right carbon.
  - (III)**: A six-membered ring with five carbon atoms. The top carbon has a vertical line pointing up with a CH<sub>2</sub>OH group below it. The right carbon has a horizontal line pointing right with an OH group above it. The bottom carbon has a horizontal line pointing left with an OH group above it. The left carbon has a vertical line pointing down with an OH group above it. The bottom-right carbon is bonded to two hydrogens (one vertical, one horizontal) and is connected to the oxygen atom at the top right.

OR

Which of the following bases is not present in DNA?

- a. Adenine  
b. Thymine  
c. Uracil  
d. Guanine

5. The molality of 98%  $\text{H}_2\text{SO}_4$  (density = 1.8 g/mL) by weight is:

a. 4 M  
b. 6 M  
c. 18 M  
d. 10 M

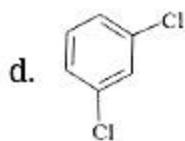
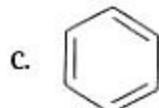
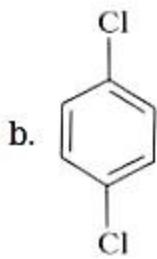
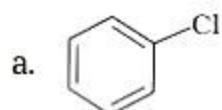
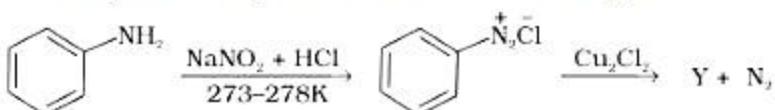
6. Which branched chain isomer of the hydrocarbon with molecular mass 72u gives only one isomer of monosubstituted alkyl halide?

a. Tertiary butyl chloride

- b. Neohexane
- c. Isohexane
- d. Neopentane

OR

Identify the compound Y in the following reaction.



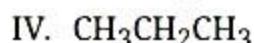
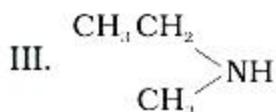
7. Amongst the following, the strongest base in aqueous medium is \_\_\_\_\_.

- a.  $(\text{CH}_3)_2\text{NH}$
- b.  $\text{NCCH}_2\text{NH}_2$
- c.  $\text{CH}_3\text{NH}_2$
- d.  $\text{C}_6\text{H}_5\text{NHCH}_3$

OR

Which of the following should be most volatile?

- I.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$



- a. IV  
b. II  
c. I  
d. III
8. Which of the following is not a favorable condition for physical adsorption?
- Higher critical temperature of adsorbate
  - High pressure
  - High temperature
  - Negative  $\Delta H$

OR

Method by which lyophobic sol can be protected.

- By addition of oppositely charged sol.
  - By addition of lyophilic sol.
  - By addition of an electrolyte.
  - By boiling.
9. The extent of adsorption increases with the
- Decrease in the surface area of the adsorbent
  - Decrease in the pressure of the gas
  - Increase in the surface area of the adsorbent
  - Increase in temperature
10. Which is the correct increasing order of boiling points of the following compounds?  
1-Iodobutane, 1-Bromobutane, 1-Chlorobutane, Butane
- Butane < 1-Iodobutane < 1-Bromobutane < 1-Chlorobutane
  - Butane < 1-Chlorobutane < 1-Iodobutane < 1-Bromobutane
  - Butane < 1-Chlorobutane < 1-Bromobutane < 1-Iodobutane
  - 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  $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$  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  $\text{KNO}_3$ .

**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<sub>2</sub> 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.

