Version No.			

ROLL NUMBER						

Answer Sheet No._____

Sign. of Candidate _____

Sign. of Invigilator _____

CHEMISTRY HSSC–II (2nd Set)

SECTION – A (Marks 17)

Time allowed: 25 Minutes

Section – A is compulsory. All parts of this section are to be answered on this page and handed over to the Centre Superintendent. Deleting/overwriting is not allowed. **Do not use lead pencil.**

Q.1 Fill the relevant bubble for each part. Each part carries one mark.

(1) Propose which one of the following reactions is more likely to occur through S_N1 mechanism?

A. $(CH_3)_2CH - Cl \xrightarrow{CCl4/NaOH} CH_2)_2\ CH - OH$ ◯

B. $C_2H_5Cl \xrightarrow{NaOH/H_2O} C_2H_5 - OH$ ◯

C. $(CH_3)_3\ CCl \xrightarrow[NaOH]{H_2O} (CH_3)_3C - OH$ ◯

D. $(CH_3)_3C - Cl \xrightarrow{CCl4/NaOH} (CH_3)_3COH$ ◯

(2) An aldehyde when strongly heated with Fehling's reagent gives red precipitate. What property of an aldehyde is observed in this reaction?

A. Reducing property. ◯ B. Oxidizing property. ◯

C. Neutralizing ability. ◯ D. Redox property. ◯

(3) Predict which one of the following compound is a monomer of an addition polymer.

A. C_2H_3Cl ◯ B. C_2H_6O ◯

C. C_6H_6 ◯ D. CH_2O ◯

(4) Identify which one of the following has the highest boiling point:

A. 1-Butanol ◯ B. 2-Butanol ◯

C. 2-Methyl-2- Propanol ◯ D. 1- Propanol ◯

(5) Identify the product Y in the following scheme:

$C_6H_6 + CH_3Cl \xrightarrow{AlCl_3} X \xrightarrow{KMnO_4 / H_2SO_4} Y$

A. Toluene ◯ B. Xylene ◯

C. Benzoic acid. ◯ D. Acetophenone ◯

(6) Predict the co-ordination number in $[Pt(OH)_2(NH_3)_4]SO_4$.

A. 4 ◯ B. -4 ◯

C. 6 ◯ D. 2 ◯

(7) Identify a mixture of two organic solvents that are used in nail polish remover.

A. Benzene and acetone ◯
B. Benzene and CS_2 ◯
C. Ethyl acetate and CS_2 ◯
D. Acetone and ethyl acetate ◯

(8) RNA contains four different nitrogenous bases **EXCEPT**.

A. Adenine ◯
B. Guanine ◯
C. Thymine ◯
D. Cytosine ◯

(9) When ozone is treated with alkene, aldehyde and ketone are produced, identify which one of the following will produce two moles of butanone.

A. 2 Butene ◯
B. 3,4-Dimethyl-3-hexene. ◯
C. 3-methyl-3-hexene ◯
D. 2 – Hexene. ◯

(10) Cyclopropane is an example of:

A. Acyclic compound ◯
B. Alicyclic compound ◯
C. Heterocyclic compound ◯
D. Aromatic compound ◯

(11) Identify an element with higher ionization energy:

A. Greater metallic character ◯
B. Larger atomic size ◯
C. Strong reducing agent ◯
D. Less electropositive ◯

(12) Quote the wave length range of IR region

A. 0.8-2.5µm ◯
B. 16-1000µm ◯
C. 2.5-16µm ◯
D. 400-800µm ◯

(13) Predict which one of the following metal hydroxide is least soluble in water?

A. $Sr(OH)_2$ ◯
B. $Mg(OH)_2$ ◯
C. $Ba(OH)_2$ ◯
D. $Ca(OH)_2$ ◯

(14) Name which one of the following gas is not pollutant?

A. Sulphur dioxide ◯
B. Carbon monoxide ◯
C. Carbon dioxide ◯
D. Nitrogen dioxide ◯

(15) Predict the color change when a base is added into potassium dichromate solution:

A. Yellow to blue ◯
B. Orange to yellow ◯
C. Yellow to orange ◯
D. Green to yellow ◯

(16) Identify carboxylic acid which is present in Vinegar:

A. citric acid ◯
B. ethanoic acid ◯
C. oxalic acid ◯
D. methanoic acid ◯

(17) Prioritize the highest acidity of carboxylic acid in the following:

A. Propanoic acid ◯
B. Ethanoic acid ◯
C. Chloro-ethanoic acid ◯
D. 2-Methyl Propanoic acid ◯

Solution HSSC-II Model Paper (2nd Set)

SECTION – A

Q 1:Answer Key

1.	C	2.	B	17.	C
3.	A	4.	A		
5.	C	6.	C		
7.	D	8.	C		
9.	B	10.	B		
11.	D	12.	C		
13.	B	14.	C		
15.	B	16.	B		

SECTION – B

i. In group II A, Mg behaves differently against water at different conditions. Prove your answer giving valid chemical equations.

