SAMPLE PAPER-05 (solved)

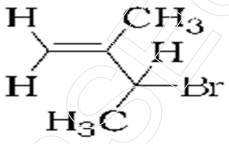
CHEMISTRY (Theory)

Class – XII

Time allowed: 3 hours Maximum Marks: 70

General Instructions:

a) All the questions are compulsory.
b) There are **26** questions in total.
c) Questions **1** to **5** are very short answer type questions and carry **one** mark each.
d) Questions **6** to **10** carry **two** marks each.
e) Questions **11** to **22** carry **three** marks each.
f) Questions **23** is value based question carrying **four** marks.
g) Questions **24** to **26** carry **five** marks each.
h) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions in five marks each. You have to attempt only one of the choices in such questions.
i) Use of calculators is **not** permitted. However, you may use log tables if necessary.

1. Why a Schottky defect is formed when calcium chloride is added to silver chloride crystal?
2. Give the IUPAC name of 

.
3. In Haber's process, it is necessary to remove CO when ammonia is obtained. Give Reason
4. What are point defects? Mention its types.
5. Why the process of adsorption is always exothermic?
6. Give the resonance structures and bond parameters for N_2O_3 and N_2O_4.
7. Give a chemical test to distinguish Ethylamine and diethylamine by giving equations.
8. What is the effect of temperature on the solubility of a solid in a solvent?
9. Give the parameters that characterize a unit cell.

Or

Explain how much portion of an atom located at a) the corner and b) body centre of a cubic unit cell is part of its neighbouring unit cell?

10. Give reasons:
    i. Ortho nitrophenol is more acidic than ortho methoxy phenol.
    ii. Ethers possess a dipole moment even if the alkyl radicals in the molecule are identical.
11. Write a note on the following with an example each:

i. Williamson synthesis of ether.
ii. Kolbe's reaction.

12. Write a note on:
i. Stephen Reaction
ii. Gatterman – Koch Reaction

13. Answer the following:
i.Give an example of an organometallic compound having sandwich structure.
ii. Why metal carbonyls are called organometallics?
iii. Give an example of a metal carbonyl having metal-metal bond.

Or

Explain using crystal field theory, whyhexaaquomanganese (II) ion contains five unpaired electrons, while the hexacyano ion contains only one unpaired electrons?

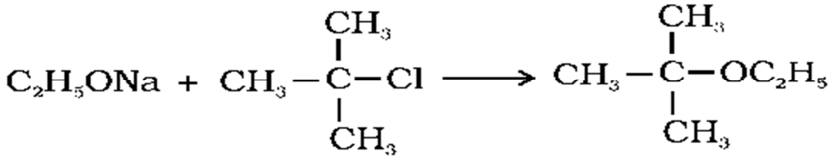
14. Write a short note on Tyndall effect and its cause.
15. Give a short note on:
i. Friedel Crafts Acylation
ii. Clemmensen Reduction Reaction

16. Give reasons:
i. Aldehydes and ketones have lower boiling points than corresponding alcohols and acids.
ii. Hydrazones of acetaldehyde are not prepared in highly acidic medium.
17. Under what conditions VantHoffs factor 'i' is equal to unity and less than one and greater than one?
18. Explain Brownian movement.
19. Give the application of colloids in electrical precipitation of smoke.
20. Give reasons:
i. HI is better reagent than HBr for cleavage of ether.
ii. Highly branched carboxylic acids are less acidic than unbranched acids.
21. Give reason: Phosphorus has more tendency for catenation than nitrogen.
22. Give the reason for the following:
a. Ethyl iodide undergoes $S_N 2$ reaction faster than ethyl bromide
b. $(\pm)$ 2-Butanol is optically inactive.
c. C – X bond length in halobenzene is smaller than C – X bond length in CH_3 – X.
23. Sara went to market to buy fruits and vegetables. The vendor put the fruits and vegetables in the polythene bag but Sara ask the vendor to put the things in the jute bag which he carried with him.
Now answer the following question
a. Why did Sara refuse to use polythene bags?
b. As a student of chemistry why would you advocate the use of jute bags instead of polythene bags? Which values are promoted through the use of jute bag?
c. Suggest two activities to promote these activities
24. Convert the following:

a. Toluene to benzaldehyde.
b. Ethanal to but-2-nal.
c. Propanone to 4-methylpent-3-en-2-one.