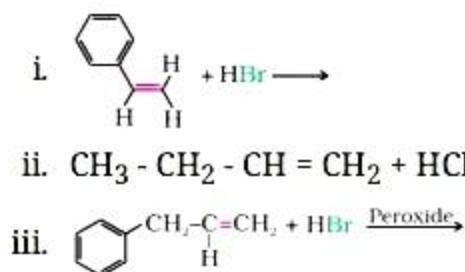
### Section B

17. Write the structure of the major organic product in each of the following reactions:



OR

Write the products of the following reactions:



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

OR

Define the following terms with a suitable example of each:

- Associated colloids
  - 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.  
 $(R = 8.314 \text{ JK}^{-1}\text{mol}^{-1})$
21. Write balanced chemical equations for the following processes:
- $\text{Cl}_2$  is passed through slaked lime.
  - $\text{SO}_2$  gas is passed through an aqueous solution of Fe(III) salt.
22. Name the different reagents needed to perform the following reactions :
- Phenol to benzene.
  - Dehydration of propan-2-ol to propene.
23. State reasons for the following: Unlike  $\text{Cr}^{3+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Fe}^{3+}$  and the subsequent other  $\text{M}^{2+}$  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
- Thionyl chloride acts upon 1 - propanol.
  - Ethanol reacts with  $P\text{Br}_3$

25. Why is glass considered as super cooled liquid?

**Section C**

26. Why are halogens strong oxidising agents?

OR

Explain the following situation:

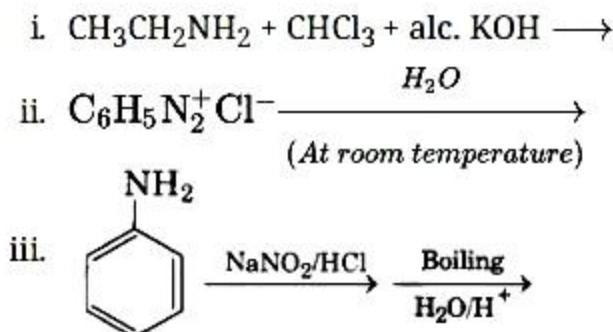
- i. In the structure of  $\text{HNO}_3$  molecule the N - O bond (121 pm) is shorter than N - OH bond (140 pm).
- ii.  $\text{SF}_4$  is easily hydrolysed whereas  $\text{SF}_6$  is not easily hydrolysed.
- iii.  $\text{XeF}_2$  has a straight linear structure and not a bent angular structure.

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:



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 expect when each of the following alcohols

- i. Butan-1-ol
- ii. 2-Methylbutan-2-ol react with
  - a.  $\text{HCl} - \text{ZnCl}_2$
  - b.  $\text{HBr}$  and
  - c.  $\text{SOCl}_2$

## Section D

31. Give reasons:-

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

OR

i. Account for the following:

- Acidic character increases from HF to HI.
- There is large difference between the melting and boiling points of oxygen and sulphur.
- Nitrogen does not form pentahalide.

ii. Draw the structure of the following:

- $ClF_3$
- $XeF_4$

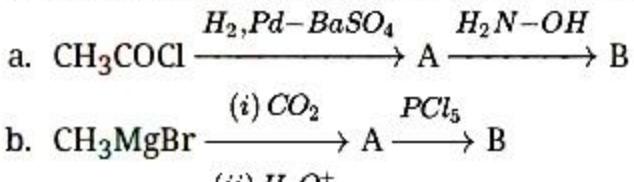
32. i. Illustrate the following name reaction: Cannizzaro's reaction

ii. How would you obtain

- butanoic acid from butanol?
- benzoic acid from ethyl benzene?

OR

i. Write the structures of A and B in the following reactions:



ii. Distinguish between

- $C_6H_5-COCH_3$  and  $C_6H_5-CHO$
- $CH_3-COOH$  and  $HCOOH$

iii. Arrange the following in increasing order of their boiling points:



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.