Ans: Magnesium reacts differently with water under different conditions

a. <u>With Cold Water</u>

Mg reacts slowly with cold water with evolution of bubbles of H_2 gas.

$Mg_{(s)} + H_2O_{(l)} \rightarrow Mg(OH)_{2\,(s)} + H_{2\,(g)}$

The reaction stops after some time because $Mg(OH)_2$ produced in the reaction forms a protective layer on the surface of metal ,thus preventing the further reaction.

<u>b. With Steam</u>

The reactivity of Mg increases at high temperature and it burns with steam to produce MgO and H_2 gas.

$Mg_{(s)} + H_2O_{(l)} \rightarrow MgO_{(s)} + H_{2\,(g)}$

ii. How Fajan rule controls the covalent or ionic character of group IV A elements?

Ans: Fajan's rule predicts the nature of compounds formed by an element existing in different oxidation states. It states that '' ***Smaller the cation with high charge density makes the bond more covalent''.***

Explanation

Three elements of Group-IV (Ge , Sn & Pb) exist in two oxidation states; +2 & +4. According to the Fajan's rule , the compounds containing larger M^{+2} cations with low charge density are ionic whereas the compounds containing smaller M^{+4} ions with high charge density are covalent.

Example :

Tin forms two chlorides ; $SnCl_2$& $SnCl_4$

$SnCl_2$ is ionic due to larger Sn^{+2} ion (low charge density)

$SnCl_4$ is covalent due to smaller Sn^{+4} ion (high charge density)

iii. $_{26}Fe^{56}$ and $_{30}Zn^{65}$ both belongs to 3d series of transition elements, but both show different magnetic behavior. Give reason.

Ans: The magnetic properties of an element depends upon its electronic structure. Fe and Zn both are present in first series of transition elements and have different number of electrons in their (n-1) d-orbitals. Valence shell electronic configuration of Fe shows that it is paramagnetic due to the presence of four unpaired electrons in 3d orbitals. It is also paramagnetic in its common +2 and +3 oxidation states & is also Ferromagnetic. Zinc is diamagnetic due to the presence of all the paired electrons in its 3d orbitals in elemental as well as its common +2 oxidation state.

↑↓	↑↓	↑↓	↑↓	↑↓	↑↓

iv. Describe the role of Chloroflouro Carbon (CFCs) in depleting ozone layer.

Ans: ChloroFluoro **Carbons** like Freon-1($CFCl_3$) and Freon-2 (CF_2Cl_2) are chemically inert and do not react with other substances. They are mostly used as refrigerants and as aerosol solvents.In the stratosphere, CFC absorb UV radiations and are broken down into free atomic chlorine (Chlorine free radical). This atomic chlorine decomposes O_3 into O_2 causing depletion of ozone layer according to the following reactions.

$CF_2Cl_2 \rightarrow Cl^{\bullet} + CF_2Cl$

$Cl^{\bullet} + O_3 \rightarrow ClO^{\bullet} + O_2$

$ClO^{\bullet} + O_3 \rightarrow Cl^{\bullet} + 2\,O_2$

v. Why do we arrange compounds in homologous series? Tabulate the first five members of homologous series of alcohol.

Ans: Homologous series is the series of organic compounds with similar functional groups in which the successive members differ by a $-CH_2$ unit**.**

This series enables the chemists to study different organic compounds systematically because:

a. the members of homologous series have same functional group.

b. they have same chemical properties.

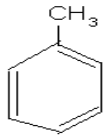
c. they have same general methods of preparation.

d. their physical properties like m.p. , b.p. , density etc increase due to increase in molecular mass.

Homologous Series For Alcohols Gen. Formula : $C_n H_{2n+1} OH$

n	Formula	Name
1	$CH_3 OH$	Methanol
2	$CH_3 CH_2 OH$	Ethanol
3	$CH_3 CH_2 CH_2 OH$	1-Propanol
4	$CH_3 CH_2 CH_2CH_2 OH$	1-Butanol
5	$CH_3 CH_2CH_2 CH_2CH_2 OH$	1-Pentanol

vi. Benzene gives ortho, para and meta substitution products. Identify A and B by completing reactions.

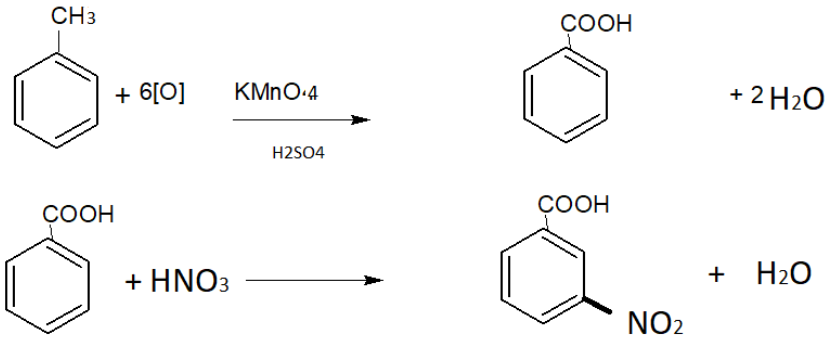


$$+ [O] \xrightarrow{KMnO_4 / H_2SO_4} A + H_2O$$

$$A + HNO_3 \xrightarrow{H_2SO_4 / 30^0C} B + H_2O$$

Ans:

Benzoic Acid (A)



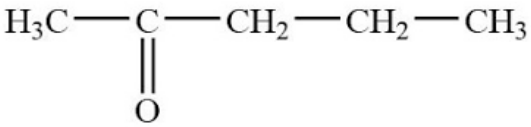
Metanitro benzoic Acid (B)

vii. Grignard's reagent is an organo-metallic compound. How Grignard's reagent is used to prepare 2- methyl pentanoic acid? Give valid chemical reaction.

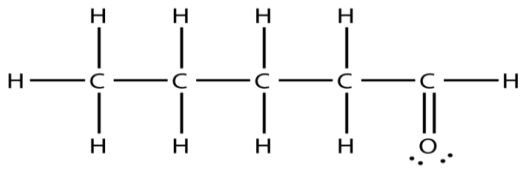
Ans: $CH_3CH_2CH(CH_3)CH_2CHMgBr + O=C=O \xrightarrow{HCl/H_2O} CH_3CH_2CH_2CH(CH_3)COOH$

viii. Show functional group isomers of $C_5 H_{10} O$.

Ans:



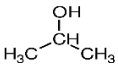
2- Pentanone.



Pentanal

ix. Haloform reaction is used to distinguish the different organic compounds. Distinguish CH_3-CH_2-CH_2-OH and CH_3-CH(OH)-CH_3 by chemical reaction.

Ans:



$+ 4I_2 + NaOH \longrightarrow CHI_3 + 5NaI + 5H_2O + CH_3 - COONa$

HeatYellow ppt.

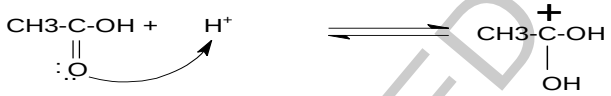
CH_3–-CH_2– CH_2–-OH $+ I_2 + NaOH \longrightarrow$ No reaction (because no methyl group adjacent to OHcarbon)

Heat

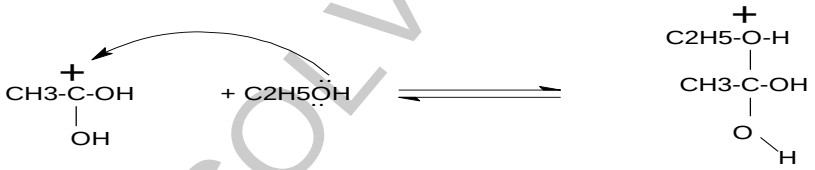
x. Carboxylic acid reacts with alcohol to form organic compound having fruity smell called ester. Show reaction mechanism of esterification.

Ans:

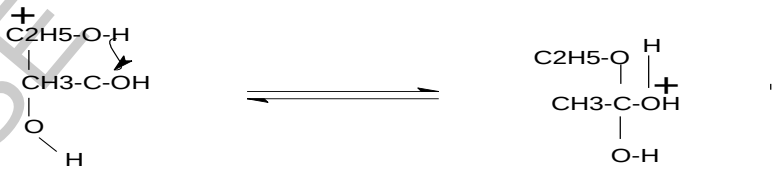
Step 1 Protonation of carboxylic acid.



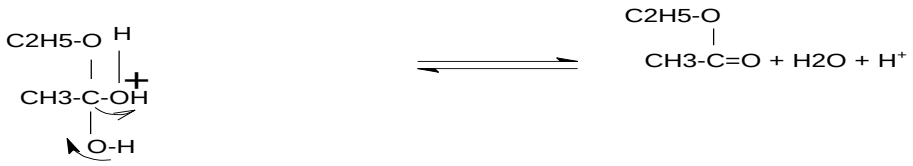
Steo 2 Attack of ethanol.



Step 3 Hhydrogen ion transfer.



Step4 Elimination of water and H^+



xi. Ethanol is used as a fuel. It is a polar compound. Illustrate the manufacturing of ethanol from the aldehyde with the help of chemical reaction with essential conditions.

Ans:

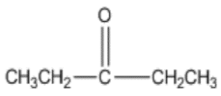
$$CH_3\text{-}CHO + 3[H] \xrightarrow{LiAlH_4} CH_3CH_2OH$$

xii. How will you distinguish between pentanal and 3-pentanone by chemical reactions.

