

Q. 2 Give detailed note on Vitamin A and Vitamin B.

Vitamin A

Retinol

Animals (source) Retinol

Plants (source) - Beta carotene or Provitamins

Importance of vitamin A

- ① visual pigments
- ② Antioxidant
- ③ Cancer Preventing properties
- ④ Formation of blood capillaries
- ⑤ Maintenance of epithelial tissues
- ⑥ Treat Skin Problems, ageing
- ⑦ useful for hair, nail, skin & improve eyesight.

Deficiency of vitamin A

- ① Night blindness
- ② Xerophthalmia
- ③ Skin Problem
- ④ Hair growth

Sources of Vitamin A

① Animal products

→ Fish liver, fish oil, egg, yolk, butter, milk etc.

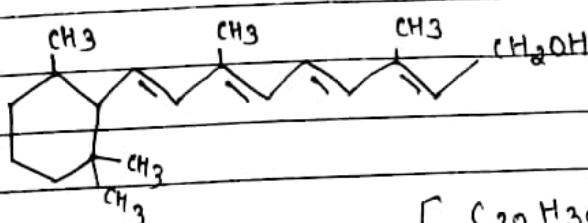
② Plant Products

→ Carrots, Papaya, Tomatoes, Red bell Pepper, Spinach etc.

\Rightarrow Excess of Vitamin A

- 1 Retinol can be poisonous in overdose.
- 2 β carotin is not poisonous in overdose.
- 3 Retinol can not be used for pregnant women in higher dose.
- 4 If person is smoker, cancer can cause by over dosage of retinol & β carotin both

[Vitamin A]



Long chain fatty acid ester
 ↑

Present in this form in animals

β carotene or provitamin A

↓ β -carotenease (enzyme)

↓ mol of Retinaldehyde or Retinol

↓ Reductase

Retinol

↓ oxidation

Retinoic acid



Q 2

H Vit. B₁ (Thiamine / Anneazine)

→ Basic substance that has a thiazol ring & pyrimidine

→ Thiamine Pyrophosphate (TPP) / Thiamine Diphosphate (TDP) is biologically active and storage form of Vit B₁

O Physical Role

→ Thiamine has a central role in energy yielding I change carbs into energy

→ Metabolism: (carbohydrate metabolism)

→ Oxidation, Decarboxylation of keto acids

1. Pyruvate dehydrogenase

2. α keto glutamate dehydrogenase

3. Branched chain α keto acid dehydrogenase

→ Formation + degradation of α ketols by transketolase

→ Fermentation I Non-oxidative decarboxylation

O Sources of vit B₁

Animal: Pork, meat, fish, yogurt, animal organs (liver, kidney)

Plants: green peas, rice, wheat, lentils (dal), beans, enrich, seeds, noodles, sunflower seeds etc.



⇒ Deficiency of Thiamine

→ Thiamine deficiency can cause three different syndromes

- 1 Chaotic peripheral neuritis
- 2 Beriberi
- 3 Acute Beriberi / Shoshin Beriberi
 - cardiac failure, edema, metabolic abnormalities without Peripheral neuritis (wet beriberi)
- 4 Dry Beriberi
- 5 Infantile beriberi

○ Diagnosis

Best diagnosed by observing an increase in RBC transketolase activity in RBC taken on addition of thiamine Pyrophosphate (TPP)

○ Role of Thiamine (vit B₁)

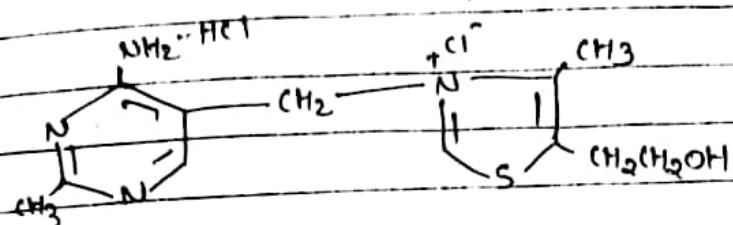
→ It is a co-factor for carbohydrates metabolism (Krebs cycle). This role enable conversion of blood sugar (glucose) into biological energy.

→ This is important for:

- provide energy to the brain
- Improve transmission of nerve impulse through the nerves by providing them with energy.

- Pooped function of heart muscles.
 - Maintenance of smooth + skeletal muscles
 - formation of RBC's

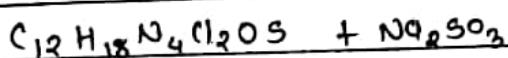
Q. Structure of vit B₁ (Thiamine)



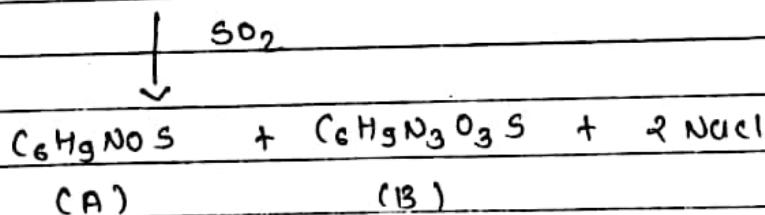
Vit B₁
(Thiamine chloride hydrochloride)

Mole formula : $C_{12}H_{18}N_4Cl_2OS$

- On treatment with a solution of sodium sulphite saturated with SO_2 at room temperature it is cleaved into two compounds A + B



vir B.



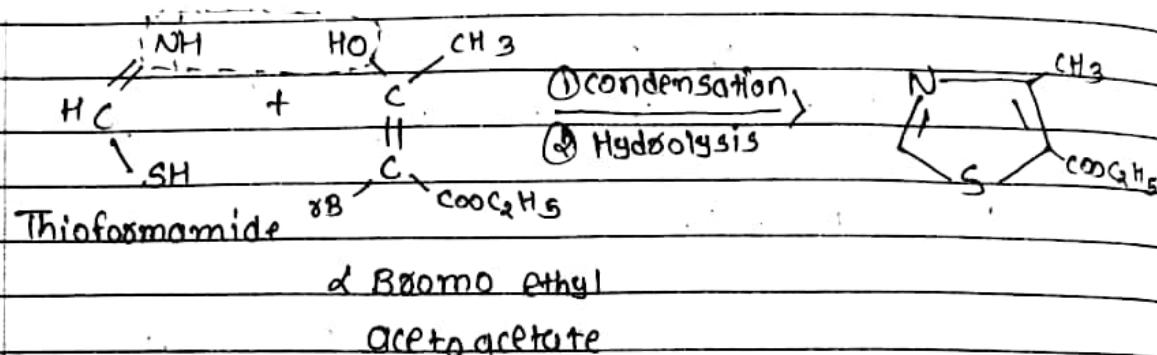
- The structure of vit B₁ was deduced by studying the structure of these two (A+B) products.

- constitution of comp A

① M.F is $C_6H_9NO_5$

2 comp A is basic but does not react with nitrous acid indicating that the nitrogen atom is in tertiary form.

→ Oxidation of comp. A with HNO_3 gives an acid ($C_5\text{H}_5\text{NO}_2\text{S}$) which was identified as 4 methylthiazole 5 carboxylic acid II the structure of this has been proved by synthesis.

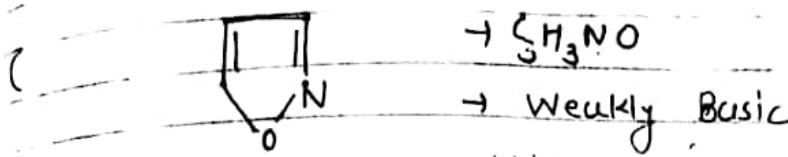


Q. 4 Synthesis & Reaction

ISOXAZOLE

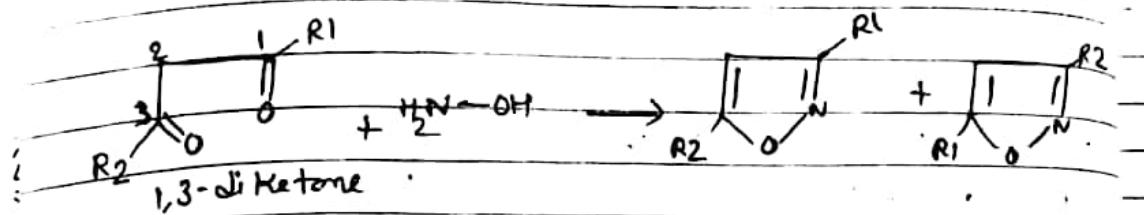
(Q. 30)

7

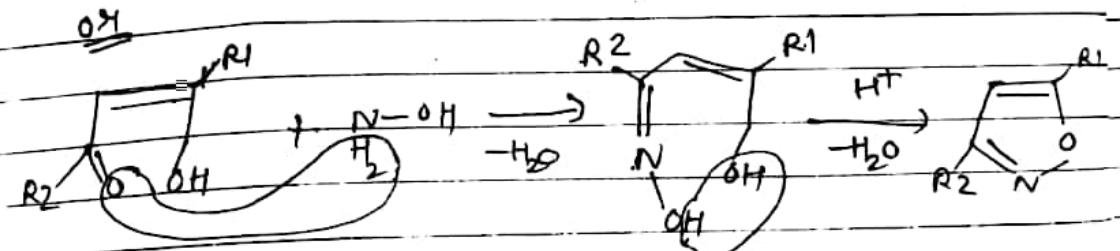
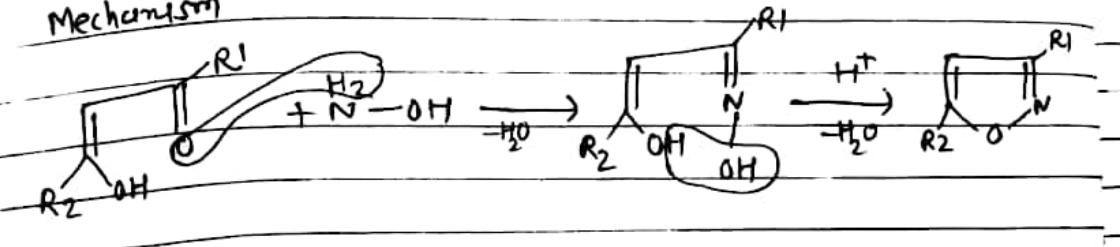


SYNTHESIS

(1) Clusien Synthesis :-
(3+2) method)

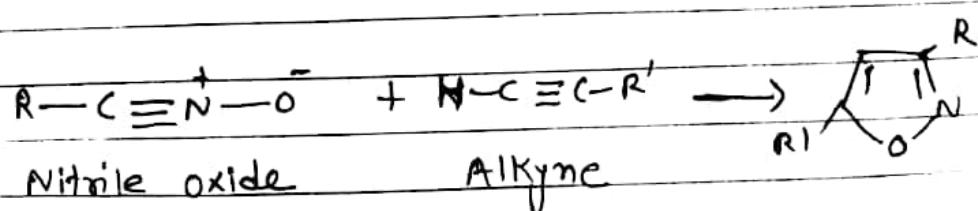


Mechanism



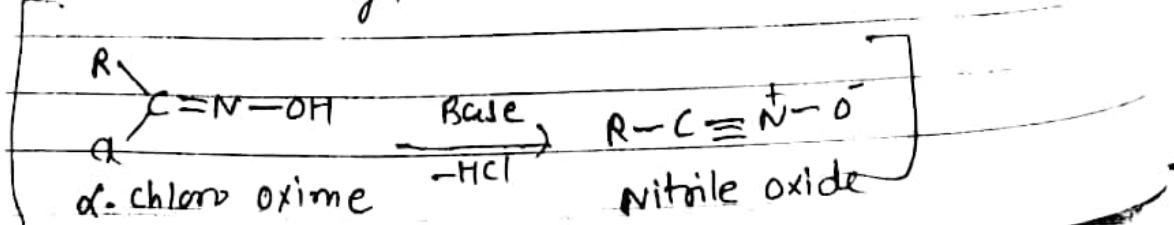
(2) Quilico Synthesis :-

or $[\text{CNO} + \text{CC}]$ Condensation :-

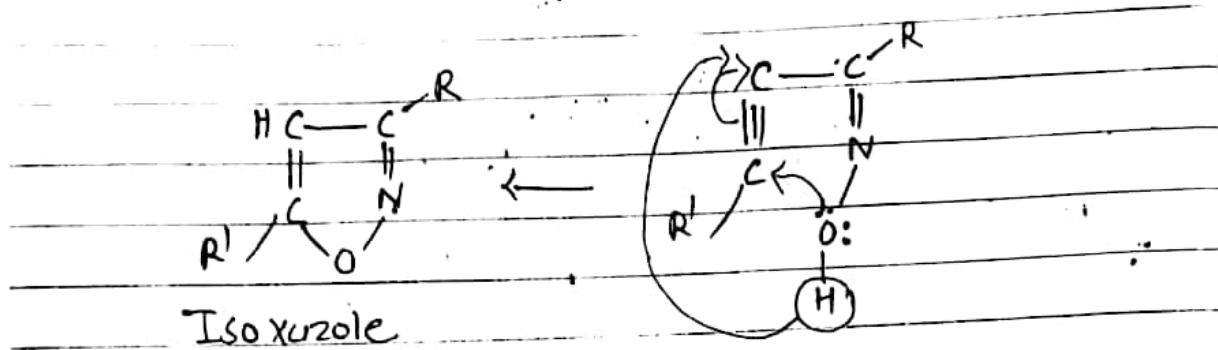
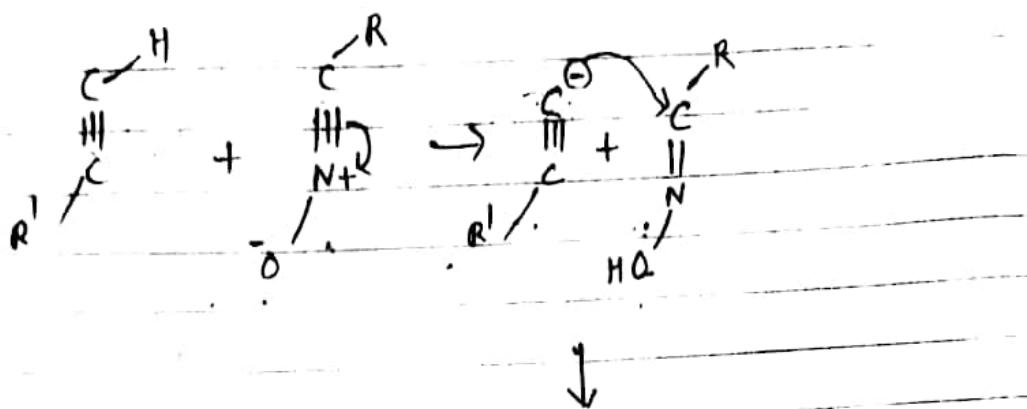