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

**Given :**  $E^0_{\text{Cr}^{3+}/\text{Cr}} = -0.74 \text{ V}$

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

OR

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

- i.  $\text{Mg(s)}|\text{Mg}^{2+}(0.001 \text{ M})||\text{Cu}^{2+}(0.0001 \text{ M})|\text{Cu(s)}$
- ii.  $\text{Fe(s)}|\text{Fe}^{2+}(0.001 \text{ M})||\text{H}^+(1 \text{ M})|\text{H}_2(\text{g})(1 \text{ bar})|\text{Pt(s)}$
- iii.  $\text{Sn(s)}|\text{Sn}^{2+}(0.050 \text{ M})||\text{H}^+(0.020 \text{ M})|\text{H}_2(\text{g}) (1 \text{ bar})|\text{Pt(s)}$
- iv.  $\text{Pt(s)}|\text{Br}_2(l)|\text{Br}^-(0.010 \text{ M})||\text{H}^+(0.030 \text{ M})|\text{H}_2(\text{g}) (1 \text{ bar})|\text{Pt(s)}$

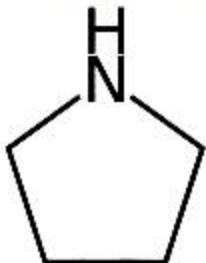
**CBSE Class 12 - Chemistry  
Sample Paper 10 (2020-21)**

**Solution**

**Section A**

1. i. (a) scandium  
ii. (b) decreases  
iii. (a) tetrahedral  
iv. (b)  $\text{FeCr}_2\text{O}_4$   
v. (c)  $\text{VO}^{2+}$
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)  $\text{sp}^3$

**Explanation:** Pyrrolidine is tetrahydropyrrole.



The nitrogen atom in pyrrolidine is  $\text{sp}^3$  hybridized. Two  $\text{sp}^3$  hybridized orbitals are involved in pairing with carbon, one  $\text{sp}^3$  hybridized orbital is involved in pairing with hydrogen and one  $\text{sp}^3$  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 anomers 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.

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

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

= 1 moles.

Also, Density of the solution = 1.8 g/cm<sup>3</sup>.

$\therefore$  Density = Mass/Volume.

$\therefore$  Volume = 100/1.8

= 55.56 cm<sup>3</sup>

= 0.0556 L.

Now, Using the Formula,

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

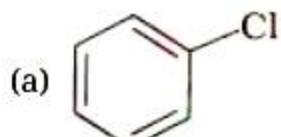
= 1/0.0556

= 17.98 M  $\simeq$  18 M

6. (d) Neopentane

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

OR



**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.

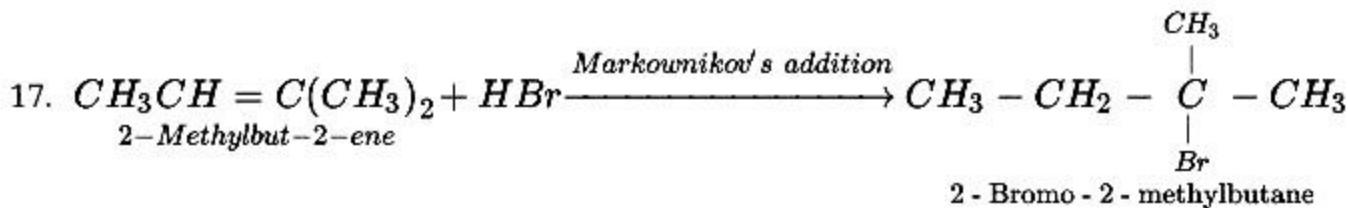
15. (a) Assertion and reason both are correct and the reason is the correct explanation of assertion.

**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.

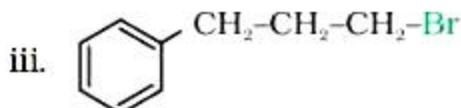
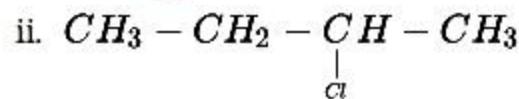
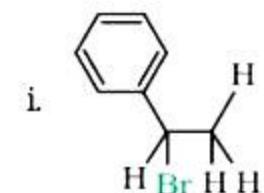
**Explanation:** The  $-NO_2$  group is a meta-directing group by m-nitro chlorobenzene is not a stable compound, and the products of the reactions contain nitro groups at o- and p-positions.