Or

The following is not an appropriate reaction for the preparation of tert-butyl ethyl ether.



i. What would be the major product of this reaction?

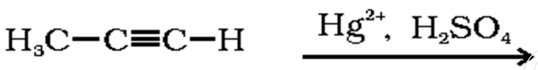
ii. Write a suitable reaction for the preparation of t-butylethyl ether.

25. Give the mechanism of nucleophilic addition reactions.

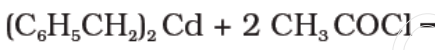
Or

Complete the reactions:

a.

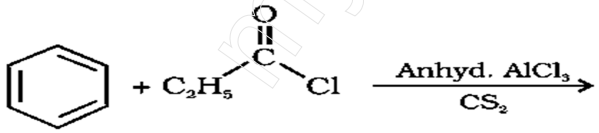


b.



c.

d.



26.

a) Can lanthanum ion exist in +4 oxidation state? Justify.
b) Why europium (II) more stable than cerium (II).
c) Explain the chemistry of all lanthanoids is so identical.

Or

a) Differentiate actinoids and lanthanoids [6 points].
b) Give similarities between actinoids and lanthanoids [4 points]

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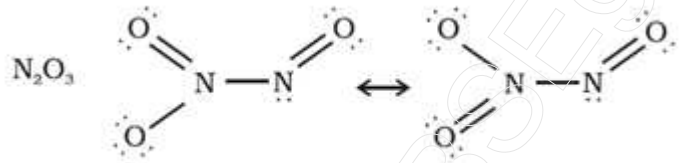
CHEMISTRY (Theory)

Class – XII

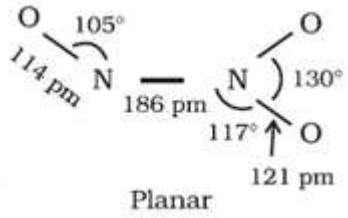
Answer

1. When calcium chloride is added to silver chloride crystal, an impurity defect is formed. The addition of one calcium ion will replace two silver ions to maintain electrical conductivity. One of the positions of silver ion will be occupied by one calcium ion and other will be left as a hole similar to Schottky defect.
2. 3-Bromo-2-methylbut-1-ene.

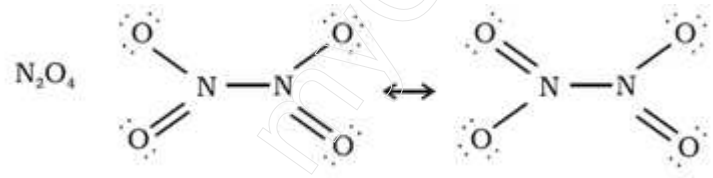
3. Since CO acts as a poison for the catalyst in Haber's process, it lowers the activity of the catalyst and so, CO must be removed when ammonia is obtained.
4. The imperfections in a crystal are caused by a departure from the periodic arrangement in the vicinity of an atom or group of atoms, the imperfections are called point defects. These arise from an error at a single point. Point defects are classified into three types namely, stoichiometric defects, impurity defects and non-stoichiometric defects.
5. This is because there is a force of attraction between adsorbate and adsorbent due to which there is decrease in surface energy which appears as heat.
6.