↑ How we get is

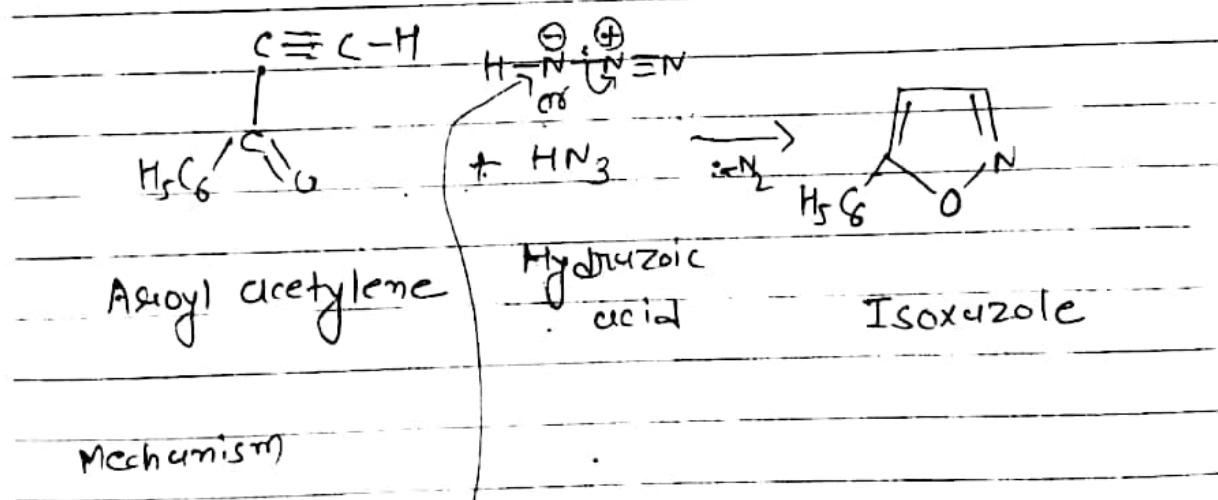
Isoxazole



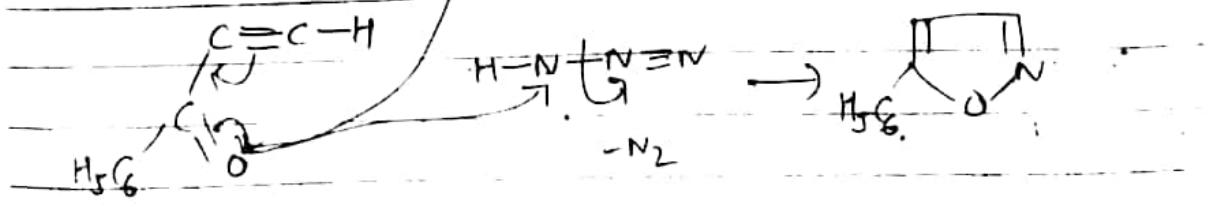
Mechanism



③ $[\text{CCC}\equiv\text{O} + \text{N}]$ condensation

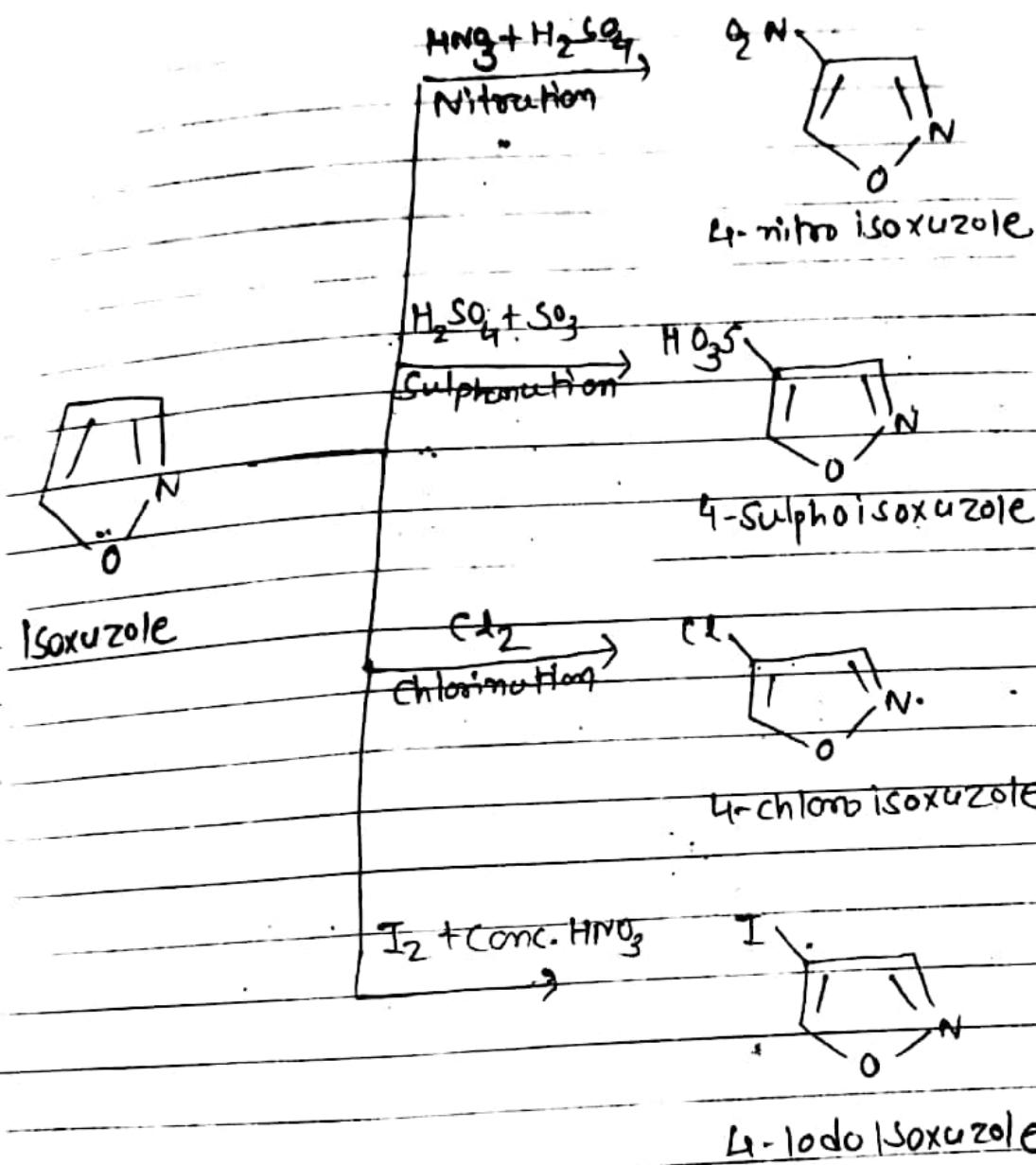


Mechanism

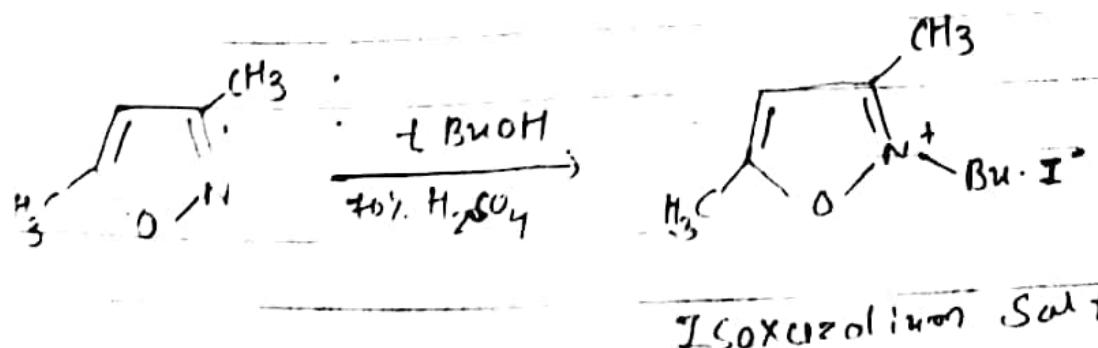


REACTIONS

① Electrophilic Substitution Reactions (at 4th position)



② Electrophilic substitution at "N" :-



Isoxazole

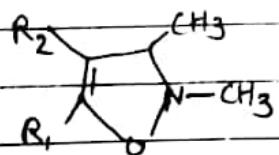
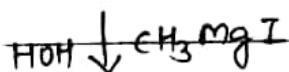
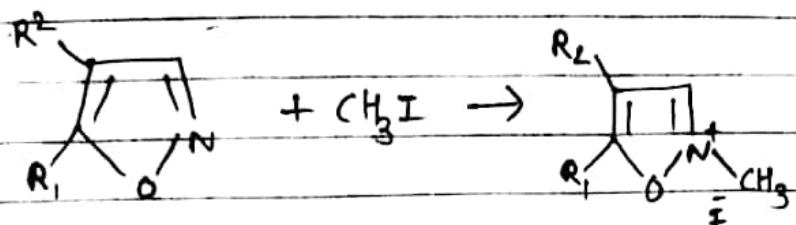
Imidazole

Pyrazole

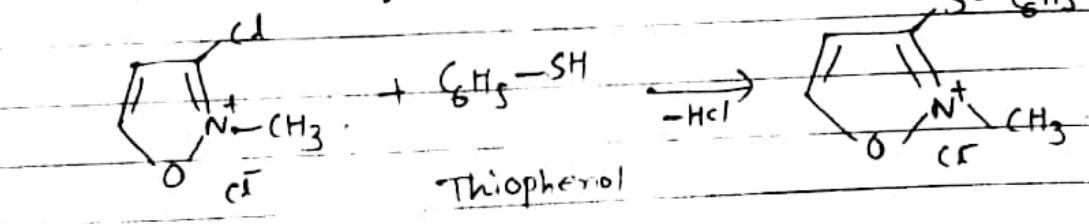
Thiazole

Oxaazole

③ Addition Reactions:

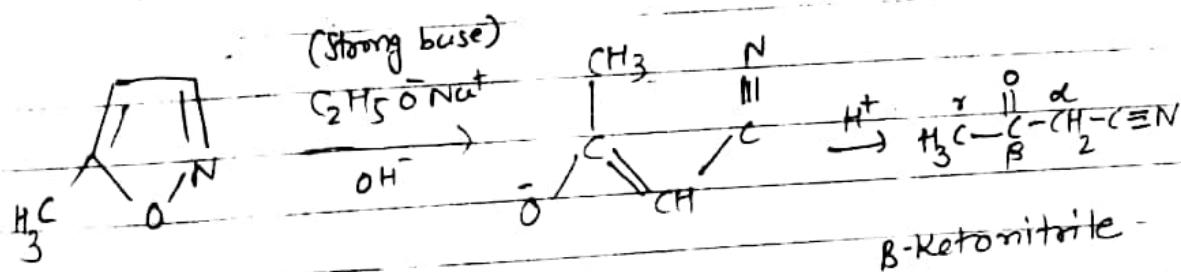


④ Replacement of Substituents:



Quaternized
isoxazole

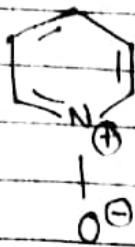
⑤ Deprotonation at C3



β -Ketonitrile



Pyridine - N - oxide

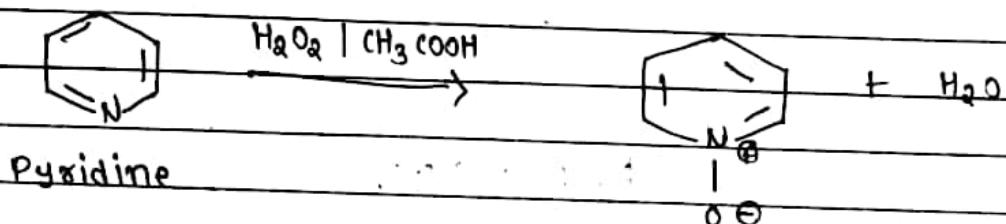


Pyridine - N - oxide

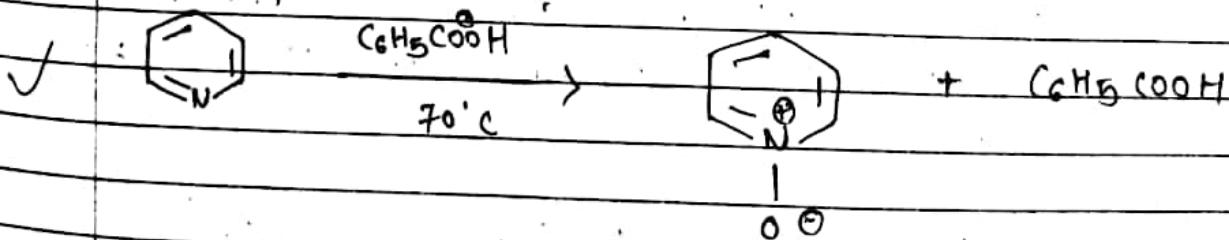
SYNTHESIS : Q. 6 two synthesis

1 From Pyridine in presence of hydrogen peroxide & acetic acid

→ Pyridine N - oxide can be easily prepared by the oxidation of pyridine in glacial acetic acid by 30% aqueous hydrogen peroxide.