### Section B



OR

Following product is form



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

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<sup>-1</sup> mol<sup>-1</sup>

From Arrhenius equation,

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

Comparing with straight line equation,  $y = mx + c$

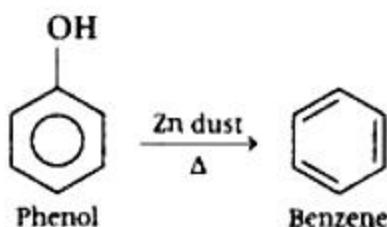
$$-\frac{E_a}{2.303R} = -4250$$

$$\Rightarrow E_a = 2.303 \times 8.314 \times 4250$$

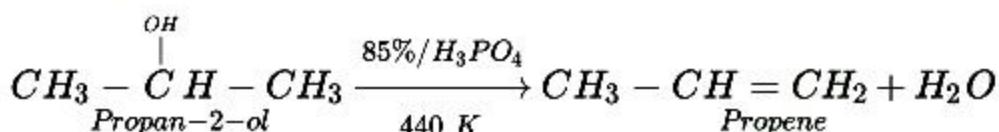
$$= 81.37 \text{ kJmol}^{-1}$$

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

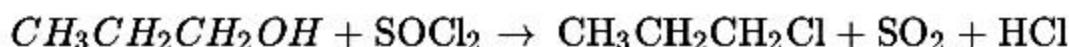


- ii. 85%  $H_3PO_4$ /440 K



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.



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



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 than at the top.

### Section C

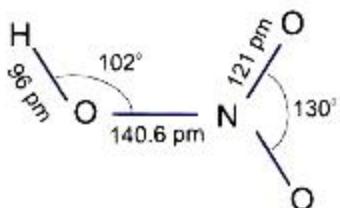
26. The general electronic configuration of halogens is  $np^5$ , where  $n = 2-6$ . Thus, halogens need only one more electron to complete their octet and to attain the stable noble gas configuration. Also, halogens are highly electronegative with low dissociation energies and high negative electron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

The relative oxidising power is;  $F_2 > Cl_2 > Br_2 > I_2$ .

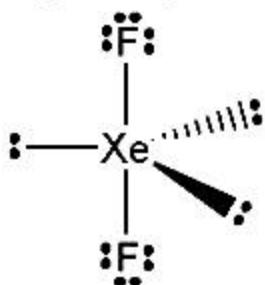
OR

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

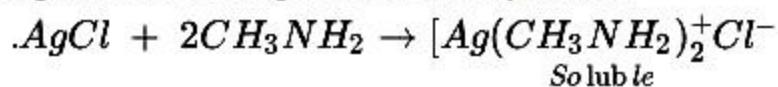
than N - OH bond length.



- 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.



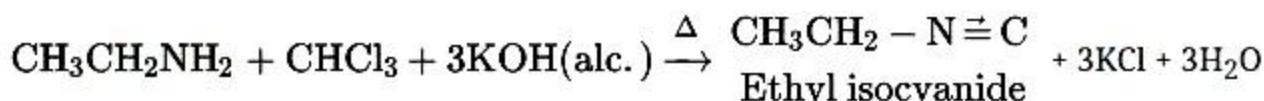
27. i.  $AgCl$  forms a complex with methylamine



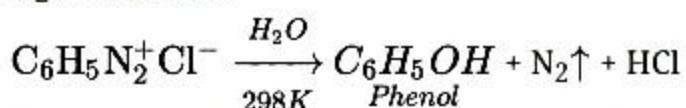
- ii. Tertiary amines do not undergo acylation because they do not have hydrogen attached to nitrogen.
- iii. In aniline,  $-NH_2$  group is electron releasing, therefore, it increases electron density at o- and p-positions. Therefore, it forms 2, 4, 6- tribromoaniline.

