SAMPLE PAPER-05
CHEMISTRY (Theory)
(Questions)
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.

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1. Give the IUPAC name of $(CH_3)_3 – C – COOH$.
2. What is meant by protective colloid?
3. Define coagulation value.
4. Give the role of desorption in the process of catalysis.
5. What is an isoelectric point?
6. Explain the term chromatography.
7. Explain the mechanism of dehydration of ethanol.
8. Classify solids based on their conductivities.

Or

Explain anti-ferromagnetism with neat sketch.

9. Name the reagents used in the following reagents:
   i. Conversion of Benzyl alcohol to benzoic acid.
   ii. Dehydration of propan-2-ol to propene.
   iii. Oxidation of a primary alcohol to carboxylic acid.
   iv. Oxidation of a primary alcohol to aldehyde.
10. Differentiate the solutions having positive deviation from ideal behaviour and the solutions having negative deviation from ideal behaviour.
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

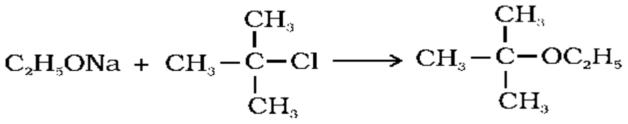
Explain using crystal field theory, whyhexaaquomanganese (II) ion contains five unpaired electrons, while the hexacyano ion contains only one unpaired electrons?

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_N2 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.



$$C_2H_5ONa + CH_3-\underset{CH_3}{\overset{CH_3}{C}}-Cl \longrightarrow CH_3-\underset{CH_3}{\overset{CH_3}{C}}-OC_2H_5$$

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:

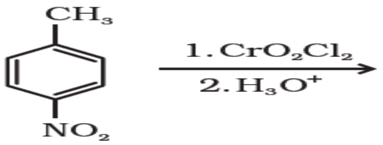
a.

$$H_3C-C\equiv C-H \xrightarrow{Hg^{2+},\ H_2SO_4}$$

b.

$$(C_6H_5CH_2)_2Cd + 2\ CH_3COCl \rightarrow$$

c.



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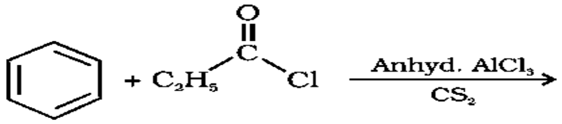

26.
a) Can lanthanum ion exist in +4 oxidation state? Justify.
b) Why europium (II) more stable than cerium (II).
c) Explain the chemistry of all lanthanoids is so identical.

Or

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

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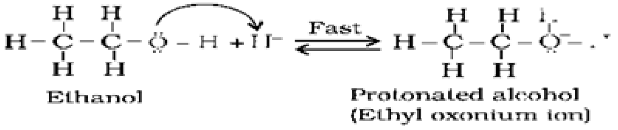
Answer

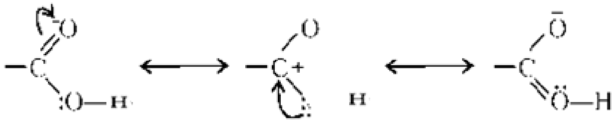
1. Triamethyl acetic acid.
2. When lyophilic sol is added to lyophobic sol to make it stable and prevent its coagulation, it is called protective colloid.
3. It is defined as the minimum number of millimoles of electrolyte required to coagulate 1 litre of colloidal solution.
4. In the process of catalysis, when desorption occurs from the surface of the catalyst, the surface becomes ready to adsorb fresh reactants and act as a catalyst.
5. The pH at which no net migration of amino acid takes place under the influence of an applied electric field is called isoelectric point.
6. It is a technique for the separation and purification based on the differences in adsorbing tendencies of the metal and its impurities on a suitable adsorbent. It is based on the principle that "different components of a mixture are differently adsorbed on an adsorbent".
7. The mechanism of dehydration of ethanol involves the following steps:

   Step 1: Formation of protonated alcohol.

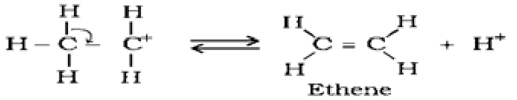
   

   Step 2: Formation of carbocation.

   Since this step is the slowest step, it is the rate determining step of the reaction.

   Step 3: Formation of ethane by elimination of a proton.

8. Based on the conductivity, solids are classified into three types as follows:

   Conductors: The solids with conductivities ranging between 10^4 to 10^7 $ohm^{-1}m^{-1}$ are called conductors. Metals have conductivities in the order of 10^7 $ohm^{-1}m^{-1}$are good conductors.

   Insulators: These are the solids with very low conductivities ranging between 10^{-20} to 10^{-10} $ohm^{-1}m^{-1}$.

   Semiconductors: These are the solids with conductivities in the intermediate range from 10^{-6} to 10^4 $ohm^{-1}m^{-1}$.

   Or

   Substances like MnO showing antiferromagnetism have domain structure similar to ferromagnetic substance, but their domains are oppositely oriented and cancel out each other's magnetic moment.

9.
- (i) Acidified or alkaline potassium permanganate.
- (ii) Concentrated sulphuric acid at 443 K.
- (iii) Acidified potassium permanganate or potassium dichromate.
- (iv) PPC in Cu at 573 K.