2 From Pyridine in presence of peracid.



Pyridine - N - oxide

HBC

Divya Momin

① Thiazole - 3 - Q. 4

Benzimidazole - 5

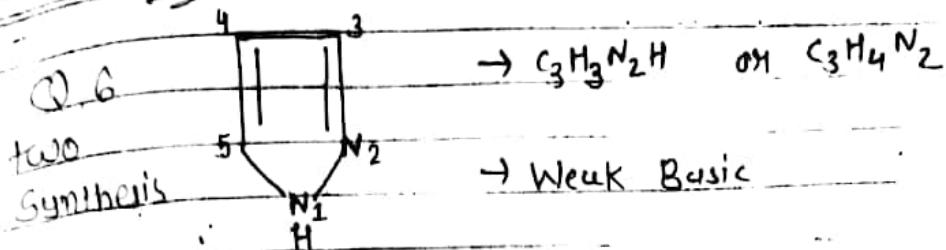
Synthesis & reaction of oxazoles - 7

Unit: 1

- Q. 4 ① PYRAZOLE

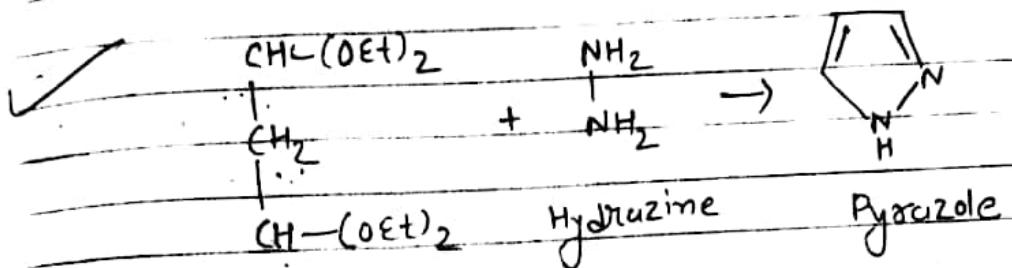
Aziridines - 10

(1)



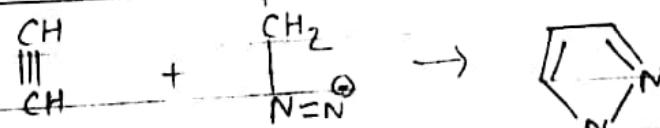
Synthesis :-

① Condensation



Tetraethoxy propane
(malonuldehyde diethyl acetal)

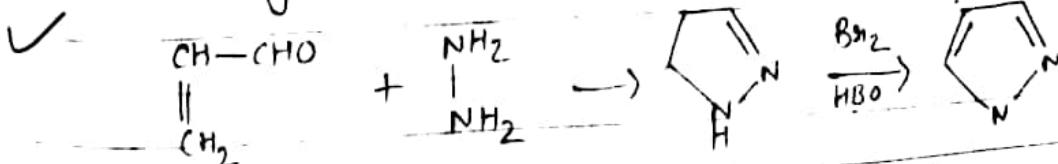
② By passing the acetylene gas into cold solution of diazomethane



Acetylene

Pyrazole

③ By reaction of α, β -unsaturated aldehydes/ketone with hydrazine



Acraldehyde

Hydrazine

Pyrazoline

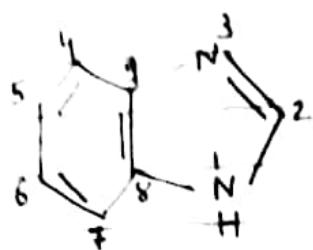
Pyrazole

Q. 29
Q. 16 Synthesis & Reaction

Q. 6

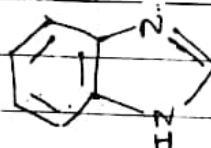
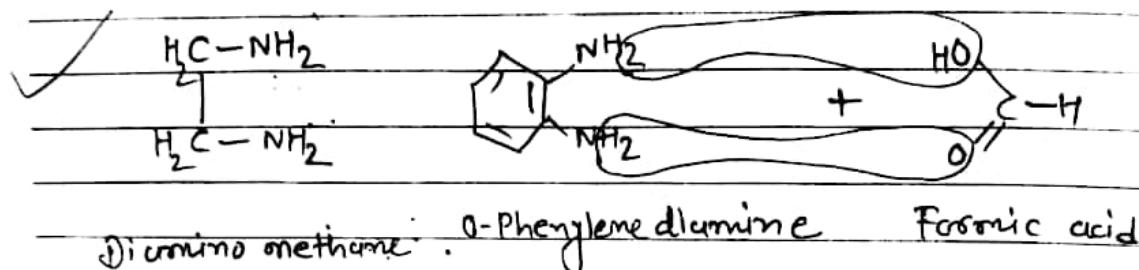
two
synthesis

Benzimidazole



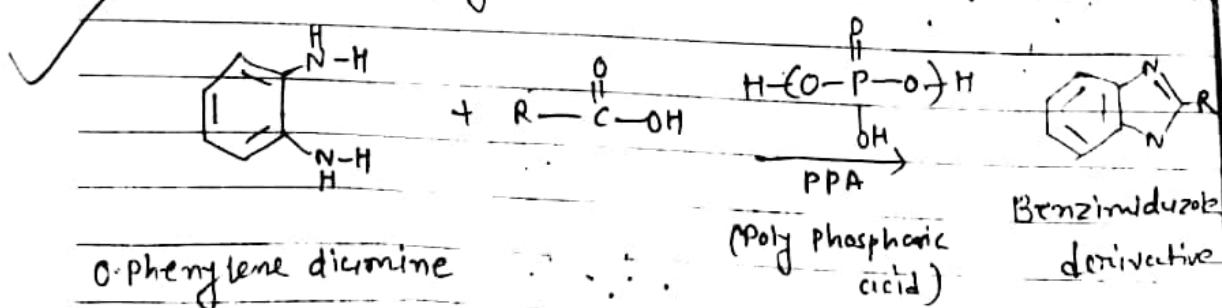
SYNTHESIS

① From O-Phenylenediamine

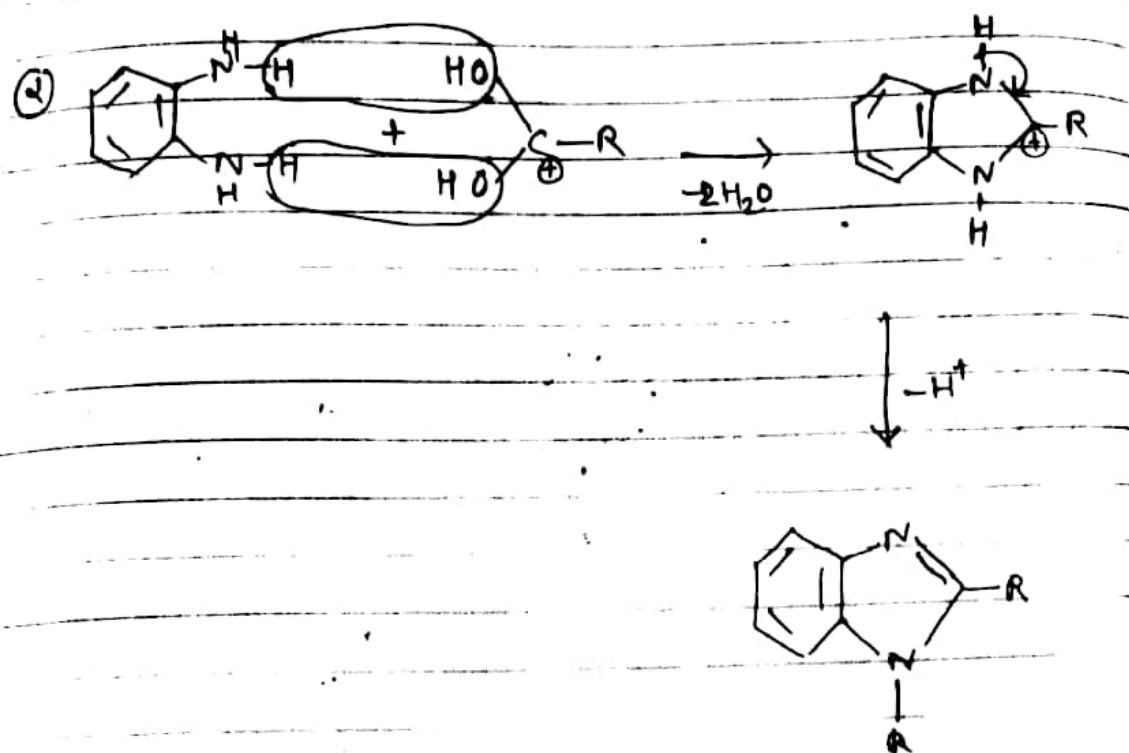
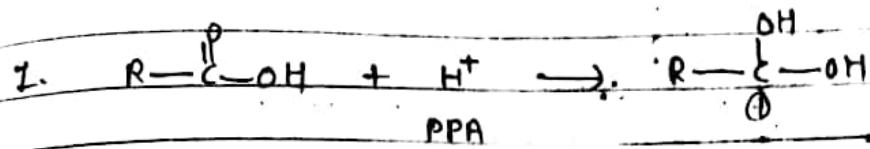


Benzimidazole

② From carboxylic acids

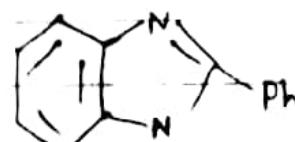
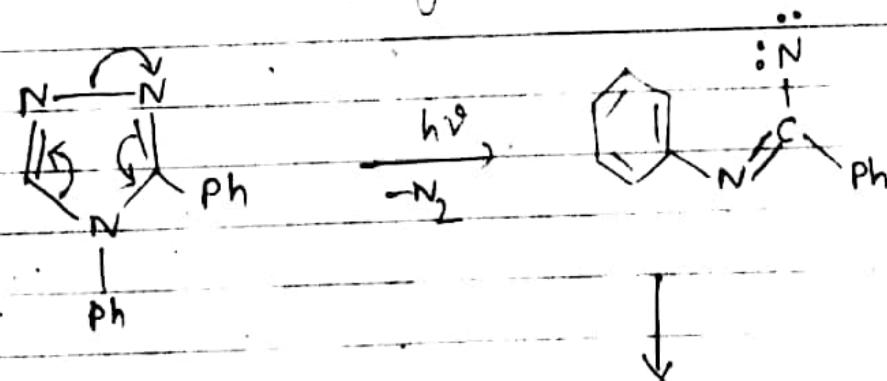


Mechanism :-



Benzimidazole derivative

③ From 1,5-Diphenyl-tetrazole



d-phenyl-benzimidazole



Q. 20 Basicity difference.

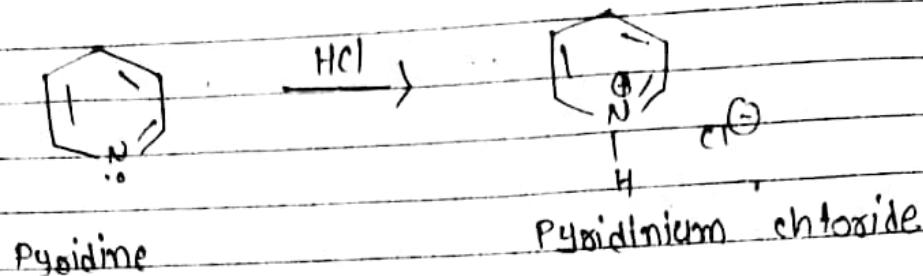
Q. Elucidate the basicity of pyridine, pyrrole and aliphatic amine in H_2O .
 + Basicity of pyridine

Pyridine is basic & reacts with acid to form salts

(2)

Date / /

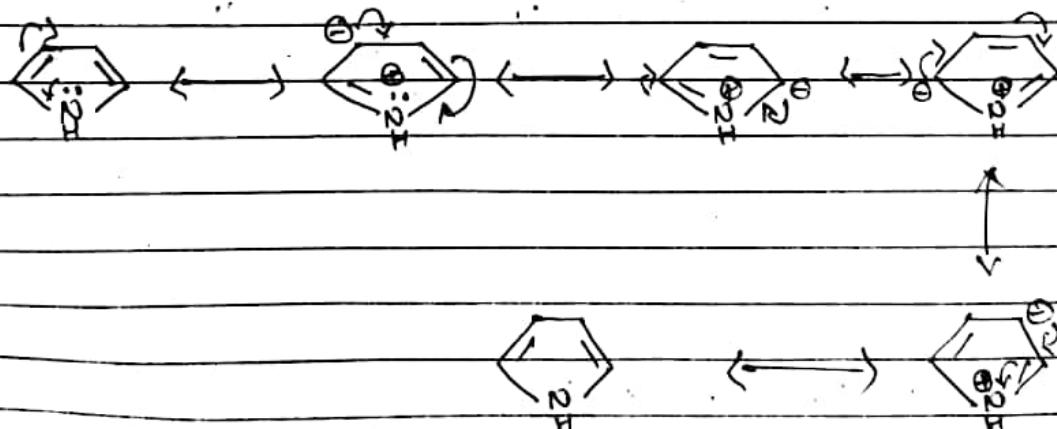
Page No.



→ The basicity of pyridine is due to the readily availability of lone pair of electron on nitrogen atom.

→ Pyridine is more basic than pyrrole because the lone pair of electron of pyridine 'N' does not involved in the resonance & those lone pair of electrons are so readily available for further reaction.

But in Pyrrole, the lone pair of electrons of 'N' involved in the resonance (delocalization) and hence that lone pair of electron are not readily available for reactions.



As the lone pair of electrons of the pyridine (N) are readily available for reaction than Pyrrole hence pyridine is more basic than Pyrrole.



→ But pyridine is less basic than aliphatic amines.

→ In pyridine the 'N' is present in sp^2 hybridized more s character more electronegative.

→ In case of aliphatic amines, the 'N' is present in sp^3 hybridized, less s character less electronegative.

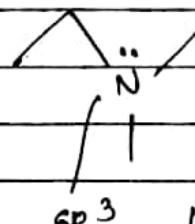
→ The lone pair of electrons on the 'N' of pyridine is more tightly held because of more s character & more electronegativity, hence it is less available for reactions.

