Sample Paper - 02
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.

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1. Give the structure of Propane-1, 2, 3-tricarbaldehyde.
2. Give the IUPAC name of $C_6H_5 - CH_2 - CH_2\,COOH$.
3. Identify all the possible monochloro structural isomers expected to be formed on free radical monochlorination of $(CH_3)_2CHCH_2CH_3$.
4. What is prosthetic group? Give its function.
5. Why the hydrolysis of ester is slow in the beginning and becomes faster after sometimes?
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 orthomethoxy 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. Differentiate different allotropes of sulphur (six points).
18. (a) Define coordination isomerism.
    (b) What is meant by linkage isomerism?
    (c) What is ionisation isomerism?

Or

Give the biological importance of the existing coordination complexes.

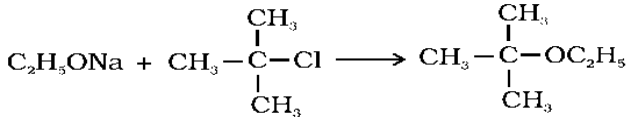
19. (a) Why H_2S is less acidic than H_2Te?
    (b) Ozone is used for purifying air in crowded places such as cinema halls, tunnels, etc.
20. Calculate the rate constant for the following data obtained during the first order thermal decomposition of N_2O_5 (g) at constant volume: $2\ N_2O_5(g) \rightarrow 2\ N_2O_4(g) + O_2(g)$.

S.No	Time/s	Total pressure/ atm
1.	0	0.5
2.	100	0.512

21. Give the prosthetic groups of the following proteins: nucleo proteins, glyco proteins, lipo proteins, phospho proteins and chromo proteins.
22. Define the following term:
    (a) Rate law.
    (b) Order of a reaction.
23. The use of hydroelectricity is increasing day-by-day. Government is trying to reduce its dependency on thermal power plants
    Now answer the following question
    (a) Why Government is trying to reduce its dependency on thermal power plant?
    (b) What values are promoted by the use of hydroelectricity?
    (c) Suggest two methods to promote above values.
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.



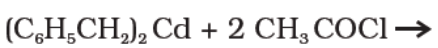
(i) What would be the major product of this reaction?
(ii) Write a suitable reaction for the preparation of t-butylethyl ether.

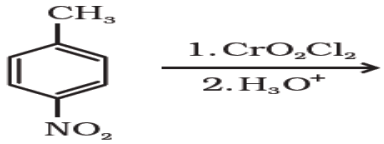
25. Give the mechanism of nucleophilic addition reactions.

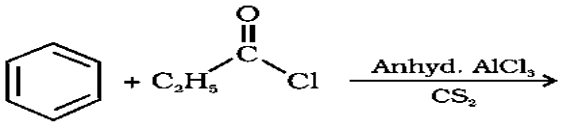
Or

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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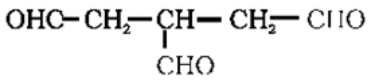
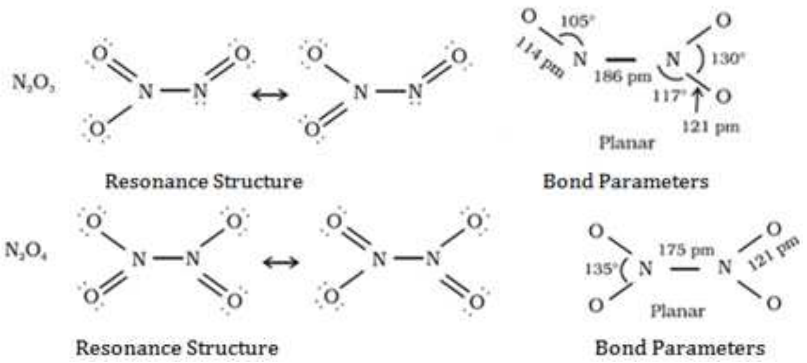
Answers

1. 
2. 3-Phenylpropanoic acid.
3. (i) $(CH_3)_2CHCH_2CH_2Cl$
   (ii) $(CH_3)_2CHCH(Cl)CH_3$
   (iii) $(CH_3)_2C(Cl)CH_2CH_3$
   (iv) $CH_3CH(CH_2Cl)CH_2CH_3$
4. It is a non-protein portion obtained by hydrolysis of conjugated proteins. The main function of the prosthetic group is to control the biological function of proteins.
5. This is due to the process of autocatalysis. In the beginning of the hydrolysis of ester gives an acid which starts as a catalyst later and so, the reaction becomes fast.
6. 

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 nearlysaturatedsolution, the dissolution process is endothermic ($\Delta sol\ H > 0$), the solubility should increase with rise in temperature and if it is exothermic ($\Delta sol\ H < 0$) 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.