OR

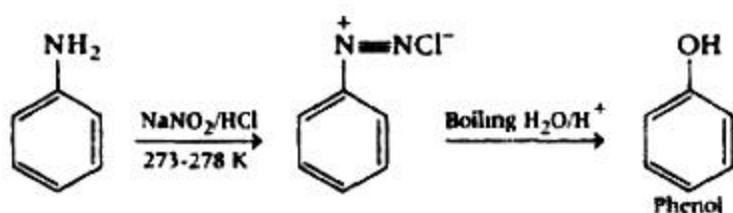
- i. Carbylamine reaction, i.e. conversion of  $-NH_2$  group in  $-NC$  group.



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



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



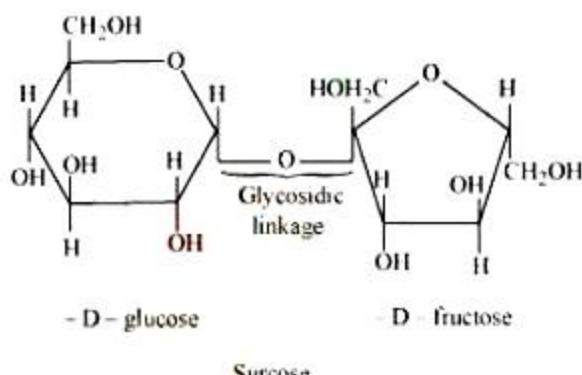
**28. Similarities:**

- 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.
- Both have high melting point.

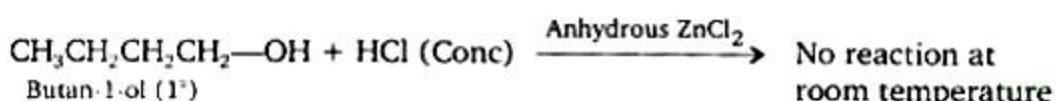
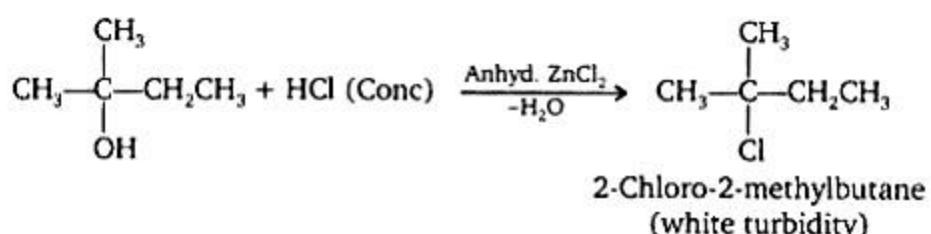
**Differences:**

- 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.
  - 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.
  - 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.

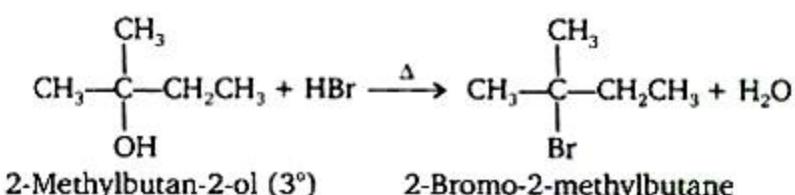
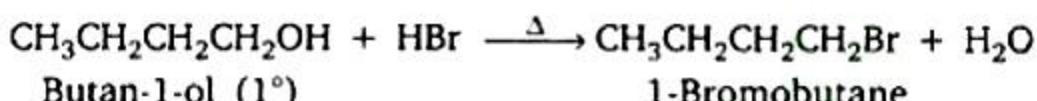
For example, in a sucrose molecule, two monosaccharide units,  $\alpha$ -glucose and  $\beta$ -fructose, are joined together by a glycosidic linkage.