→ while in the case of aliphatic amines, the lone pair of electrons on the 'N' is loosely held because of less s character & less electronegative, so it is more readily available for reactions. Hence the aliphatic amines are more basic than pyridine.

pyridine



(More electronegative)
more 's' character

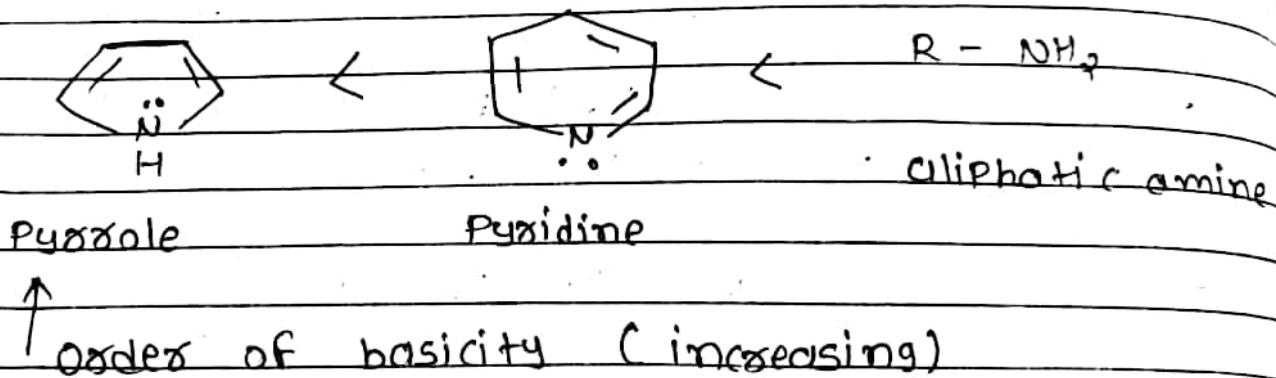


sp^3 less electronegative
less 's' character

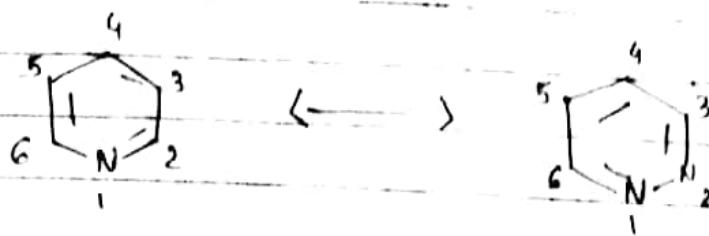
aliphatic amine

4

Conclusion



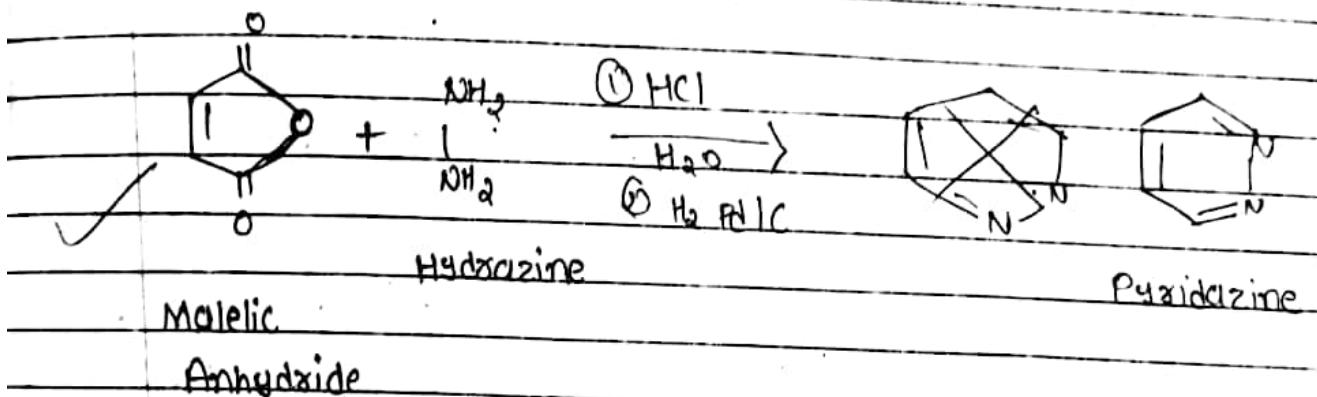
PYRIDAZINE [1,1,2 diazine]



Q. 8

Synthesis

① Form maleic anhydride

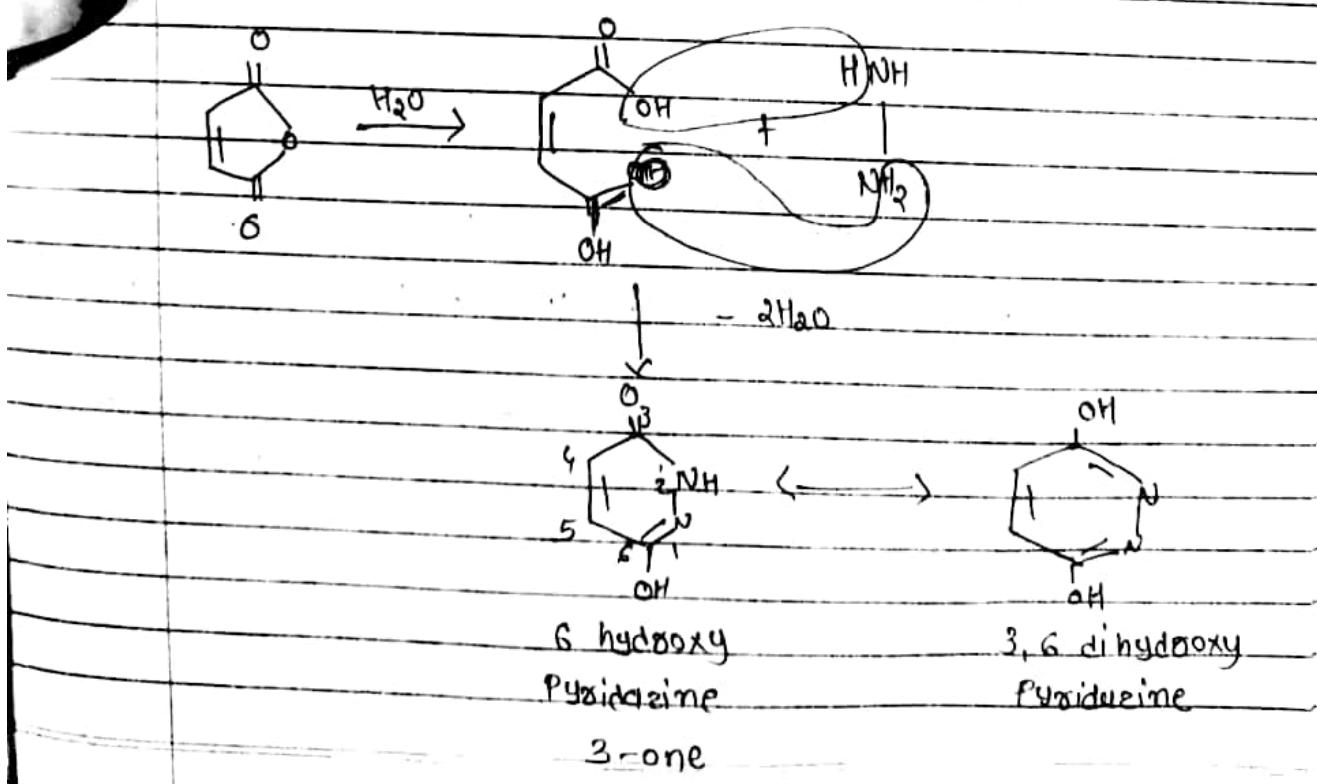


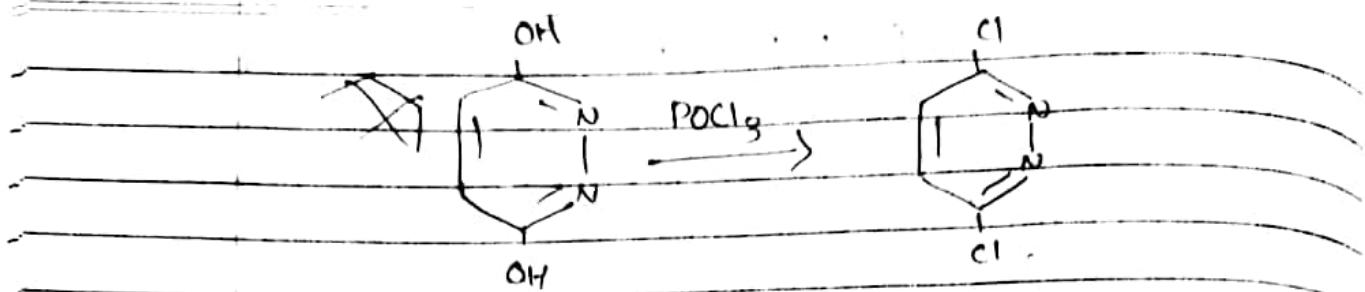
Maleic

Anhydride

Pyridazine

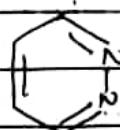
Mechanism.





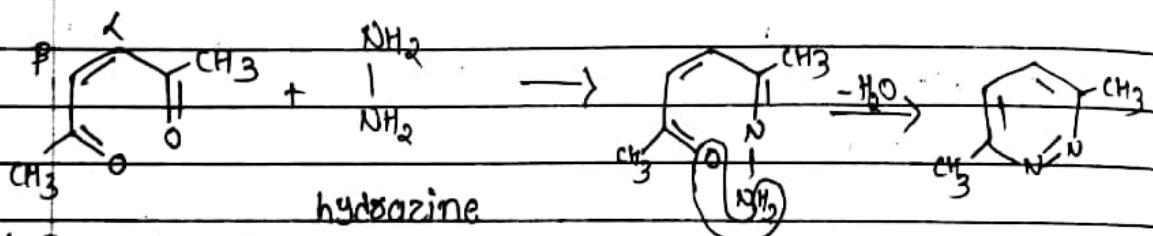
3,6 dichloro Pyridazine

$\downarrow \text{Pd/C H}_2$



Pyridazine

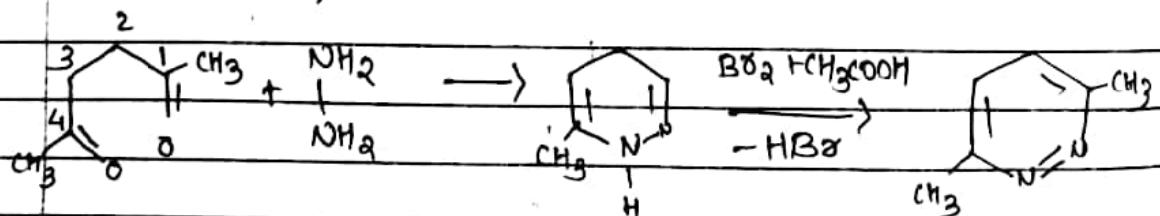
of Form 1,4 dicarbonyl compound.



α, β unsaturated

1,4 dicarbonyl

compound

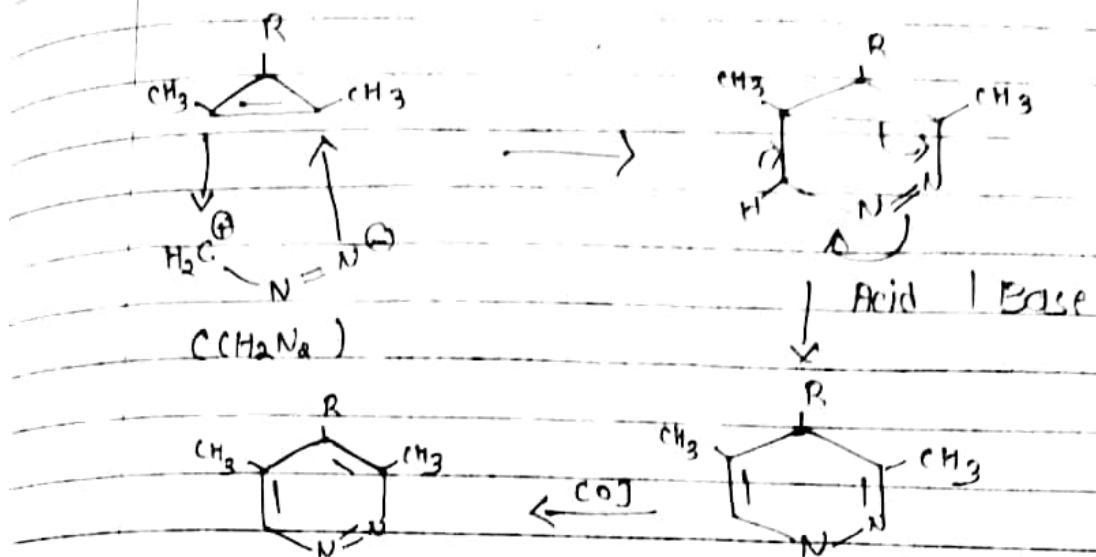


α, β unsaturated
1,4 dicarbonyl
compound

1,4 dihydro
Pyridazine

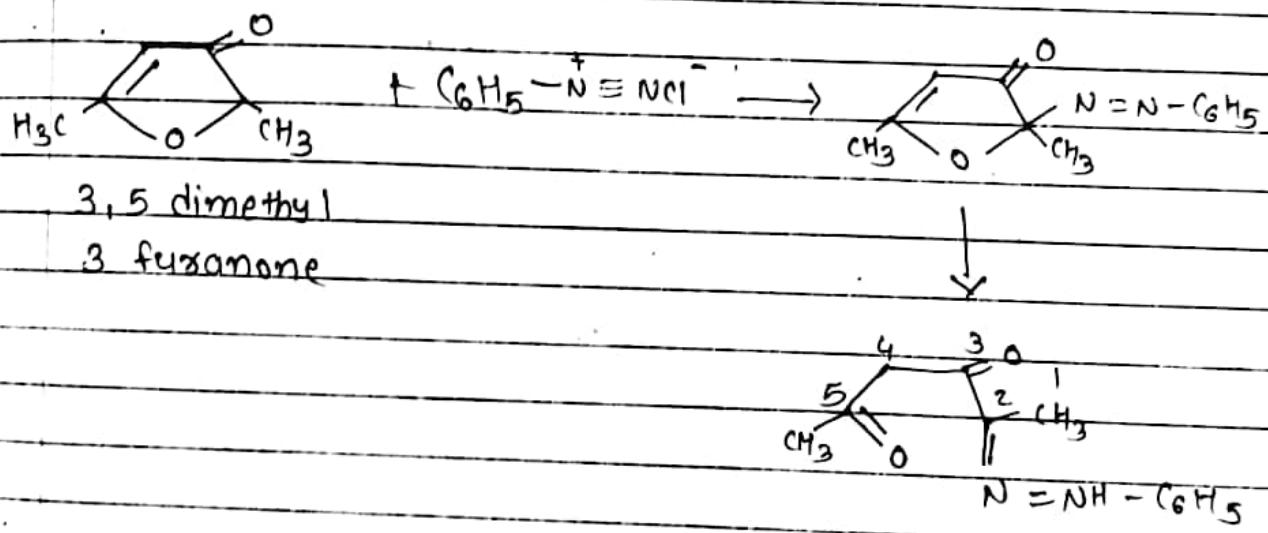
3,6 dimethyl
Pyridazine

3 [3 + 3] Condensation method:

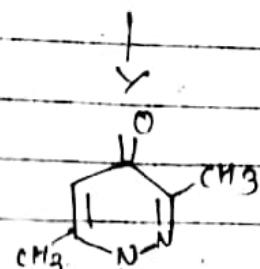


Pyridazine derivative

4 From Furanone derivative.



Mono hydrazone of
4,3,5 tri Ketone



N Phenyl 3,5 dimethyl
Pyridazine 4-one

Pyrimidine



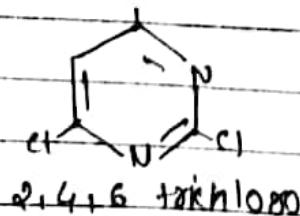
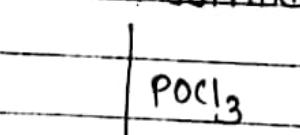
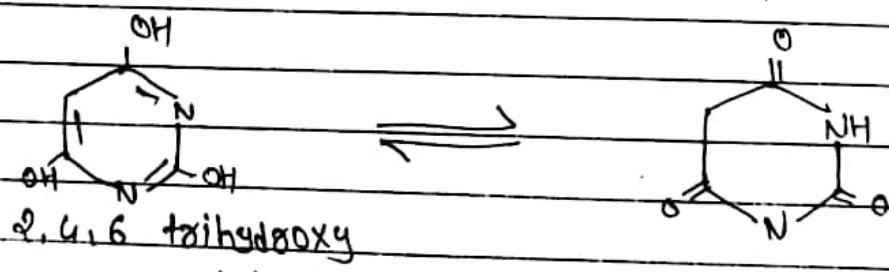
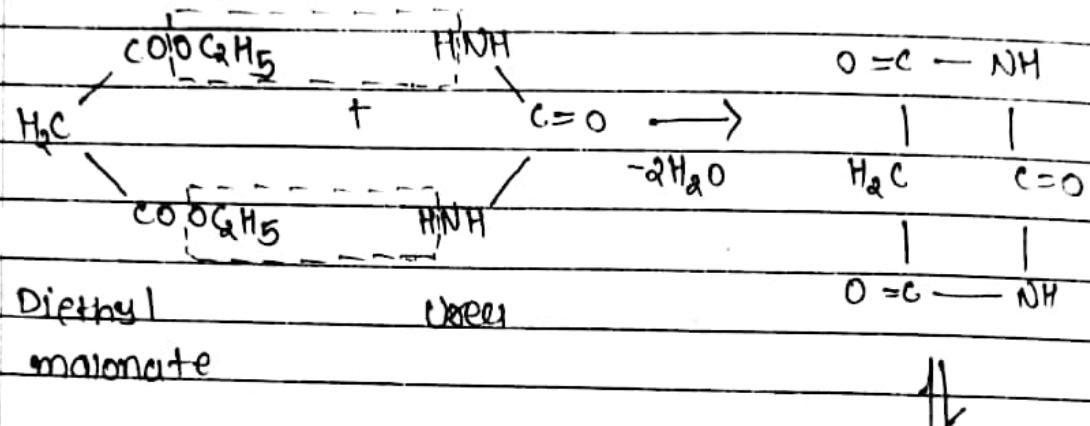
[1,3 DIAZINE]

G. S

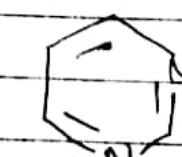
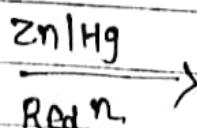
too

Synthesis

1. From Malonic ester:



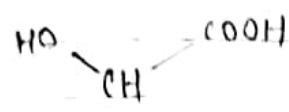
Pyrimidine



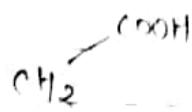
Pyrimidine



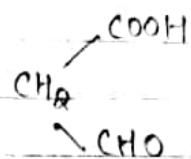
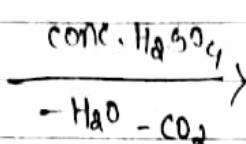
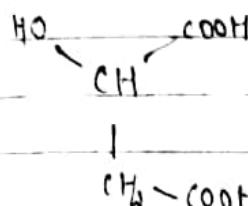
2. From malic acid



Malic acid



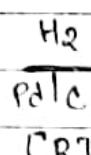
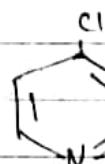
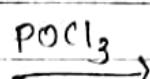
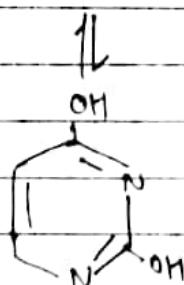
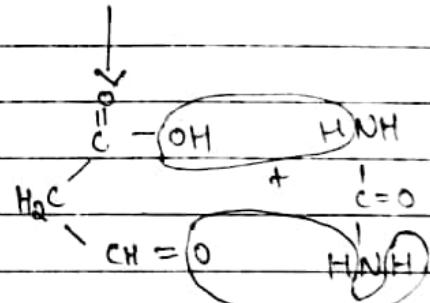
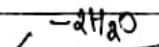
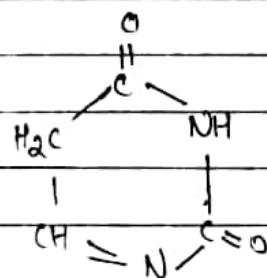
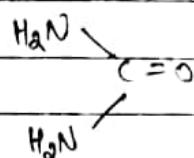
Succinic acid



formyl acetic acid



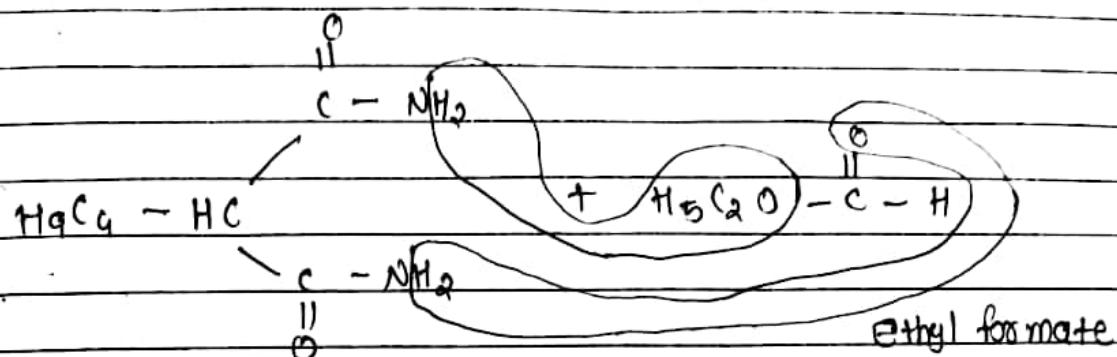
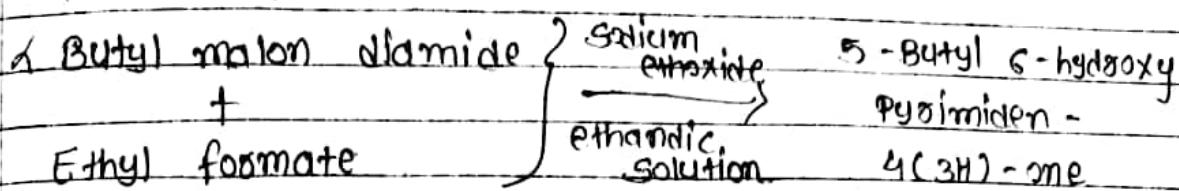
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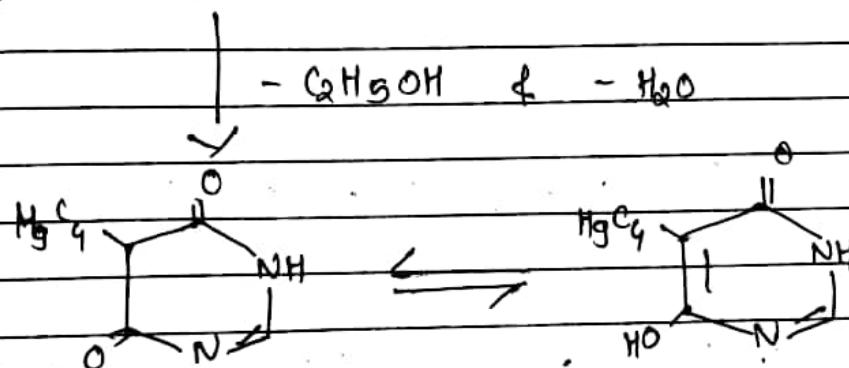
Pyrimidine

2,4 dihydroxy
Pyrimidine

(4) Remfay - Hull Synthesis

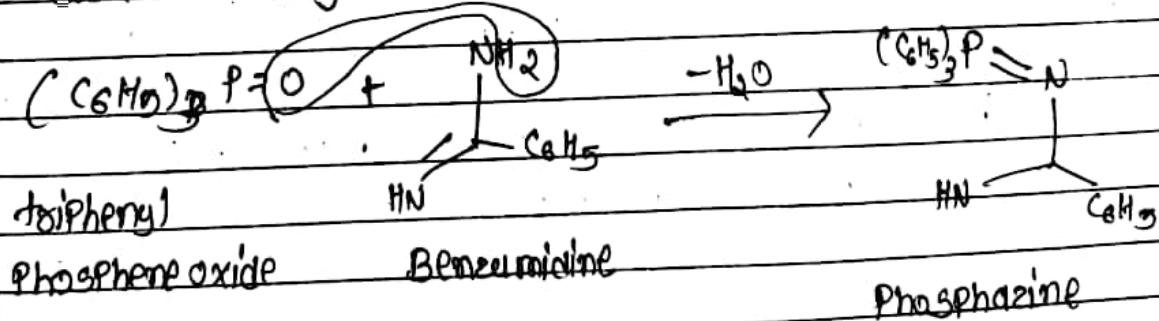


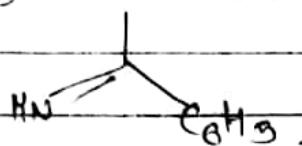
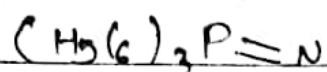
(5) Butyl malon diamide



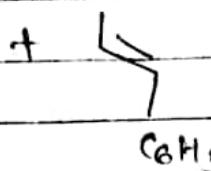
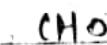
5 Butyl 6 hydroxy pyrimidine 4(3H)-one

(6) Ozoer Wittig Reaction

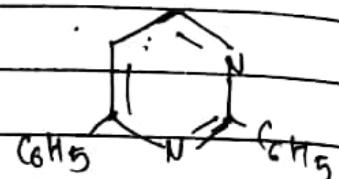
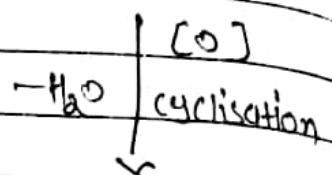
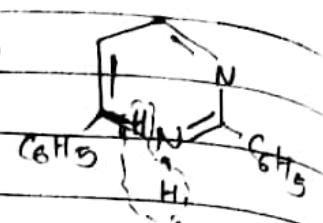




Phosphazine

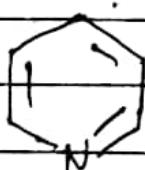


cinnamaldehyde

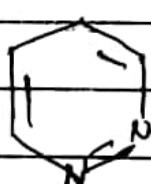


2,6 diphenyl
Pyrimidine

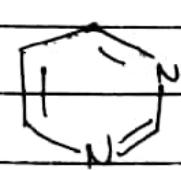
Chemical Properties.



Pyridine



Pyridazine



Pyrimidine

5.6

2.33

1.3

Basicity in decreasing order →

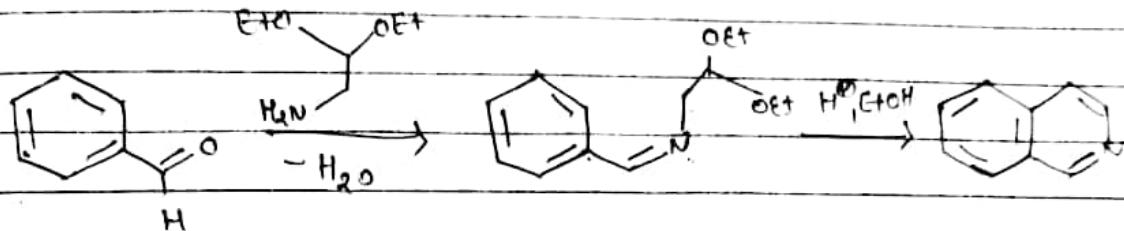
Basic strength ∝ pKa

Isoquinolines

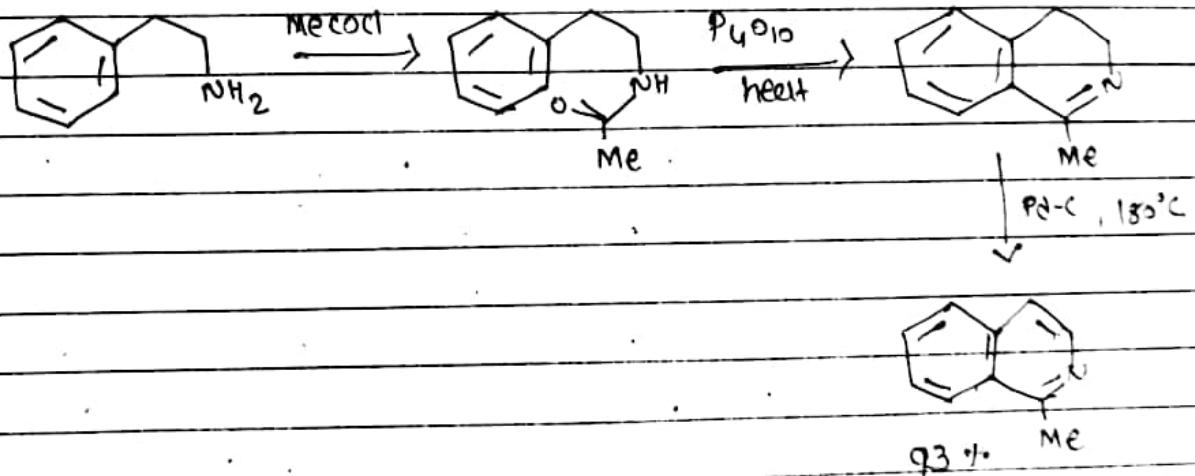
Q.8 Isoquinolines

Synthesis

1 Pomeranz - Fritsch Synthesis (3+3)



2 Bischler - Napieralski Synthesis (5+1)



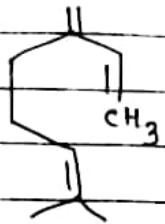
- cyclisation can be accomplished using POCl_3 or PCl_5
- oxidation of the dihydriodisoquinoline can be performed using a mild oxidant.

Q.9 Provide the formulae of monocyclic monoterpenoids, acyclic, Monocyclic and bicyclic sesquiterpenoids.

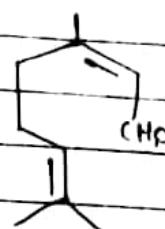
21

A) Mono terpenoids:

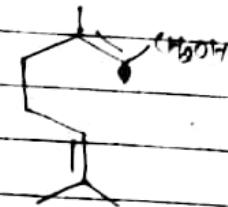
(i) Acyclic Mono terpenoids.



Myrcene

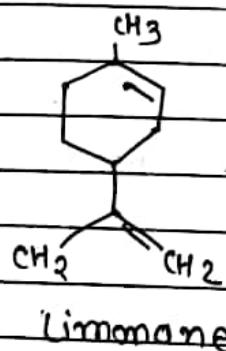


Citraol

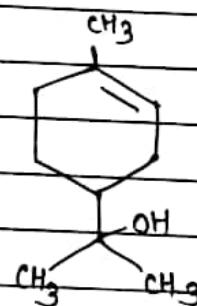


Oreganol

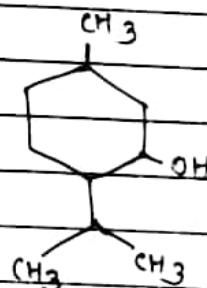
(ii) Mono cyclic monoterpenoids.