Ans: Heat

$$CH_3\text{—}CH_2\text{—}CH_2\text{—}CH_2\text{—}CHO + Cu(OH)_2 + NaOH \longrightarrow \underset{\text{Red ppt}}{Cu_2O} + CH_3\text{—}CH_2\text{—}CH_2\text{—}CH_2\text{—}COONa + 2H_2O$$

Heat

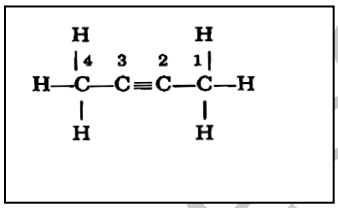


$+Cu(OH)_2 + NaOH \longrightarrow$ No Red ppt

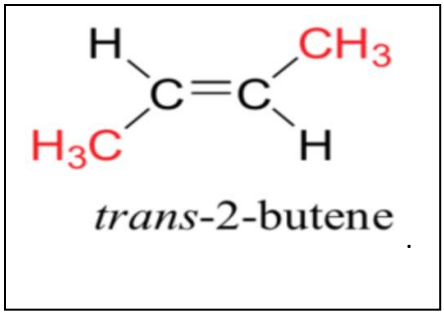
3- pentanone

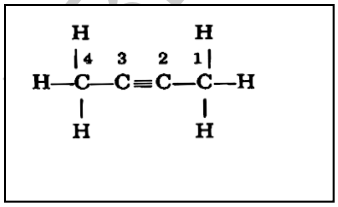
xiii. Partial hydrogenation of 2-Butyne gives two geometrical isomers. Justify the statement with the help of valid chemical equations with conditions

Ans.

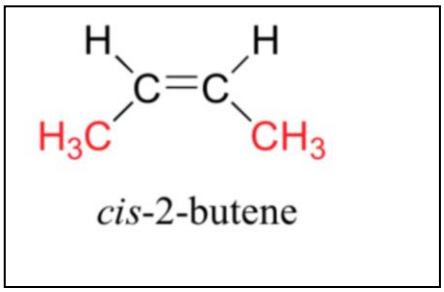


$\xrightarrow{Na/liq\ NH_3\text{-}33C^o}$





$\xrightarrow{Pd/BaSO_4\ quinoline}$



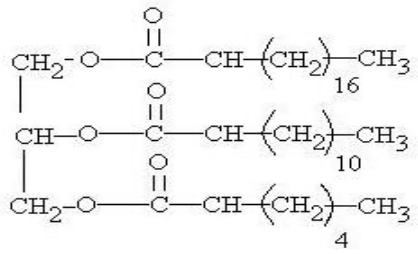
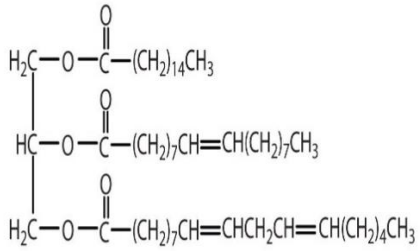
xiv. Name different routes for the loss of mineral zinc from human body.

Ans:

All specific enzymes require zinc for their catalytic function. If zinc is removed from the catalytic site, Activity is lost. Approximately half of the zinc is eliminated from gastrointestinal tract from the body. Considerable amount of zinc is secreted through the biliary and intestinal secretions, but most of it is reabsorbed and this process is important for regulation of zinc balance. Other routes of zinc excretion include the urine and surface losses (hair, sweat).

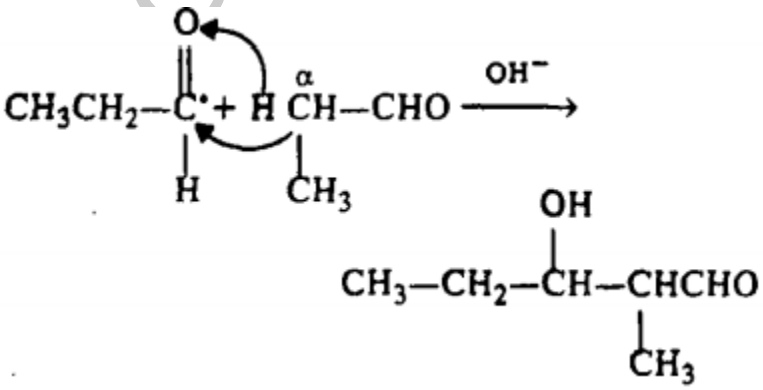
xv. Lipids possess different physical and chemical properties. Differentiate between fats and oils, with the structural formula.

Ans:

Structure of FAT	**Structure of OIL**
	

xvi .Demonstrate the structural product when CH_3-CH_2-CHO reacts with NaOH. Also given the name of the reaction.

Ans.



Name of reaction: Aldol condensation

xvii. The 0.5439g of organic compound consist of C, H and O was subjected to combustion analysis and yield 1.03g CO_2, 0.636g H_2O. Determine its molecular formula when molar mass of organic compound is 138g/mole.