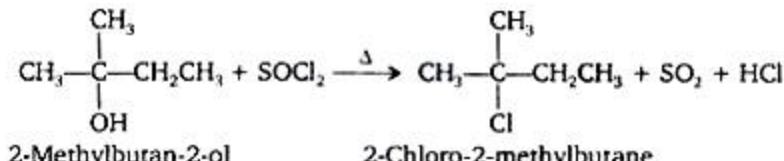
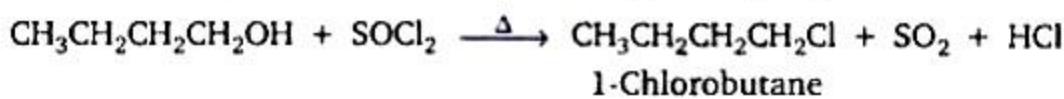
30. i. a. With HCl - ZnCl<sub>2</sub> (Lucas reagent) 2-Methylbutane-2-ol  
 ii. Being a 3° alcohol, reacts with Lucas reagent to produce turbidity immediately due to the formation of insoluble tert-alkyl chloride while butane-1-ol (i) being a 1° alcohol does not react with Lucas reagent at room temperature.



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



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



## Section D

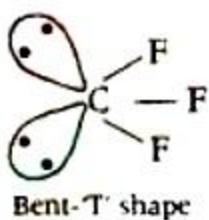
31. i. Oxygen being small in size forms effective and strong  $P\pi - P\pi$  bonds with other oxygen atoms. Therefore oxygen molecule is diatomic and discrete whereas Sulphur due to its larger size, its orbitals cannot overlap effectively to form  $P\pi - P\pi$  bonds & completes valency by forming  $\sigma$  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.  $\text{H}_2\text{O}$  is liquid at room temperature due to the presence of intermolecular Hydrogen bonding which is absent in  $\text{H}_2\text{S}$
- 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

$\text{H}_2\text{O} < \text{H}_2\text{S} < \text{H}_2\text{Te}$ .

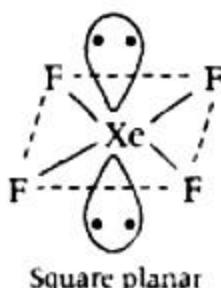
- v.  $\text{SF}_6$  exceptionally stable due to steric reasons. Hydrogen being electropositive or less electronegative than fluorine cannot make the s- electrons of sulphur to participate in bonding. Therefore,  $\text{SH}_6$  does not exist.

OR

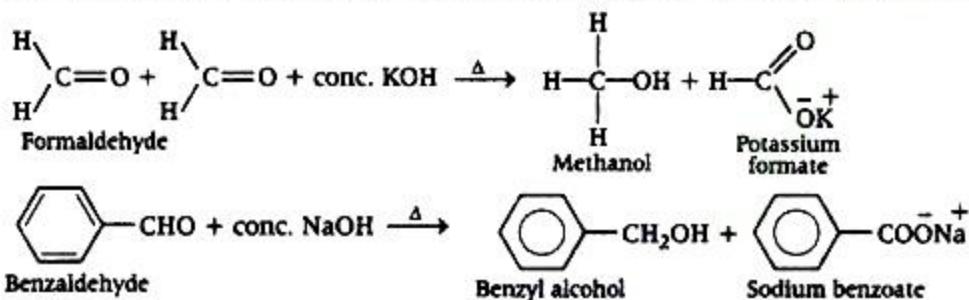
- i. a. The acidic strength of hydrogen halides increases from HF to HI. This is because, down the group, the size of halogen atoms increases and the stability of these halides decreases down the group due to a decrease in bond dissociation enthalpy of H-X bond from HF to HI. The order of acidic strength of halogen acids is given as  $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$ .  
b. Because of small size and high electronegativity oxygen form  $p\pi - p\pi$  multiple bonds exists as a diatomic,  $\text{O}_2$  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,  $\text{S}_8$  molecule. Because of the bigger size of  $\text{S}_8$  molecule than  $\text{O}_2$  molecule, the force of attraction holding the  $\text{S}_8$  molecules together are much stronger than  $\text{O}_2$  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  $\text{ClF}_3$  is T-shaped involving  $\text{sp}^3\text{d}^2$  hybridisation. The structure is given below:



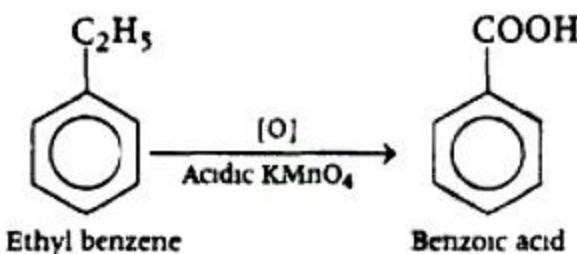
- b. Structure of  $\text{XeF}_4$  is square planar involving  $\text{sp}^3\text{d}^2$  hybridisation. The structure is given below:



32. i. **Cannizzaro's reaction:** Aldehydes which do not have  $\alpha$ -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.

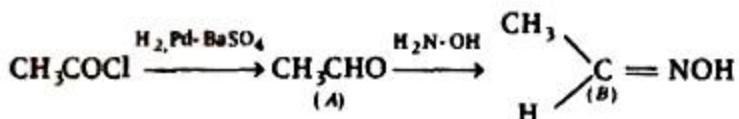


- ii. a.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$   $\xrightarrow[\text{Butanol}]{(i) \text{K}_2\text{Cr}_2\text{O}_7}$   $\xrightarrow[\text{(ii) Dil H}_2\text{SO}_4]{}$   $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$   $\text{Butanoic acid}$
- b.

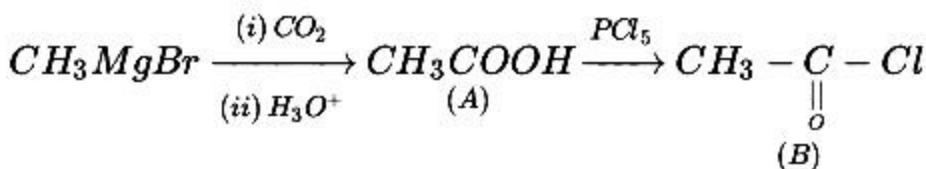


OR

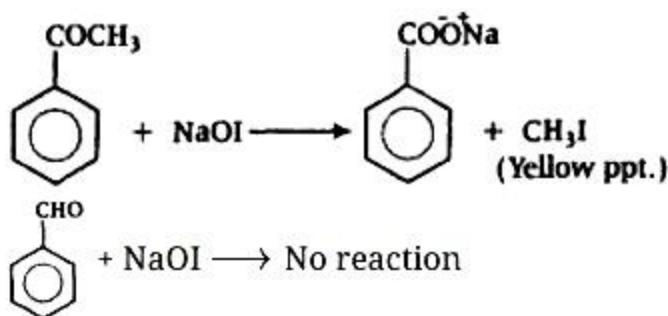
- i. a.



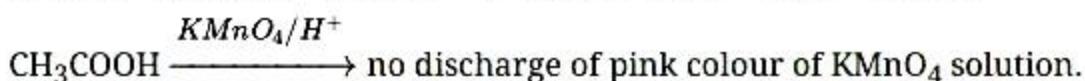
- b.



- ii. a.  $\text{C}_6\text{H}_5\text{COCH}_3$  give positive iodoform test whereas  $\text{C}_6\text{H}_5\text{CHO}$  does not.



- b. HCOOH decolourises pink colour of  $\text{KMnO}_4$  (acidifier) whereas  $\text{CH}_3\text{COOH}$  does not show this test.