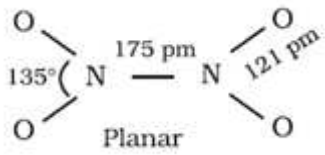
Resonance Structure



Bond Parameters



Resonance Structure



Bond Parameters

7. Carbylamine test – Aliphatic and aromatic primary amines on heating with chloroform and ethanolic potassium hydroxide form isocyanides or carbylamines which are foul smelling substances. Secondary and tertiary amines do not show this reaction. This reaction is known as carbylamines reaction or isocyanide test and is used as a test for primary amines.

$$R - NH_2 + CHCl_3 + 3KOH \xrightarrow{Heat} R - NC + 3KCl + 3H_2O$$

8. The solubility of a solid in a liquid is significantly affected by temperature changes. Consider the equilibrium represented by equation:

$$Solute + Solvent \Leftrightarrow Solution$$

This, being dynamic equilibrium, must follow Le Chateliers Principle. If in a nearly saturated solution, the dissolution process is endothermic (Δsol H > 0), the solubility should increase with rise in temperature and if it is exothermic (Δsol H < 0) the solubility should decrease. These trends are also observed experimentally.

9. A unit cell is characterized by two parameters,
   a) Dimensions along the three edges represented as a, b and c.
   b) Angles between edges α between b and c, β between a and c and γ between a and b. Hence a unit cell is represented by six parameters.

Or

a) 1/8 part of an atom located at the corner belongs to neighbouring unit cell.
b) No part.

10.

i. This is because the nitro group is electron withdrawing group and will increase the positive charge on oxygen to make it more acidic. On the other hand, methoxy group is electron releasing group and will decrease positive charge on oxygen making it less acidic as O – H bond will not break easily.

ii. Ethers have angular structure similar to water, in which oxygen involves sp^3 hybridisation. Oxygen is surrounded by two O – R bonds and two lone pairs. Due to angular structure, ethers have dipole moment even if the two alkyl groups are identical because two C – O moments do not cancel each other.

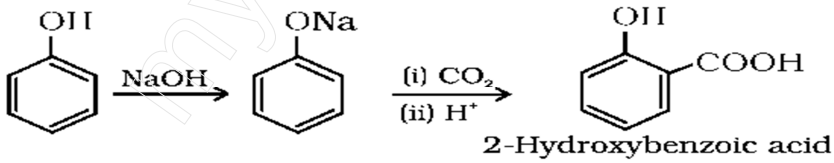
11.

i. This reaction is used to prepare both symmetrical and unsymmetrical ethers by treating alkyl halide with either sodium alkoxide or sodium phenoxide.

CH_3Br + C_2H_5ONa → $CH_3OC_2H_5$ + NaBr

Methylbromide Sod.ethoxide Methoxyethane

ii. Phenoxide ion generated by treating phenol with sodium hydroxide is even more reactive than phenol towards electrophilic aromatic substitution. Hence, it undergoes electrophilic substitution with carbon dioxide, a weak electrophile. Orthohydroxybenzoic acid is formed as the main reaction product.



2-Hydroxybenzoic acid
(Salicylic acid)

12.

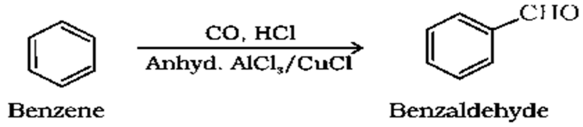
i. Stephen Reaction

Nitriles are reduced to corresponding imine with stannous chloride in the presence of hydrochloric acid, which on hydrolysis give corresponding aldehyde. This reaction is called Stephen reaction.

$$RCN + SnCl_2 + HCl \rightarrow RCH = NH \xrightarrow{H_3O} RCHO$$

ii. Gatterman – Koch Reaction

When benzene or its derivative is treated with carbon monoxide and hydrogen chloride in the presence of anhydrous aluminium chloride or cuprous chloride, it gives benzaldehyde or substituted benzaldehyde. This reaction is known as Gatterman – Koch reaction.



13.

i. Ferrocene.

ii. This is because C atom of CO is linked to the metal atom.

iii. $Mn_2(CO)_{10}$.