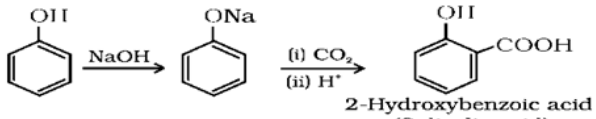
   Or

   (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.

$$\underset{\text{Methylbromide}}{CH_3Br} + \underset{\text{Sod. ethoxide}}{C_2H_5ONa} \rightarrow \underset{\text{Methoxyethane}}{CH_3OC_2H_5} + NaBr$$

    (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.

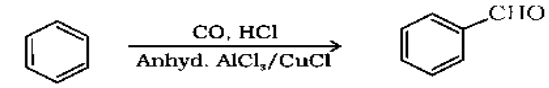


2-Hydroxybenzoic acid
(Salicylic acid)

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.



Benzene Benzaldehyde

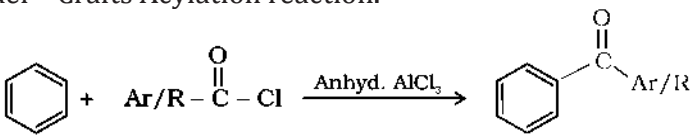
13. (i) Ferrocene.
    (ii) This is because C atom of CO is linked to the metal atom.
    (iii) $Mn_2(CO)_{10}$.

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.

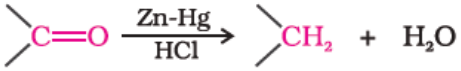
14. If a homogeneous solution placed in dark is observed in the direction of light, it appears clear and, if it is observed from a direction at right angles to the direction of light beam, it appears perfectly dark. Colloidal solutions viewed in the same way may also appear reasonably clear or translucent 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)

(iii) 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.

Rhombic sulphur	Monoclinic sulphur	Plastic sulphur
It is formed by slowly evaporating the solution of roll sulphur in carbon disulphide.	It is formed by melting rhombic sulphur in a dish and cooling till a crust is formed. Two holes are made in the crust and the remaining liquid poured out. On removing the crust, colourless needle shaped crystals are formed.	It is formed by pouring molten sulphur into cold water when a soft rubber like mass is formed.
It is readily soluble in carbon disulphide.	It is soluble in carbon disulphide.	It is insoluble in carbon disulphide.
Its M.P is 385.8 K.	Its M.P is 393 K.	It has no sharp M.P.
It has specific gravity 2.07 g/cm^3.	It has specific gravity 1.98 g/cm^3.	It has specific gravity 1.95 g/cm^3.
It is octahedral crystals.	It is puckered with crown shape.	It is an amorphous form of sulphur.
It exists as S_8 molecules.	It exists as S_8 molecules.	It exists as S_6 molecules.

18. (a) The type of isomerism occurs in compounds containing both cationic and anionic entities and the isomers differ in the distribution of ligands in the coordination entity of cationic and anionic parts.

(b) The compounds which have the same molecular formula but differ in the mode of attachment of a ligand to the metal atom or ion are called linkage isomers.

(c) The compounds which have same molecular formula but gives different ions in solution are called ionisation isomers.

Or

(a) Chlorophyll: The green pigments in plants, central to photosynthesis are a complex compound of magnesium ions.

(b) Haemoglobin: The red pigment of blood which acts as oxygen carrier is a complex compound of ferric ions.

(c) Vitamin B_{12}: It is chemically cyanocobalamine is anti-pernicious anaemia factor, is a complex compound of cobalt ions.

19. (a) In H_2Te, the size of central Te is more than that of S inH_2S and so, the distance between the central atom and hydrogen. The bond between Te – H is more than that of S – H. As a result of large bond length, the bond dissociation enthalpy of Te – H is less than that of S – H and bond cleavage of Te – H bond is easy.

(b) Ozone is an endothermic compound and easily decomposes to produce oxygen and so purifies crowded places.

20. Let the pressure of N_2O_5 (g) decrease by 2*x* atm. As two moles of N_2O_5 decompose to give two moles of N_2O_4 (g) and one mole of O_2 (g), the pressure of N_2O_4 (g)increases by 2*x*atm and that of O_2 (g), increases by x atm.

	$2N_2O_5(g)$	→	$2N_2O_4(g)$	+	$O_2(g)$
Start $t = 0$	0.5 atm		0 atm		0 atm
At time t	(0.5 – 2x) atm		2x atm		x atm

$P_t = P_{N_2O_5} + P_{N_2O_4} + P_{O_2}$

= (0.5 -2x) + 2x + x = 0.5 + x

x = p_t – 0.5

$P_{N_2O_5}$ = 0.5 – 2x = 0.5 – 2(p_t-0.5) = 1.5-2p_t

At t = 100 s; p_t = 0.512 atm

$P_{N_2O_5}$ = 1.5 – 2 x 0.512 = 0.476 atm

Using equation

$$k = \frac{2.303}{t}\log\frac{p_1}{p_A} = \frac{2.303}{100s}\log\frac{0.5\ atm}{0.476\ atm}$$

$$= \frac{2.303}{100s}x\ 0.0216 = 4.98\ x10^{-4}\ s^{-1}$$

21. NucLeo proteins – nucleic acids, glyco proteins –sugars, lipo proteins – lipids, phospho proteins – phosphoric acid residues and chromo proteins – pigment having metals like Cu, Fe etc.