Ans:
Carbon: 1.039 g x (12.011 g / 44.0098 g) = 0.28 g

Hydrogen: 2.70 g x (2.0158 g / 18.0152 g) = 0.0712 g

Amount of O = 0.5439-(0.28+0.0712) = 0.1922

2) Convert grams of C and H to their respective amount of moles.
Carbon: 0.28 g / 12.011 g/mol = 0.0233 mol

Hydrogen: 0.0712 g / 1.0079 g/mol = 0.0697 mol

Oxygen: 0.1922/16 g/mol = 0.012

3) Divide each molar amount by the lowest value, seeking to modify the above molar amounts into small, whole numbers.
Carbon: 0.0233 mol / 0.012 mol = 2

Hydrogen: 0.0697 mol / 0.012 mol = 2.9986 = 6

Oxygen: 0.12 mol /0.12 mol = 1

The molecular formula of the substance is C_2H_6O.

Molecular Formula = n x empirical formula

n= Relative molecular mass/ empirical formula mass

n= 138/ 46

n=3 Molecular Formula = n x empirical formula

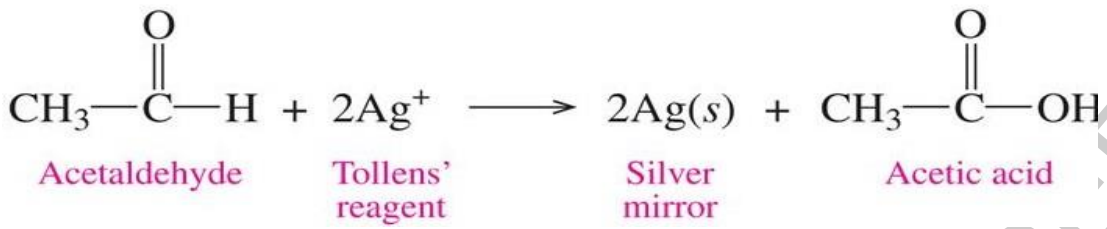
Molecular Formula = 3 x C_2H_6O = $C_6H_{18}O_3$

xviii Two compounds X and Y having carbonyl functional group (C=O) along with four carbons. When X and Y are treated with ammonical silver nitrate solution silver mirror is formed with X while Y does not give silver mirror. Identify X compound by reaction and give IUPAC name of the X and Y compounds.

Ans.

Compound X is Aldehyde (Acetaldehyde) and Y (Acetone) is ketone.

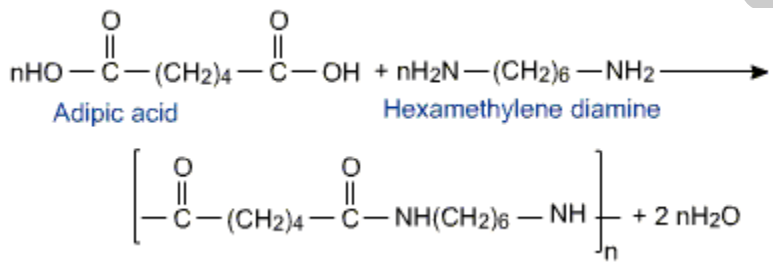
Acetaldehyde gives silver mirror on treatment with Ammonical silver nitrate while Acetone doesn't give this reaction.



xix. Polymers consist of monomers joined by either addition or condensation reactions. Discuss synthetic condensation polymer with reaction.

Ans.

Condensation polymers are formed by combination of monomers with the elimination of condensation molecules. Nylon6,6 is an example of synthetic condensation polymer.



xx. Carboxylic acid can be converted into primary alcohol by following sequence of reactions

$$CH_3CH_2CO_2H \xrightarrow{\text{Step I}} A \xrightarrow{\text{Step 2}} CH_3CH_2CO_2H$$

Predict the reagent for step 1 and 2. Also identify A by its IUPAC name.

Ans. Step 1 is $LiAlH_4$

A is CH_3CH_2COH

Step 2 is $K_2Cr_2O_7 + H_2SO_4$

Section C

Q.3 a. Halogens show different oxidizing trend down the group. How they react with concentrated H_2SO_4? Support your answer by giving suitable chemical reaction. (2+2+2)

Ans: . i. **<u>With Chloride Ions</u>**

The chloride ions will not reduce the concentrated Sulphuric acid.

$$2NaCl + H_2SO_4 \longrightarrow Na_2SO_4 + 2HCl$$

ii. With Bromide Ions

Bromide ions are strong reducing agents and reduce concentrated Sulphuric acid. In this process, the bromide ions are oxidized to bromine.

$$2NaBr + H_2SO_4 \longrightarrow Na_2SO_4 + 2HBr$$
$$2HBr + H_2SO_4 \longrightarrow Br_2 + SO_2 + H_2O$$

The oxidation state of sulphur decreases from +6 in the sulphuric acid to +4 in the SO_2.

iii. With Iodide Ions

Iodide ions are stronger reducing agents than bromide ions.

$$2NaI + 4H_2SO_4 \longrightarrow 4Na_2SO_4 + 8HI$$
$$8HI + H_2SO_4 \longrightarrow 4I_2 + H_2S + 4H_2O$$

Oxidation state of Sulphur decrease from +6 to -2.

b. Transition metals have ability to form complex compounds. Describe the components of complex compounds.