10.

Solutions having positive deviation	Solutions having negative deviation
Heating increases solubility.	Heating decreases solubility.
A – B forces are less than A – A and B – B forces.	A – B forces are more than A – A and B – B forces.
Dissolution is endothermic and positive.	Dissolution is exothermic and negative.

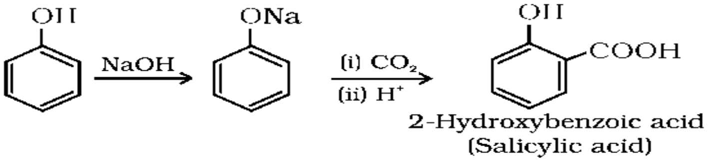
11.

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

$CH_3Br + C_2H_5ONa \rightarrow CH_3OC_2H_5 + NaBr$

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.



12.

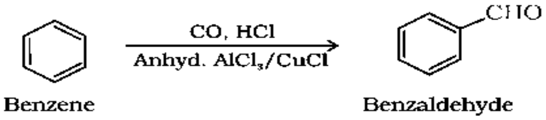
i. Stephen Reaction

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

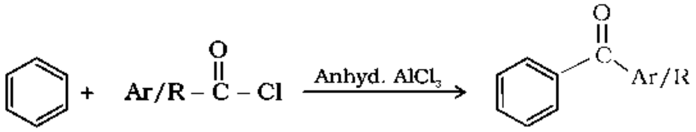
Or

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.

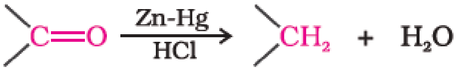
15.

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

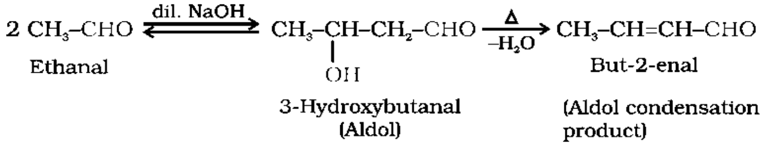
  Reducing environmental pollution, concern for environmental protection

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

24.

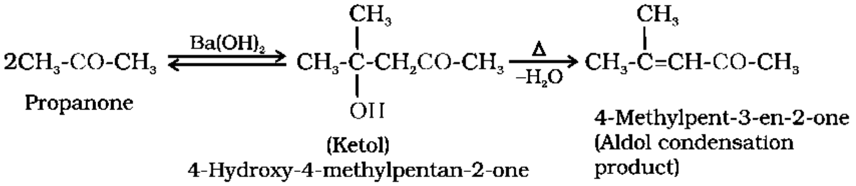
a.

b.



$$2\,CH_3\text{–}CHO \xrightleftharpoons{\text{dil. NaOH}} CH_3\text{–}\underset{\displaystyle OH}{\underset{|}{C}H}\text{–}CH_2\text{–}CHO \xrightarrow[-H_2O]{\Delta} CH_3\text{–}CH{=}CH\text{–}CHO$$

c.

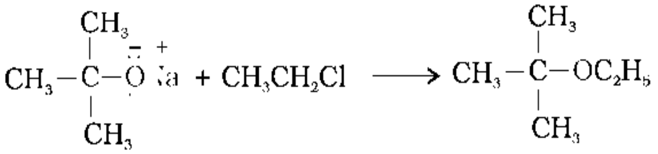


$$2CH_3\text{-}CO\text{-}CH_3 \xrightleftharpoons{Ba(OH)_2} CH_3\text{-}\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle OH}{\underset{|}{C}}}}\text{-}CH_2CO\text{-}CH_3 \xrightarrow[-H_2O]{\Delta} CH_3\text{-}\overset{\displaystyle CH_3}{\overset{|}{C}}{=}CH\text{-}CO\text{-}CH_3$$

Or

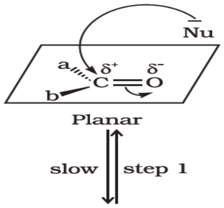
i. The major product of the given reaction is 2-methylprop-1-ene. It is because sodium ethoxide is a strong nucleophile as well as a strong base. Thus elimination reaction predominates over substitution.

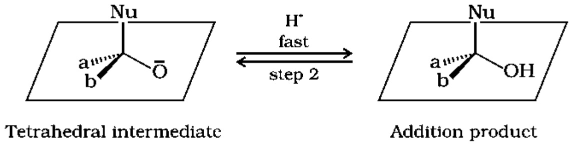
ii.



$$CH_3-\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-\overset{-}{O}\overset{+}{N}a + CH_3CH_2Cl \longrightarrow CH_3-\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-OC_2H_5$$

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.



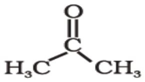


Reactivity

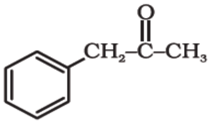
Aldehydes are generally more reactive than ketones in nucleophilic addition reactions due to stearic and electronic reasons. Sterically, the presence of two relatively large substituents in ketones hinders the approach of nucleophile to carbonyl carbon than in aldehydes having only one such substituent.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

Or

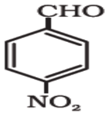
a.



b.



c.



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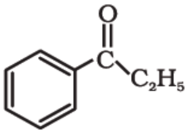

26.

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.