22. (a) It may be defined as the mathematical expression which denotes the rate of a reaction in terms of molar concentrations of reactants with each term raised to some power which may or may not be the same as the stoichiometric coefficient of the reacting species in a balanced chemical equation.

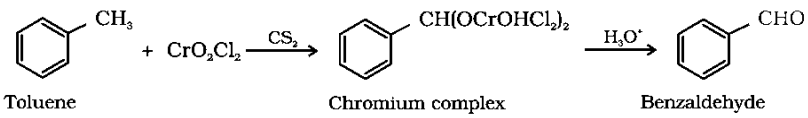
(b) The order of a reaction can be defined as the sum of powers to which the concentration terms are raised in the rate law equation to express the observed rate of the reaction.

23. (a) Thermal power plant causes air pollution. They use coal, which is non-renewable source of energy.

(b) Promoted values – Reducing environmental pollution. Reducing dependency of fossil fuels,

(c) Organizing mass campaigns for spreading awareness. Increase in the use of renewable sources energy such as solar energy etc.,

24. (a)



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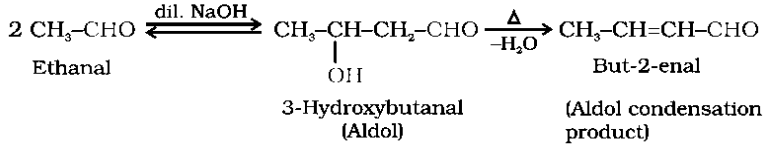
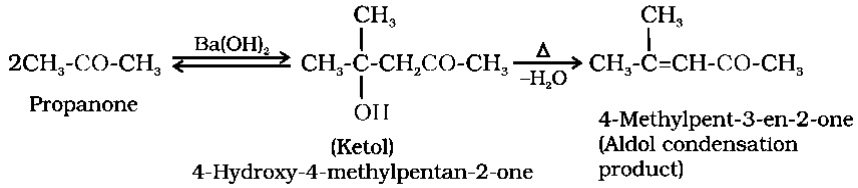


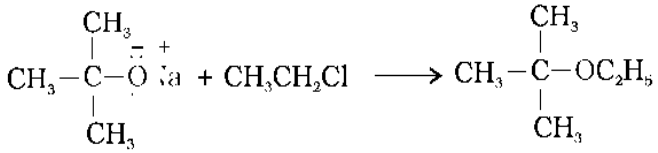
(c)



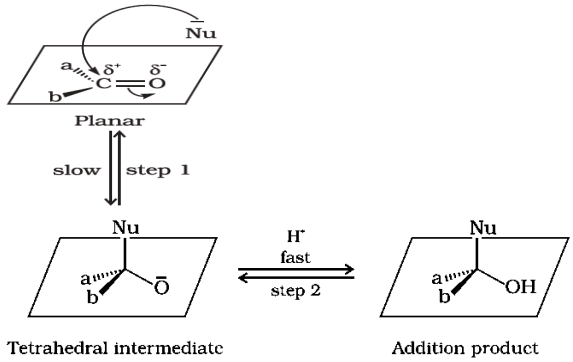
Or

(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)



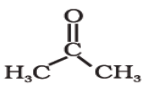
25. A nucleophile attacks the electrophilic carbon atom of the polar carbonyl group from a direction approximately perpendicular to the plane of sp^2hybridised orbitals of carbonyl carbon. The hybridisation of carbon changes from $sp^2$to sp^3in this process, and a tetrahedral alkoxide intermediate is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



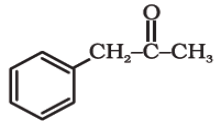
Reactivity: Aldehydes are generally more reactive than ketones in nucleophilic addition reactions due to stearic and electronic reasons. Sterically, the presence of two relatively large substituents in ketones hinders the approach of nucleophile to carbonyl carbon than in aldehydes having only one such 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)



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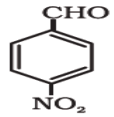

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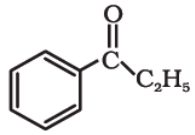

26. (a) Lanthanum forms 3+ by the removal of all the three electrons of outermost shell resulting in noble gas configuration of xenon. To form La^{4+} ion, the electron has to be removed from stable xenon core which is very difficult. Thus, La^{4+} cannot exist.

(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.