Ans:Components of Complex Compounds

a) **Central metal atom or ion:**
A central metal atom or ion is usually a transition element. It is surrounded by a number of ligands.

b) **Ligand:**

The atom, ion (usually anions) or neutral molecule which surrounds the central metal atom or ion by donating the electron pair is called ligand. e.g. $K_4[Fe(CN)_6]$ and $K_3[Fe(CN)_6]$, CN- is the ligand.

Types of Ligands:

Depending upon number of donatable electron pairs, ligands are of many types:

1) Monodentate Ligands:

Those ligands which have only one donatable electron pair. Such ligands may be negatively charged, or neutral.

Examples:

1) Negatively charged ligands F^-, Cl^-, Br^-, I^-, OH^-, CN^-

2) Neutral ligands H_2O, NH_3, CO

2) Bidentate Ligands:

Those ligands which have two donatable electron pairs are called bidentate ligands.

Examples:

Carbonate ion, Sulphate ion, Oxalate ion, Hydrazine, Ethylene diamine

$$CO_3^{-2}, SO_4^{-2}, (COO)_2^{-2}, NH_2\text{-}NH_2, NH_2\text{-}CH_2\text{-}CH_2\text{-}NH_2$$

3) Tridentate Ligands:

Those ligands which have three donatable electron pairs

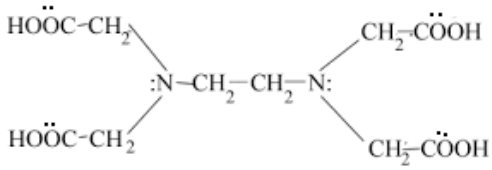
Examples

$$H_2NCH_2 - CH_2 - NH - CH_2 - CH_2 - NH_2$$

Diethylenetriammine

4) Hexadentate Ligands:

Those ligands which have six donatable electron pairs.



structure of EDTA

c) <u>Coordination Sphere</u>

The central neutral metal atom or ion along with ligand is called coordination sphere. It is usually placed in the square brackets. It may be positively charged, negatively charged or neutral. E.g. $K_4[Fe(CN)_6]$, the $[Fe(CN)_6]^{-4}$ is the coordination sphere of this complex compound.

d) <u>Coordination Number</u>

Ligancy or coordination number: It is total number of ligands that can coordinate to central metal atom or ion. It represents total no of chemical bonds formed between central metal atom or ion & donor atoms of ligands

Q.4 a. Consider the reaction

$$(CH_3)_3C\text{-}Cl \xrightarrow{\text{Aqueous/NaOH}} x$$

Demonstrate the reaction mechanism of the reaction. Also explain reaction mechanism. (3+4)

Ans:

i) This type of mechanism involves two steps .

ii) The first step is the reversible ionization of the alkyl halide in the presence of an aqueous acetone or an aqueous ethyl alcohol .This step provides a carbocation as an intermediate.

iii) In the second step this carbocation is attacked by the nucleophile to give the product.

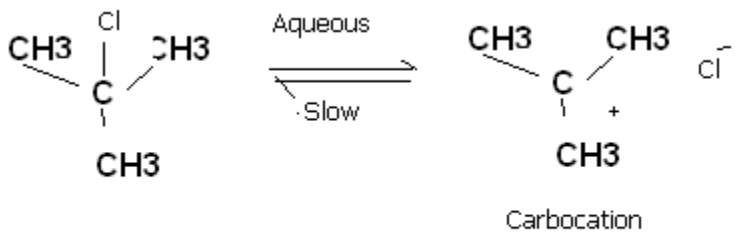
iv) First step involves the breakage of a covalent bond so it is a slow step as compared to the second step which involves the energetically favorable combination of ions.

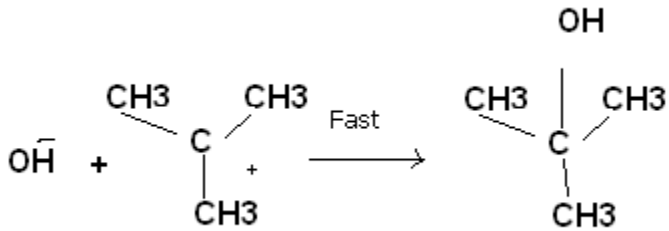
v) Mathematically, the rate can be expressed as.

Rate=k[alkyl halide]

vi) Therefore we, observe 50% inversion of configuration and 50% retention of configuration.