- 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:



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

**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.  $\text{Cr(s)} | \text{Cr}^{3+}(1\text{M}) || \text{Cd}^{2+}(1\text{M}) | \text{Cd(s)}$

$$E_{\text{cell}}^0 = E_{\text{Cd}^{2+}/\text{Cd}}^0 - E_{\text{Cr}^{3+}/\text{Cr}}^0$$

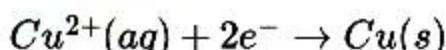
$$= -0.40 \text{ V} - (-0.74 \text{ V})$$

$$= 0.34 \text{ V}$$

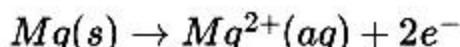
OR

- i. The electrode reactions and cell reactions are

**At Cathode:**



**At Anode:**



Overall reaction is:



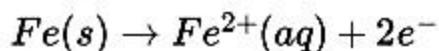
Number of moles of electrons for this reaction is  $n = 2$

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

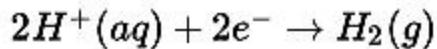
$$\begin{aligned}E_{cell} &= E_{cell}^\Theta - \frac{0.0591}{n} \log \frac{[Mg^{2+}]}{[Cu^{2+}]} \\&= \{0.34 - (-236)\} - \frac{0.0591}{2} \log \frac{0.001}{0.0001} \\&= 2.7 - \frac{0.0591}{2} \log 10 \\&= 2.7 - 0.02955 \\&= 2.6805 \text{ V}\end{aligned}$$

- ii. The electrode reaction and overall cell reactions are:

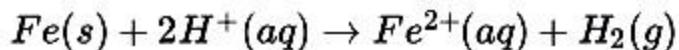
**At Cathode:**



**At Anode:**



Overall reaction of the reaction is:



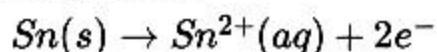
Number of moles of electrons for this reaction is  $n = 2$

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

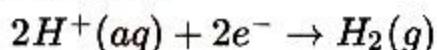
$$\begin{aligned}E_{cell} &= E_{cell}^\Theta - \frac{0.0591}{n} \log \frac{[Fe^{2+}]}{[H^+]^2} \\&= \{0 - (-0.44)\} - \frac{0.0591}{2} \log \frac{0.001}{1^2} \\&= 0.44 - 0.02955(-3) \\&= 0.52865 \text{ V}\end{aligned}$$

- iii. The electrode reactions and overall cell reaction are:

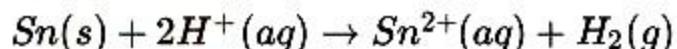
**At Cathode:**



**At Anode:**



Overall reaction is



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

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

$$\begin{aligned}E_{cell} &= E_{cell}^\Theta - \frac{0.0591}{n} \log \frac{[Sn^{2+}]}{[H^+]^2} \\&= \{0 - (-0.14)\} - \frac{0.0591}{2} \log \frac{0.050}{(0.020)^2}\end{aligned}$$

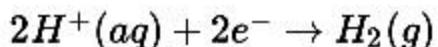
$$= 0.14 - 0.0295 \times \log 125$$

$$= 0.14 - 0.062$$

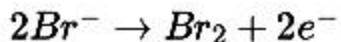
$$= 0.078 \text{ V}$$

iv. The electrode reaction and overall cell reactions are:

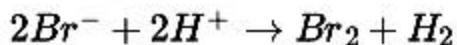
**At Cathode:**



**At Anode:**



Overall reactions is



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

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

$$\begin{aligned}E_{cell} &= E_{cell}^\Theta - \frac{0.0591}{n} \log \frac{1}{[Br^-]^2 [H^+]^2} \\&= (0 - 1.09) - \frac{0.0591}{2} \log \frac{1}{(0.010)^2 (0.030)^2} \\&= -1.09 - 0.02955 \times \log \frac{1}{0.00000009} \\&= -1.09 - 0.02955 \times \log \frac{1}{9 \times 10^{-8}} \\&= -1.09 - 0.02955 \times \log (1.11 \times 10^7) \\&= -1.298 \text{ V}\end{aligned}$$