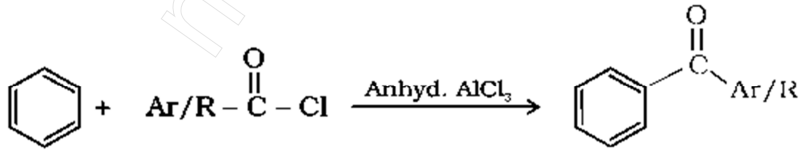
Or

Mn (II) has $3d^5$ electronic configuration. Water is a weak field ligand and therefore Δ_0 is small. So, hexaaqua complex will be high spin complex containing 5 unpaired electrons. On the other hand, CN^- is a strong field ligand and so Δ_0 is large. Therefore, it has only one unpaired electron.

14. If a homogeneous solution placed in dark is observed in the direction of light, it appears clear and, if it is observed from a direction at right angles to the direction of light beam, it appears perfectly dark. Colloidal solutions viewed in the same way may also appear reasonably clear or translucent by the transmitted light but they show a mild to strong opalescence, when viewed at right angles to the passage of light, i.e., the path of the beam is illuminated by a bluish light. This effect was first observed by Faraday and later studied in detail by Tyndall and is termed as Tyndalleffect. The bright cone of the light is called Tyndallcone. The Tyndall effect is due to the fact that colloidal particles scatter light in all directions in space. This scattering of light illuminates the path of beam in the colloidal dispersion.

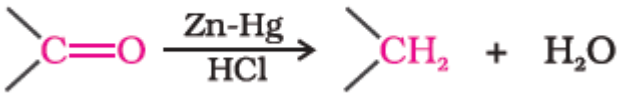
15.

i. When benzene or substituted benzene is treated with acid chloride in the presence of anhydrous aluminium chloride, it affords the corresponding ketone. This reaction is known as Friedel – Crafts Acylation reaction.



ii.

The carbonyl group of aldehydes and ketones is reduced to CH2 group on treatment with zinc amalgam and concentrated hydrochloric acid.



16.

i. Aldehydes and ketones are polar compounds having sufficient intermolecular dipole-dipole interactions between opposite ends of C=O dipoles. However, these dipole-dipole interactions are weaker than the intermolecular hydrogen bonds present in alcohols and carboxylic acids.

ii. The carbonyl group is protonated in weakly acidic medium. Due to the presence of positive charge on carbon, the protonated carbonyl group undergoes nucleophilic attack of hydrazine easily. The hydrazine being basic in nature forms its salt in strongly acidic medium by protonating the unshared pair of electrons on nitrogen atom. This salt cannot act as nucleophile. In order to carry out the reactions, the pH should be between 3 and 4.

17.

i) When the solute does not undergo any dissociation or association in the solution, it is equal to unity.

ii) When the solute undergoes association in the solution, it is less than one.

iii) When the solute undergoes dissociation in the solution, it is greater than one.

18. When colloidal solutions are viewed under a powerful ultra-microscope, the colloidal particles appear to be in a state of continuous zig-zag motion all over the field of view. This motion was first observed by the British botanist, Robert Brown, and is known as Brownian movement. This motion is independent of the nature of the colloid but depends on the size of the particles and viscosity of the solution. Smaller the size and lesser the viscosity, faster is the motion.

19. Smoke is a colloidal solution of solid particles such as carbon, arsenic compounds, dust, etc., in air. The smoke, before it comes out from the chimney, is led through a chamber containing plates having a charge opposite to that carried by smoke particles. The particles on coming in contact with these plates lose their charge and get precipitated. The particles thus settle down on the floor of the chamber. The precipitator is called Cottrell precipitator.

20.

i. HI is a stronger acid than HBr and therefore, oxonium ions are produced. I^- is also a better nucleophile than Br for nucleophilic substitution reaction.

ii. The carboxylate ($RCOO^-$) of branched chain acids is shielded from solvent molecules and therefore cannot be stabilized by solvation as effectively as the carboxylate ion of unbranched acids.