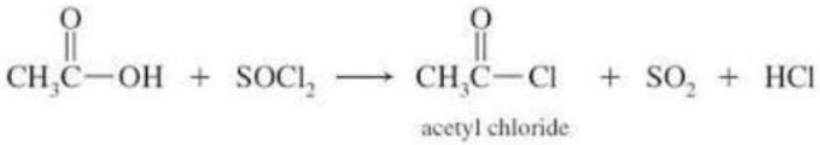
vii) Order of reactivity of alkyl halide is Tertiary alkyl halides ≥ secondary alkyl halides≥ primary alkyl halides

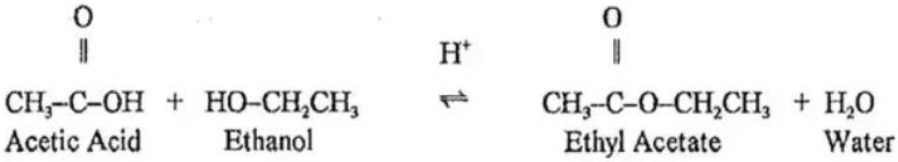


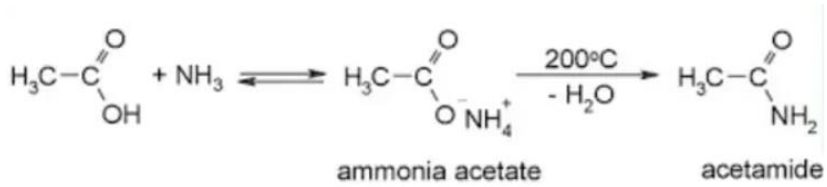


b. Acetic acid is a weak acid. It is present in vinegar. Illustrate the preparation of three derivatives from acetic by chemical reactions. (2+2+2)

Ans:





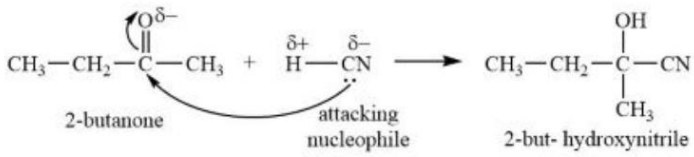


Q.5 a. Identify A and B compounds by completing the chemical reactions. Also write IUPAC names of A and B. (2+2+1.5+1.5)

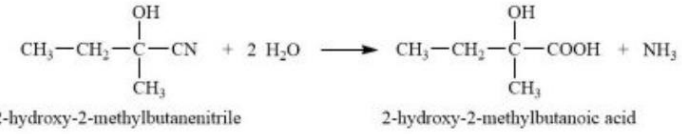
$$CH_3CH_2\overset{\overset{\large O}{\|}}{C}CH_3 + HCN \xrightarrow{NaCN/HCl} A$$

$$A + HCl + H_2O \longrightarrow B + NH_4Cl$$

Ans:



When this 2-hydroxy 2-methylbutanenitrile reacts with water gives carboxylic acid(2-hydroxy 2-Methylbutanoic acid).



2- cyano – 2 – butanol 2- hydroxy- 2- methylbutanoicacid.

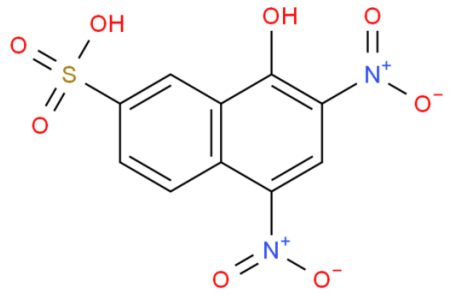
b. Dye is a colored compound capable of being fixed to a fabric. Discuss any three classifications of dyes based on chromophores with examples.(2+2+2)

Ans:

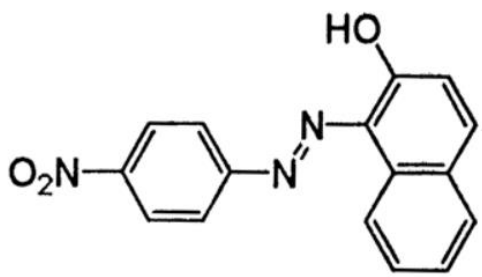
CLASSIFICATION OF DYES BY STRUCTURE:

Dyes may be classified according to the type of chromophores present in their structures. This method of classification includes the following main types:

1. **<u>Nitro and Nitroso Dyes:</u>** The NO_2 and NO groups are chromophores in this class of dyes examples are,

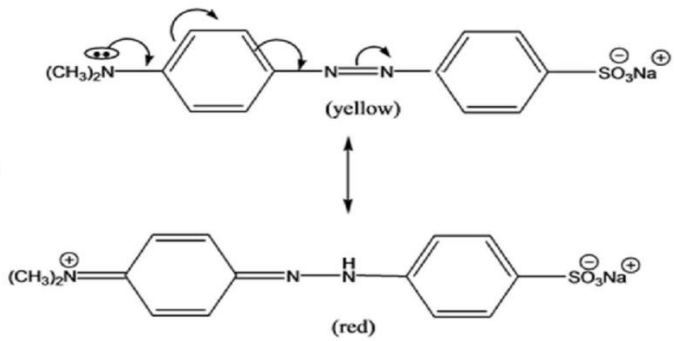


2. **Azo Dyes:** The azo dyes contain one or more azo groups, -N=N- as the primary chromophore. The common auxochromes are NH_2, NR_2, OH, SO_3H, etc.