Limonane



L-terpineol



Menthol

(iii) Bicyclic mono terpenoids.

These are further divided into three classes.

- containing - 6 + 3 membered rings
- containing - 6 + 4 membered rings
- containing - 6 + 5 membered rings



Thujane



Cineole



Pinano

(6 + 3 membered ring)

- 6 + 4 membered ring



Bornane
(camphane)



norbornane
(iso camphane)

- 6 + 5 Membered rings

Some bicyclic monoterpenes are



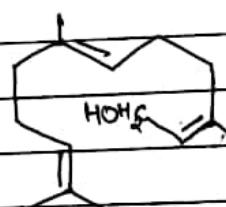
camphor



α pinene

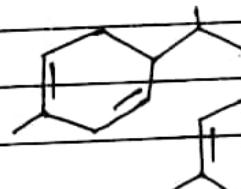
8. Sesquiterpenoids:

i Acyclic Sesquiterpenoids



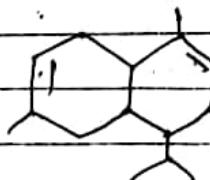
Farnesol

(ii) Monocyclic Sesquiterpenoids



zinzibolene

(iii) Bicyclic sesquiterpenoids



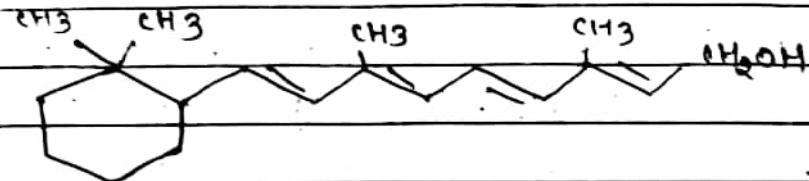
Cadinene

c. Diterpenoids:

i. Acyclic diterpenoids



ii. Monocyclic diterpenoids.



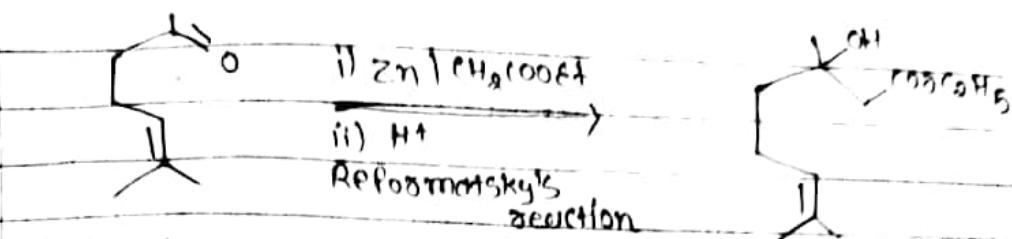
Vitamin A

Synthesis:

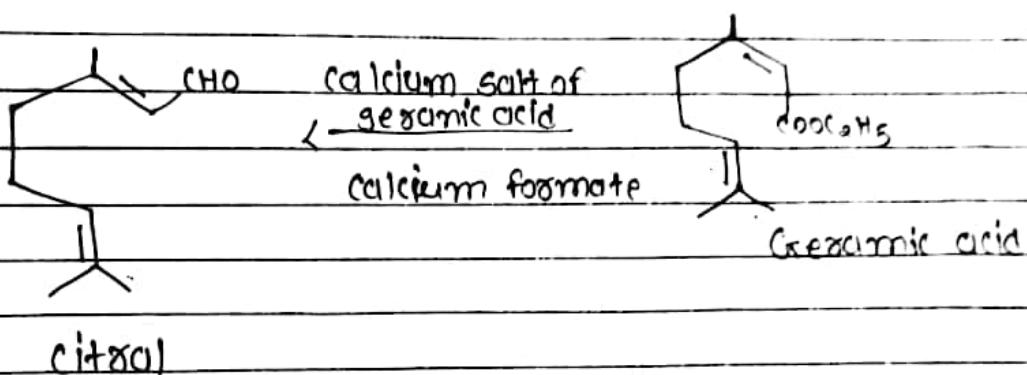
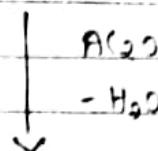
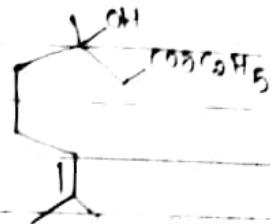
~~Finally~~ To illustrate the synthesis, we have taken
the synthesis of citral.

(A) Baudier - Bouveault - Tiemann's Synthesis.

→ In this synthesis methyl heptenone is converted to geranic ester by using Reformatsky's reaction. Geranic ester is then converted to citral by distilling a mixture of α calcium salt of geranic and formic acid.

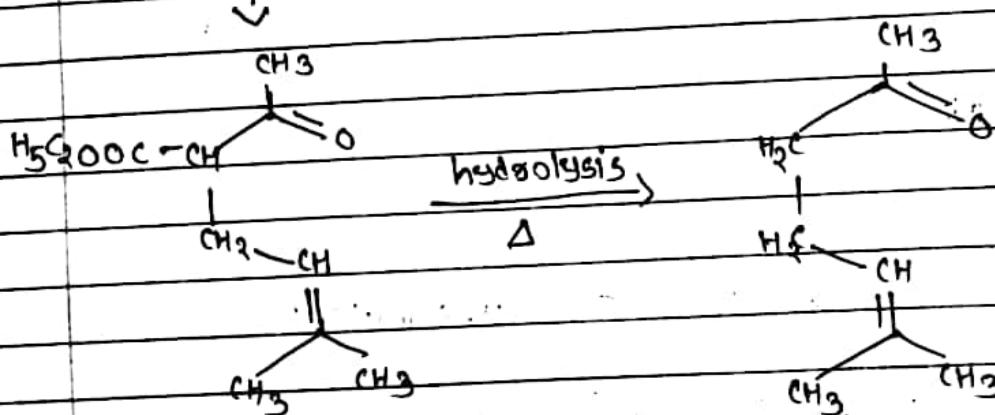
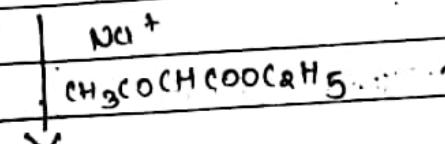
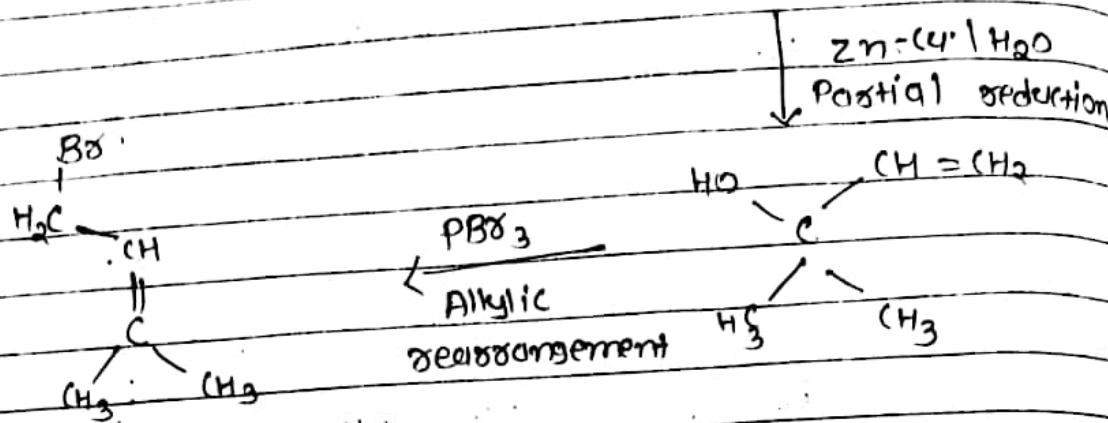
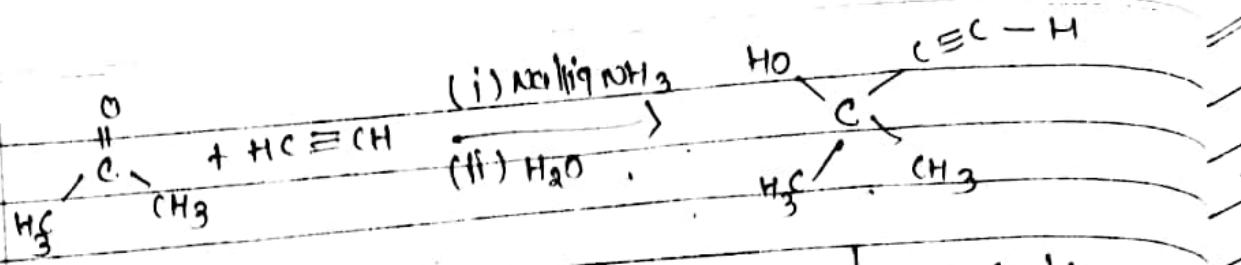


Methyl heptenone

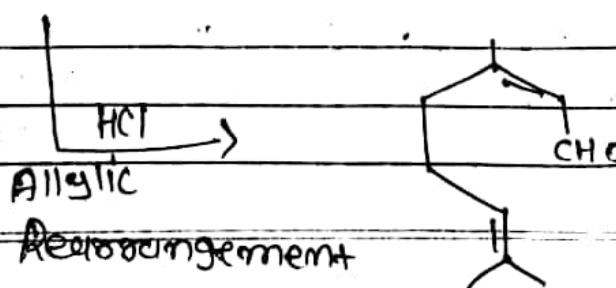
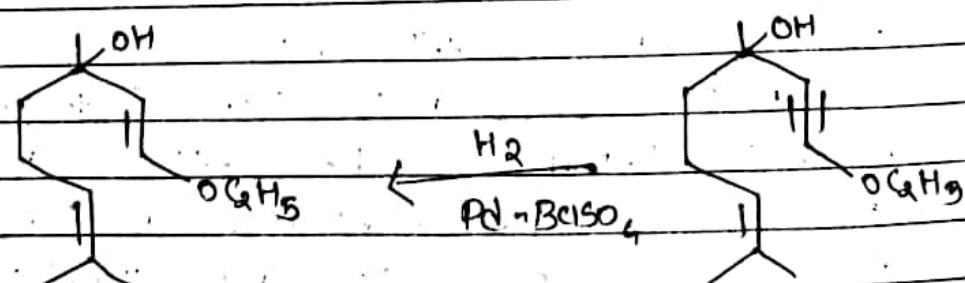


(B) Arens - Van Doop's Synthesis:

→ This synthesis involves condensation of acetone with acetylene in the presence of liquid ammonia. Condensation product is then reduced and treated with PbO_2 . Allylic rearrangement takes place. The rearranged product so obtained is treated with sodium salt of acetoacetic ester and then hydrolysed to yield methyl heptenone. The latter compound on condensation with ethoxy acetylene magnesium bromide, followed by the partial reduction and acidification yields citral by allylic rearrangement.



$\text{C}-\text{O(C}_2\text{H}_5)$
 $\text{C}-\text{MgBr}$
 Ethynyl acetate
 magnesium bromide



4. There are groups of co-enzymes

8.5 FACTORS AFFECTING ENZYME ACTIVITY

Velocity or rate of enzymatic reaction is assessed by the rate of change in concentration of substrate or product at a given time duration. Various factors which affect the activity of enzymes include:

1. Substrate concentration
2. Enzyme concentration
3. Product concentration

4. Temperature
5. Hydrogen ion concentration (pH)
6. Presence of activators
7. Presence of inhibitor

8.5.1 Effect of substrate Concentration

Reaction velocity of an enzymatic process increases with constant enzyme concentration and increase in substrate concentration. The velocity (V) is expressed in micromoles of substrate converted per minute. As the concentration of substrate increases, the velocity of the reaction increases. Continued increase in substrate concentration may lead to a reduction in rate of the reaction and leads to flattened curve. The maximum velocity obtained from a enzymatic reaction is called as V_{max} . V_{max} represents the maximum reaction rate possible in the presence of excess substrate.

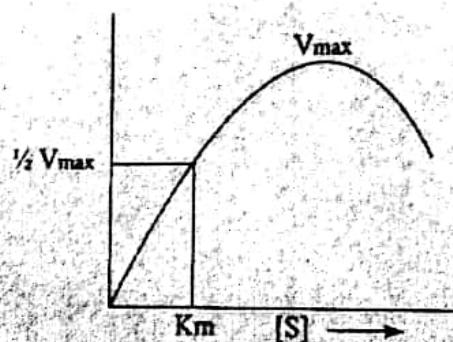


Fig. 8. 1: Effect of substrate concentration

8.5.2 Effect of enzyme Concentration

As there is optimal substrate concentration, rate of an enzymatic reaction or velocity (V) is directly proportional to the enzyme concentration. Presence of excess substrate and an increase in the enzyme concentration may result in some limitations. It is worthy of note that the enzymes are rarely saturated with substrates under physiological conditions.

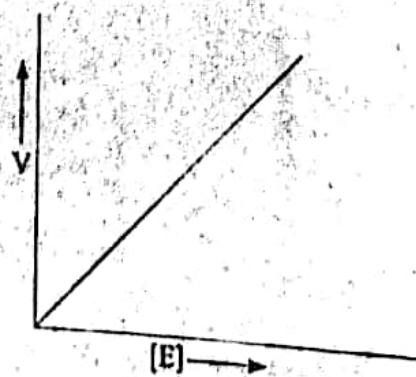
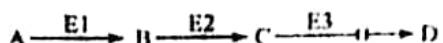


Fig. 8.2: Effect of enzyme concentration

8.5.3 Effect of product concentration

In case of a reversible reaction catalyzed by an enzyme, as per the law of mass action the rate of reaction is slowed down with equilibrium. So, rate of reaction is slowed, stopped or even reversed with increase in product concentration. This phenomena can be better explained by the equation



In the above equation, in case of absence of the enzyme E3, the product C will accumulate. Enzymatic activity of E2 will be inhibited with accumulation of the product C. In such inborn error of one enzyme will block the whole pathway

8.5.4 Effect of temperature

Velocity of enzymatic reaction increases with temperature of the medium which they are most efficient and the same is termed as optimum temperature. As temperatures increases it leads to denaturation; a molecular arrangement which causes a loss of the active sites of the enzyme surfaces and results in a loss of efficiency.