21. Nitrogen has little tendency for catenation because N – N single bond is weak due to the small size and the lone pairs on two nitrogen atom which repel each other. On the other hand, phosphorus is comparatively large in size and so the atoms do not repel each other. Due to this P – P bond is stronger than N – N bond. Thus, phosphorus has tendency for catenation because of high bond enthalpy of P – P bond.

22.

a. Iodide is a better leaving group because of its larger size, than bromide, therefore, ethyl iodide undergoes S_N2 reaction faster than ethyl bromide

b. $(\pm)$ 2-butanol is a racemic mixture. It is a mixture which contains two enantiomers in equal proportion and thus, has zero optical rotation. Therefore it is optically inactive.

c. Due to the delocalization of lone pairs of electrons of the X atom over the benzene ring C – X bond in halobenzene acquires some duble bond character while in CH_3 – X , C – X bond is a pure single bond. Therefore C – X bond in halobenzene is shorter than in CH_3 – X

23.

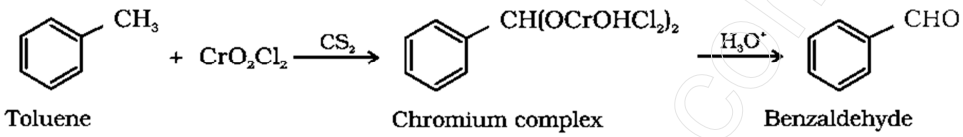
a. Polythene is non-biodegradable hence causes environmental pollutions

b. Jute bag are biodegradable revenue, hence do not cause any environmental pollution.
Promoted Values
Reducing environmental pollution, concern for environmental protection

c. Use paper bags instead of polythene bags. Organizing mass campaigns for spreading awareness.

24.

a.



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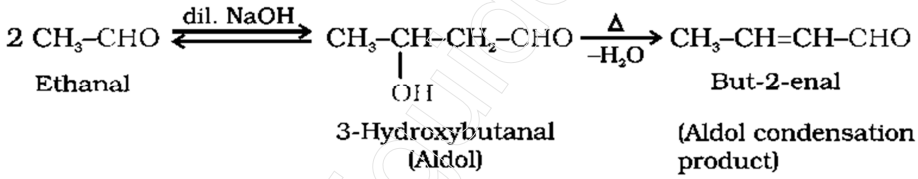

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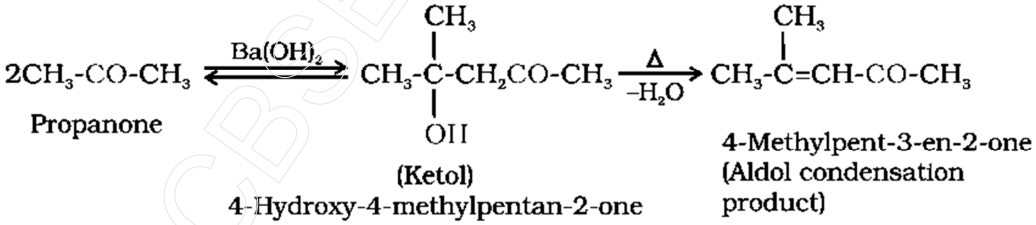
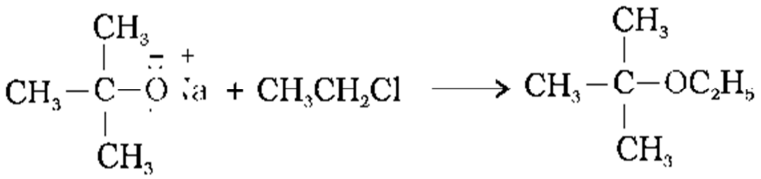