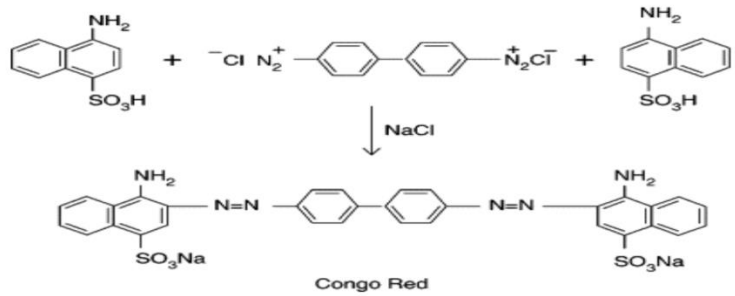


a. **Para Red:** It was the first azo dye to be prepared. Para red is obtained by the reaction of diazotized p-nitroaniline with β-naphthol on fabric itself.

b. **Methyl Orange:** Methyl orange imparts orange color to wool and silk but the color is not fast to sunlight or washing. It is a valuable indicator for acid – base titrations because it gives yellow color in basic solution and red color in acid solution. The change in color is due to the change in the structure of the ions.

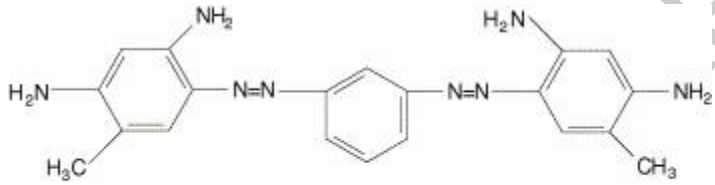


c. **Congo Red:** Congo red contains two azo groups. It is obtained by coupling tetrazotised benzidine with two molecules of naphthionic acid.



Congo Red

d. **<u>Bismarck Brown:</u>** It is obtained by coupling tetrazotised m-diaminobenzene with two molecules of m-diaminobenzene.

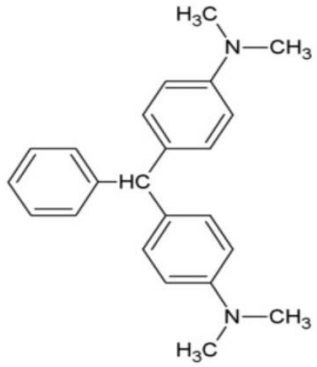


Bismarck brown (2)

3. <u>Triarylmethane Dyes:</u> In triarylmethane dyes, a central carbon is bonded to three aromatic rings one of which is in the quinoid form (the chromophore). The auxochromes are $-NH_2$, $-NR_2$ and $-OH$. Examples are

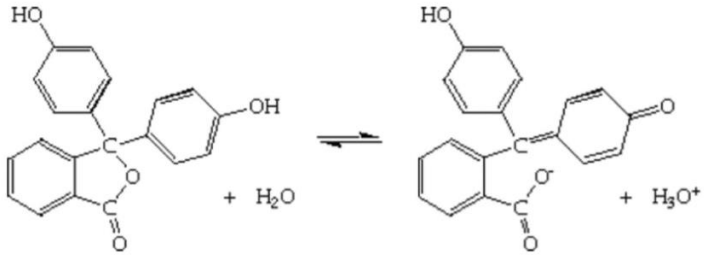
a. <u>Malachite Green:</u>

Malachite green has a deep green-blue color. Although the color fades in light, malachite green is used as a direct dye for wool and silk,



b. <u>Phenolphthalein:</u>

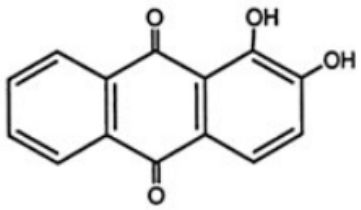
It is also a triarylmethane dye but it is better known as an acid-base indicator.



Colourless (acid) Pink (base)

4. <u>Anthraquinone Dyes:</u>

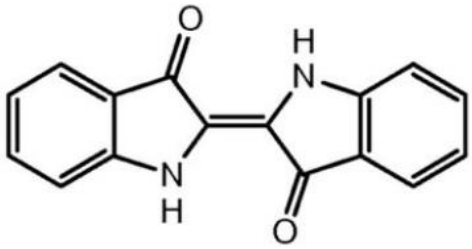
The para quinoid chromophore is present in these anthracene-type dyes. Alizarin is a typical anthtraquinone dye. Alizarin forms ruby red crystals which dissolve in alkali to give purple solutions. It is used to dye wool and cotton.



alizarin

5. <u>Indigo Dyes:</u>

Indigo is an example of the type of dyes which contain carbonyl chromophore. It is a dark-blue crystalline compound, insoluble in water. It is used for dyeing cotton by the Vat process.



Indigo

Note: Any three out of five can be explained by the student.