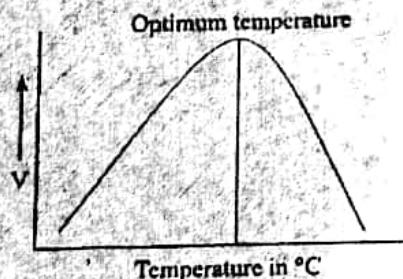


Fig. 8.3: Effect of temperature

8.5.5 Effect of pH

Like temperature, all enzymes have a optimum pH, at which the enzymatic activity will be at maximum. Many enzymes are most efficient in the region of pH 6-7, which is the pH of the cell. Outside this range, enzyme activity drops off very rapidly. Reduction in efficiency caused by changes in the pH is due to changes in the degree of ionization of the substrate and enzyme. Highly acidic or alkaline conditions bring about a denaturation and subsequent loss of enzymatic activity. Some exceptions such as pepsin (with optimum pH 1-2), alkaline phosphatase (with optimum pH 9-10) and acid phosphatase (with optimum pH 4-5) are even noticed.

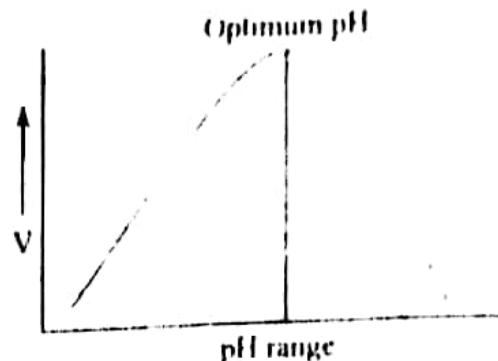


Fig. 8.4: Effect of pH

8.5.6. Presence of activators

Presence of certain inorganic ions increases the activity of enzymes. The best examples are chloride ions activated salivary amylase and calcium activated lipases.

8.5.7. Effect of Inhibitors

The catalytic enzymatic reaction may be inhibited by substances which prevent the formation of a normal enzyme-substrate complex. The level of inhibition then depends entirely upon the relative concentrations of the true substrate and the inhibitor. Such inhibition, which depends on competition with the substrate for the active sites of the enzyme, is termed competitive inhibition. In other cases, the inhibitor combines with the enzyme-substrate complex to give an inactive enzyme-substrate-inhibitor complex, which cannot undergo further reaction to give the usual product. This is termed uncompetitive inhibition. Non competitive inhibition involves combination of the inhibitor with the enzyme or the enzyme substrate complex, to give inactive complexes. In this case, the inhibitor binds to sites, on the enzyme other than enzyme sites, resulting in deformation of the enzyme molecule so that the formation of the enzyme-substrate complex is slower than normal. Some enzymes undergo irreversible inactivation; reaction of the inhibitor with a functional group of the enzyme, resulting in a loss of its catalytic activity. Enzyme inhibitor plays a vital role in clinical utility and is listed in table 8.2.

Table 8.2: Effect of Enzyme Inhibitors

Sl.No	Enzymatic inhibitor/drug	Enzyme inhibited	Clinical use
1.	Allopurinol	Xanthine oxidase	gout
2.	Dicoumarol	Vitamin-K-epoxide-reductase	Anti-coagulant
3.	Penicillin	Transpeptidase	Anti-bacterial
4.	Sulphonamide	Pteroid synthetase	Anti-bacterial
5.	Primaquine	FH2-reductase	Anti-malarial
6.	5-fluorouracil	Thymidylate synthetase	Anti-cancer

MECHANISM OF ENZYME CATALYSIS

T and

12

The long chains of the enzyme (protein) molecules are coiled on each other to make a ~~big~~ colloidal particle with cavities on its surface. These cavities which are of characteristic shape and abound in active groups (NH_2 , COOH , SH , OH) are termed Active centres. The molecules of substrate which have complementary shape, fit into these cavities just as key fits into a lock (Lock-and-Key theory). By virtue of the presence of active groups, the enzyme forms an activated complex with the substrate which at once decomposes to yield the products. Thus the substrate molecules enter the cavities, forms complex and reacts, and at once the products get out of the cavities.

Michaelis and Menten (1913) proposed the following mechanism for enzyme catalysis (Fig. 21.11).



where E = enzyme; S = substrate (reactant); ES = activated complex; P = products.

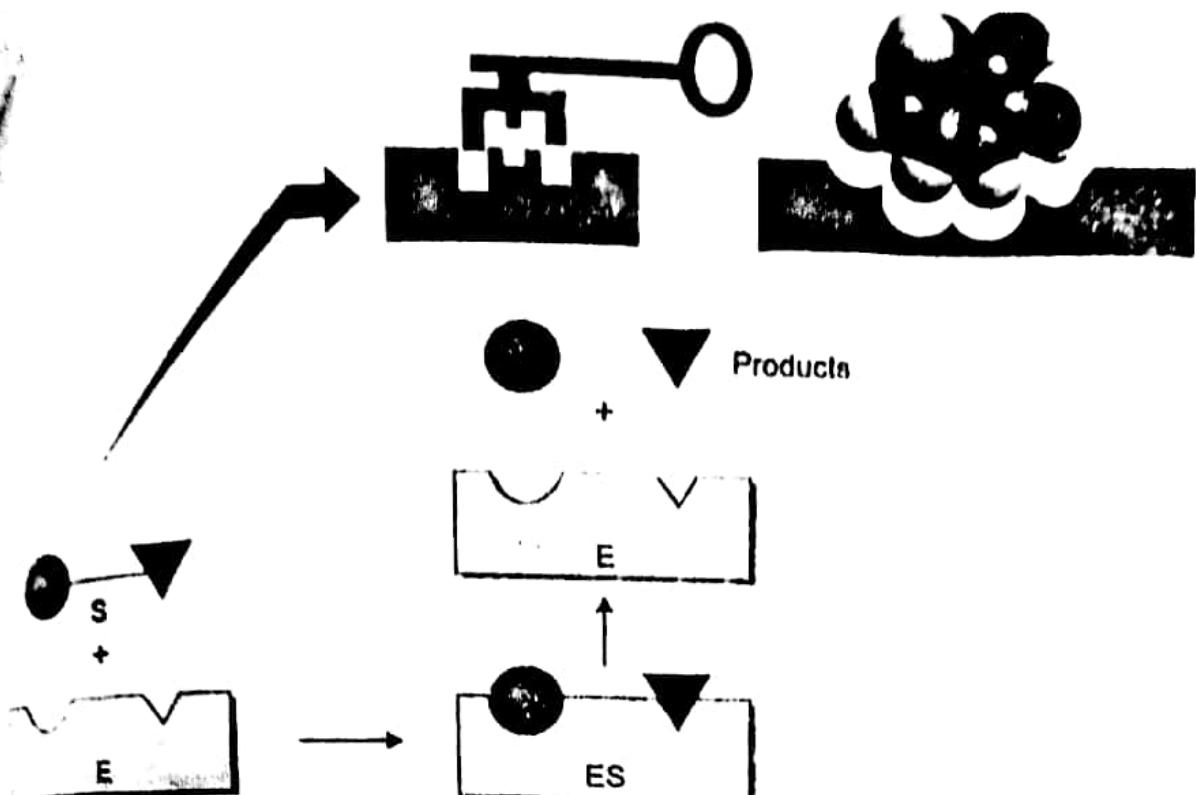


Figure 21.11
Illustration of the lock-and-key model of enzyme catalysis.

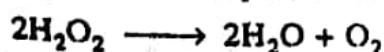
CHARACTERISTICS OF ENZYME CATALYSIS

In general, enzymes behave like inorganic heterogeneous catalysts. However, they are unique in their efficiency and high degree of specificity. Some more important features of enzyme catalysis are listed below.

(1) Enzymes are the most efficient catalysts known

The enzyme catalysed reactions proceed at fantastic high rates in comparison to those catalysed by inorganic substances. Thus one molecule of an enzyme may transform one million molecules of its substrate (reactant) per minute.

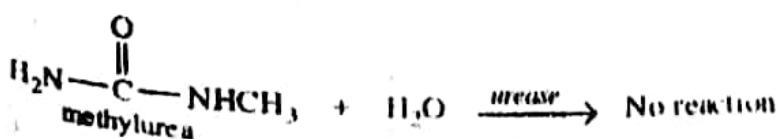
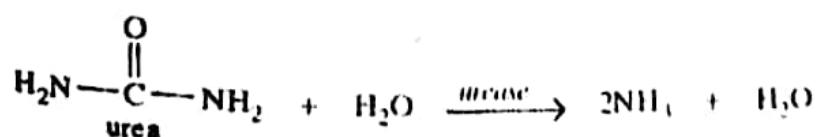
Like inorganic catalysts, enzymes function by lowering the activation energy of a reaction. For example, the activation energy of the decomposition of hydrogen peroxide,



Without a catalyst it is 18 kcal/mole. With colloidal platinum (inorganic catalyst), the activation energy is lowered by 11.7 kcal/mole. The enzyme *catalase* lowers the activation energy of the same reaction to less than 2 kcal/mole.

(2) Enzyme catalysis is marked by absolute specificity

An enzyme as a rule catalyses just one reaction with a particular substance. For example, *urease* (an enzyme derived from soya bean) catalyses the hydrolysis of urea and no other amide, not even



ENZYME CATALYSIS

Numerous organic reactions are taking place in the body of animals and plants to maintain life process. These reactions being slow remarkably catalysed by the organic compounds known as Enzymes. All enzymes have been found to be complex protein molecules. Thus

Enzymes are protein molecules which act as catalysts to speed up organic reactions in living cells. The catalysis brought about by enzymes is known as Enzyme Catalysis.

Each enzyme is produced in a particular living cell to catalyse a reaction occurring in that cell. Many enzymes have been identified and obtained in pure crystalline state from the cells to which they belong. However the first enzyme as prepared by synthesis in the laboratory in 1969

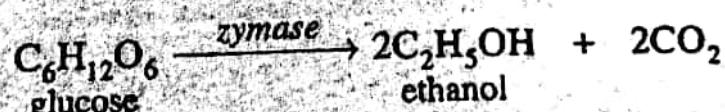
Examples of Enzyme Catalysis

Some common examples of the biochemical reactions catalysed by enzymes are:

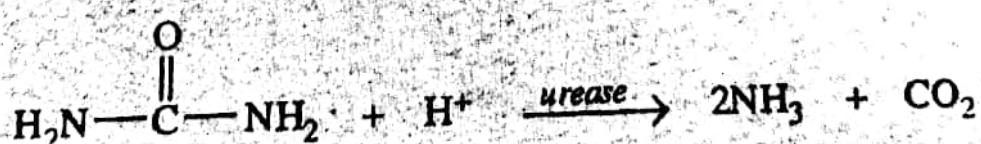
(1) Inversion of cane sugar ($C_{12}H_{22}O_{11}$) by Invertase present in yeast.



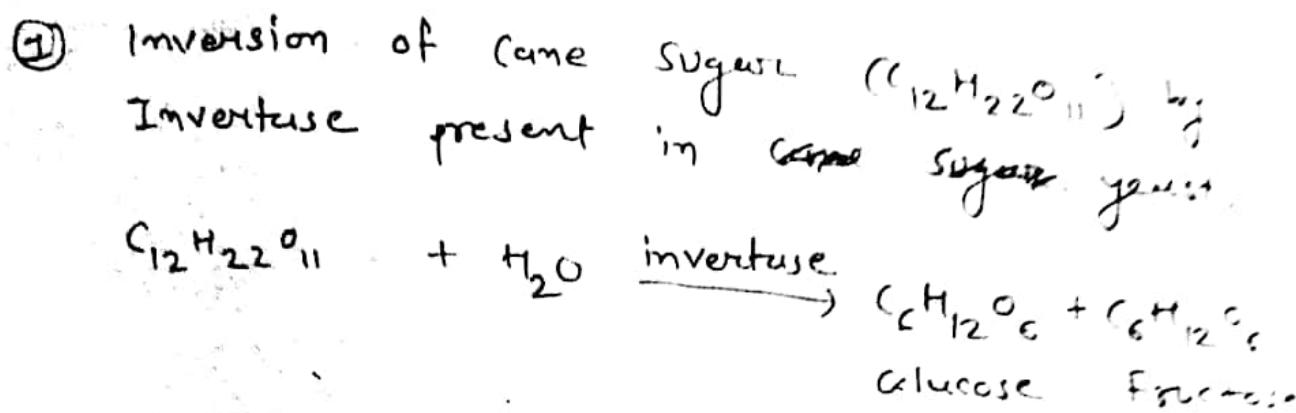
(2) Conversion of glucose into ethanol by Zymase present in yeast.



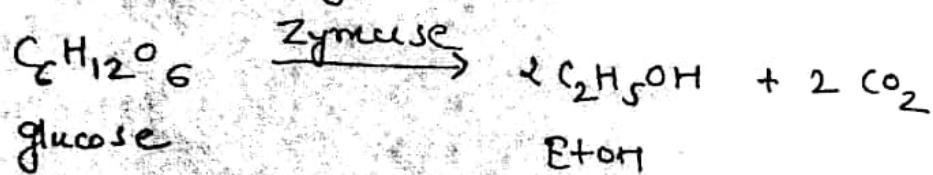
(3) Hydrolysis of urea ($\text{H}_2\text{N}-\text{CO}-\text{NH}_2$) by Urease present in soya bean,



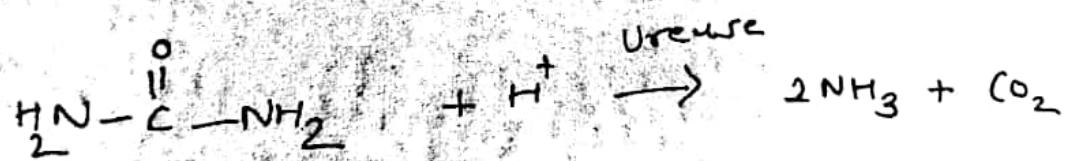
✓ Examples of Enzyme catalysis:



② Conversion of glucose into ethanol by zymase present in yeast.



③ Hydrolysis of urea ($H_2N-CO-NH_2$) by urease present in soybean.



Defn: Enzymes are protein molecules which act as catalysts to speed up organic reaction in living cells. Such catalysis by enzyme is called cis enzyme catalysis.