Or

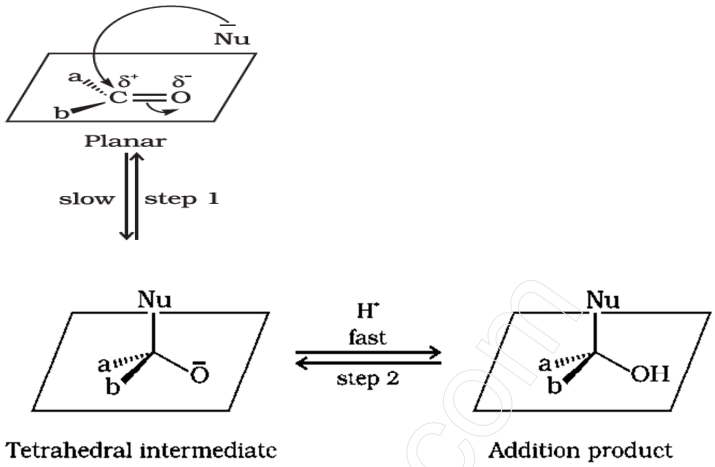
i. The major product of the given reaction is 2-methylprop-1-ene. It is because sodium ethoxide is a strong nucleophile as well as a strong base. Thus elimination reaction predominates over substitution.

ii.



25. A nucleophile attacks the electrophilic carbon atom of the polar carbonyl group from a direction approximately perpendicular to the plane of sp^2 hybridised orbitals of carbonyl carbon. The hybridisation of carbon changes from sp^2 to sp^3 in this process, and a tetrahedral

alkoxide intermediate is produced. This intermediate captures a proton from the reaction medium to give the electrically neutral product. The net result is addition of Nu^- and H^+ across the carbon oxygen double bond.

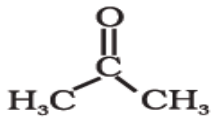


Reactivity

Aldehydes are generally more reactive than ketones in nucleophilic addition reactions due to stearic and electronic reasons. Sterically, the presence of two relatively large substituents in ketones hinders the approach of nucleophile to carbonyl carbon than in aldehydes having only one such substituent. Electronically, aldehydes are more reactive than ketones because two alkyl groups reduce the electrophilicity of the carbonyl more effectively than in former.

Or

a.



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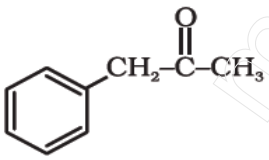

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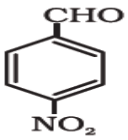

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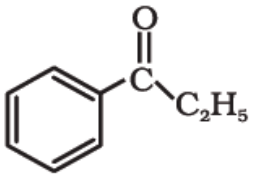

26.

a) Lanthanum forms 3+ by the removal of all the three electrons of outermost shell resulting in noble gas configuration of xenon. To form La^{4+} ion, the electron has to be removed from stable xenon core which is very difficult. Thus, La^{4+} cannot exist.

b) Europium (II) has electronic configuration [Xe] $4f^7$ $5d^{10}$ while cerium (II) has [Xe] $4f^1$ $5d^1$. In Eu (II) ion, the 4f subshell is half-filled and 5d-subshell is empty. Since half-filled and completely filled electronic configurations are more stable. Thus Eu (II) is more stable than Ce (II).

c) All the lanthanoids have similar outer electronic configuration and show +3 oxidation states in their compounds. Therefore, all the lanthanoids have similar chemical properties. The different lanthanoids differ mainly in the number of 4f-electrobs which are buried deep in the atoms and hence do not influence the properties.

Or

a)

S. No	Lanthanoids	Actinoids
1.	Binding energies of 4f are higher.	Binding energies of 5f are lower.
2.	All are non-radioactive except promethium.	All are radio-active.
3.	They do not form oxo ions.	They form oxo ions.
4.	Most of their ions are colourless.	Most of their ions are coloured.
5.	Their magnetic properties can be easily explained.	Their magnetic properties cannot be explained easily.
6.	The tendency to form complexes is lesser	The tendency to form complexes is greater.

b)

i. Both show oxidation state +3 predominantly.
ii. In both the series, f-orbitals are progressively filled.
iii. Both are electropositive and have high reactivity.
iv. The hydroxides, fluorides and carbonates of the elements of both the series are insoluble.