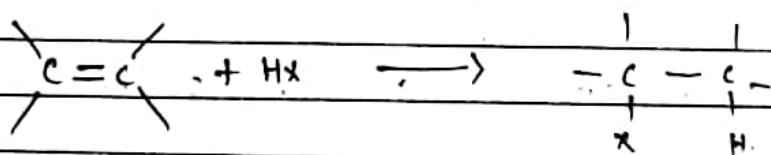
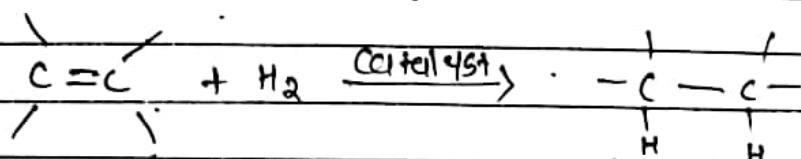
Q.15 Explain the method to confirm
the unsaturation in terpenoids

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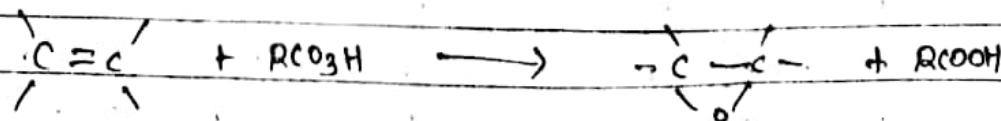
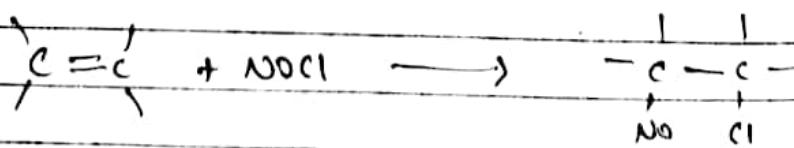
iii. Unsaturation:

→ The presence of olefinic double bond is confirmed by means of bromine and number of double bond determination by analysis of the bromide or by quantitative hydrogenation or by titration with monopersulfuric acid.

→ Presence of double bond also confirmed by means of catalytic hydrogenation or addition of halogen acids. Number of moles of HX absorbed by one molecule is equal to number of double bond present.



Addition of nitrosonyl chloride (NOCl) (Tilden's reagent) and epoxide formation with peracid also gives idea about double bond present in terpenoid molecule.

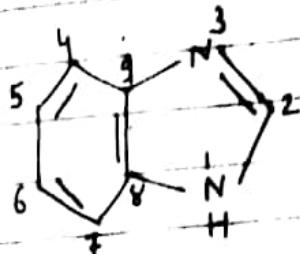


(Q.29)
 (Q.16) SYNTHESIS & PROPERTIES

(Q.6)

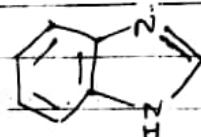
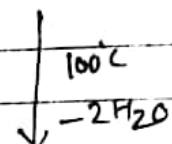
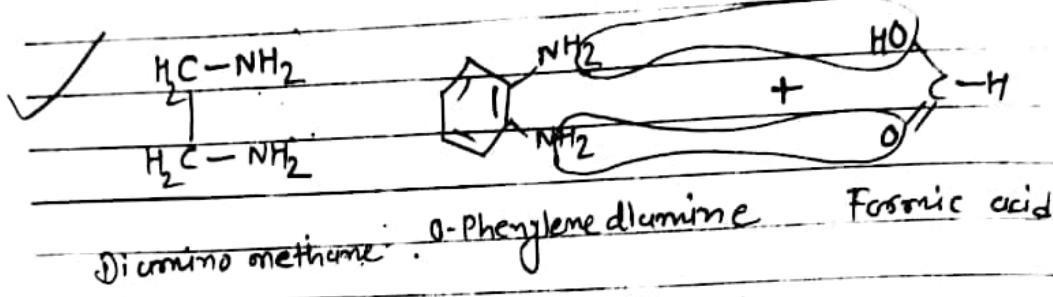
100%
 synthesis

Benzimidazole



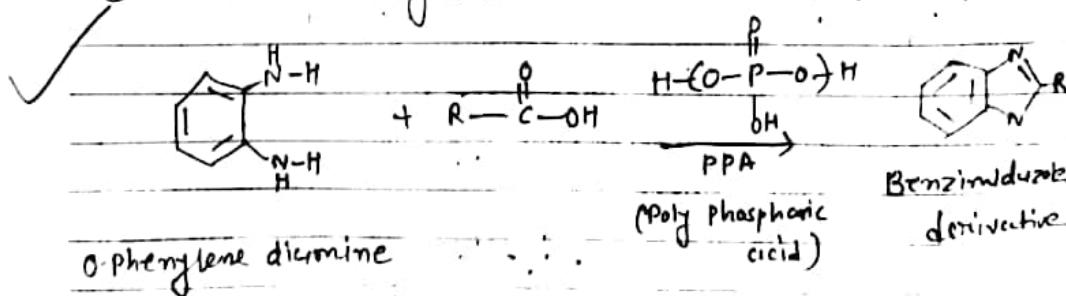
SYNTHESIS

① From α -Phenylene diamine

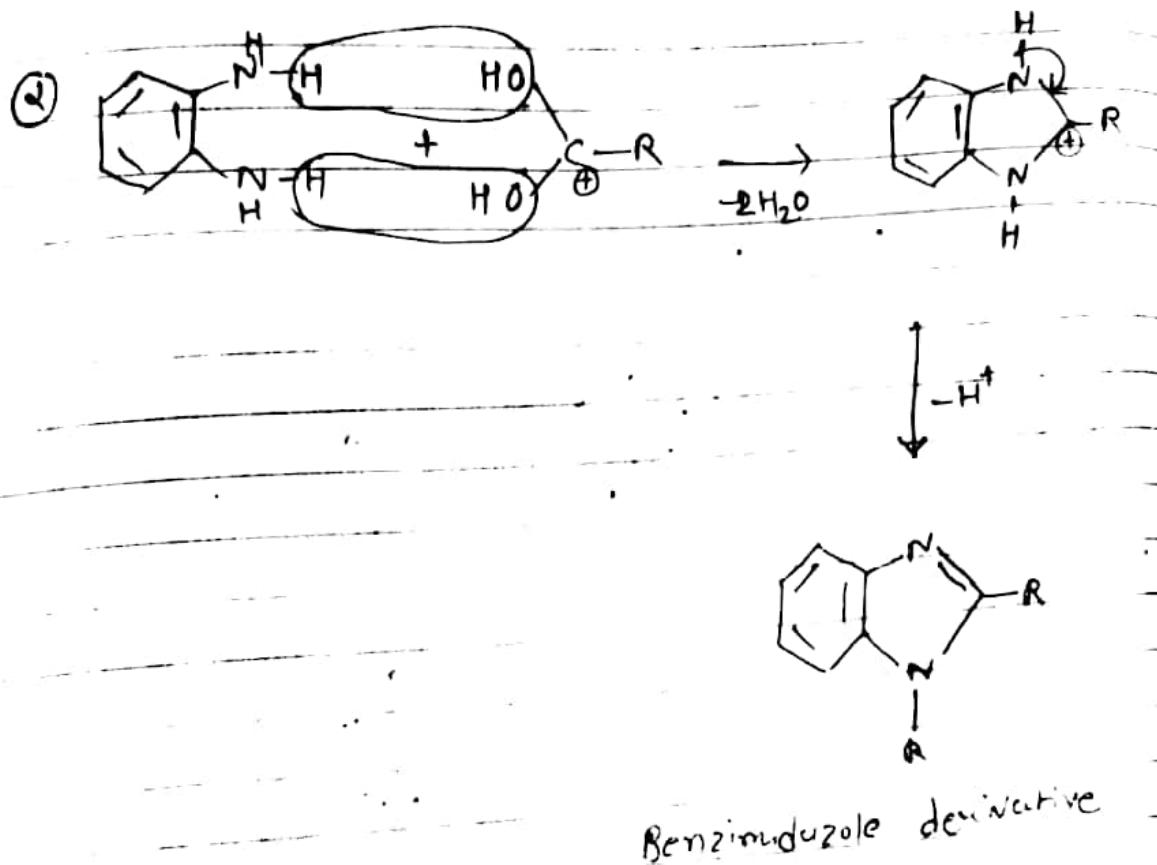
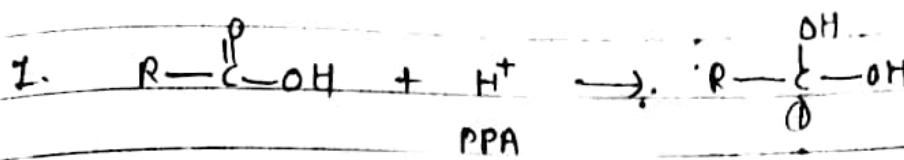


Benzimidazole

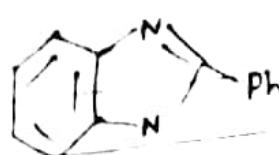
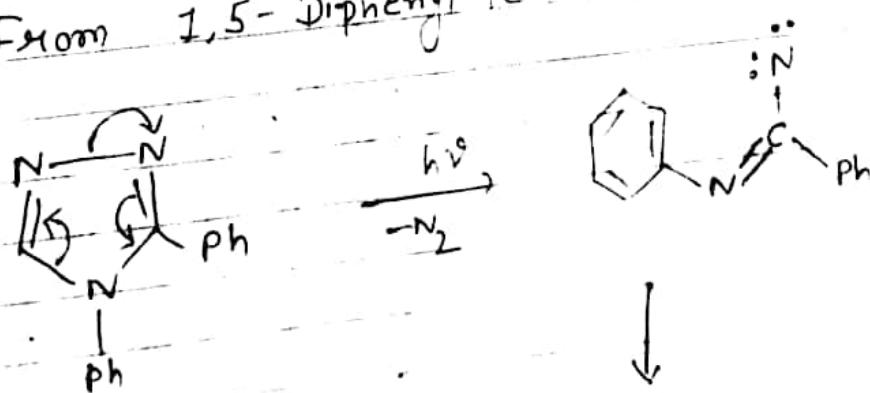
② From Carboxylic acids



Mechanism :-



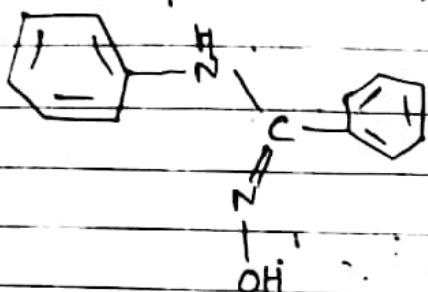
③ From 1,5-Diphenyl-tetrazole



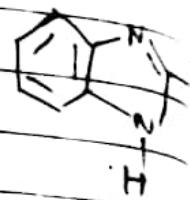
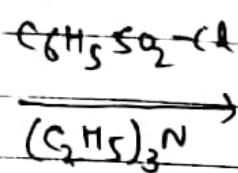
o-phenyl-benzimidazole

(4) From Arylamidines:-

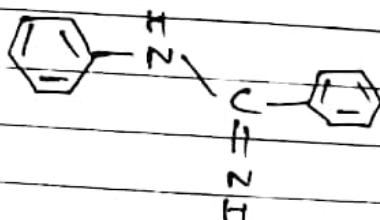
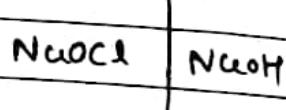
①



N-Phenyl-N-hydroxyimidine



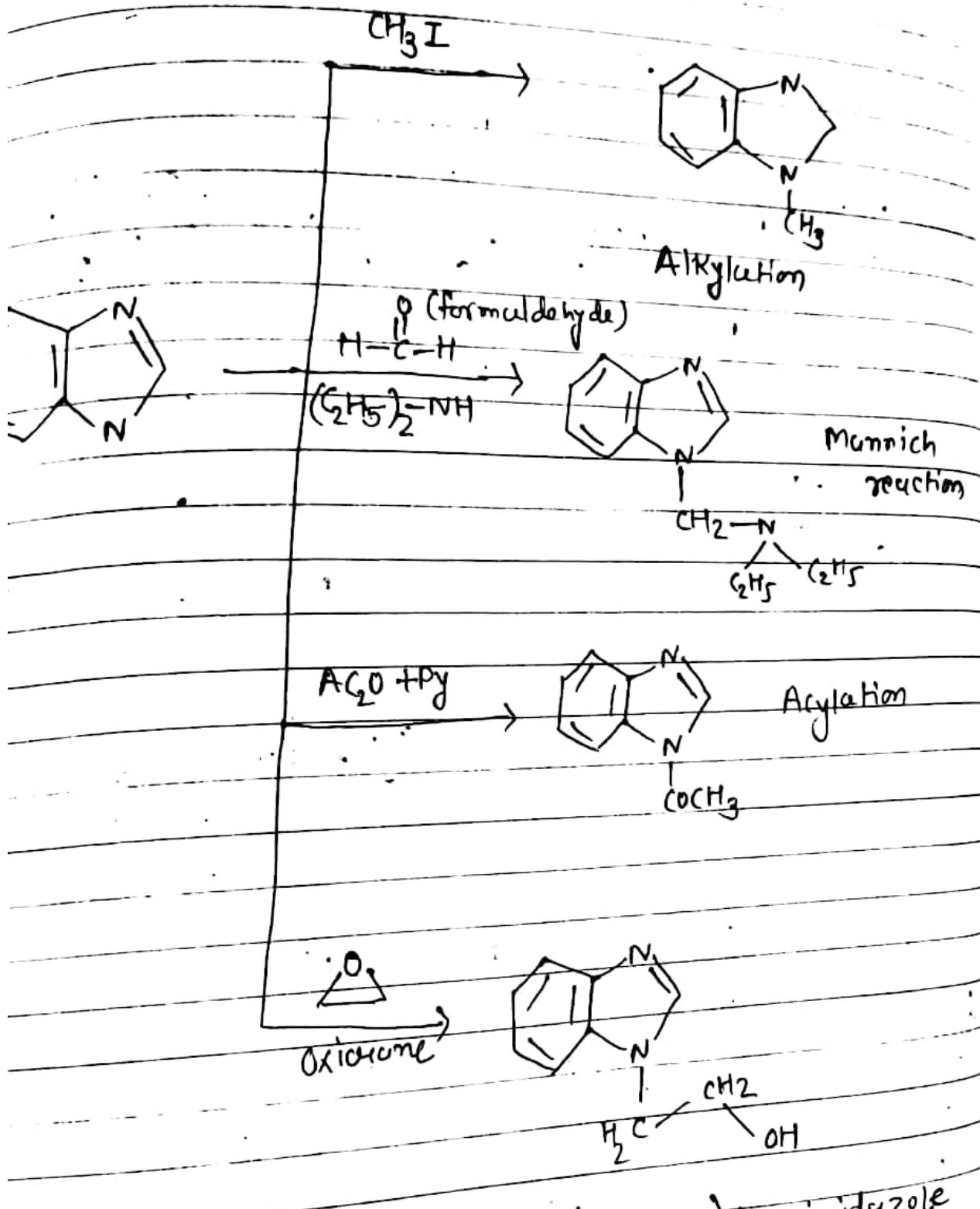
2-Phenylbenzimidazole



REACTIONS

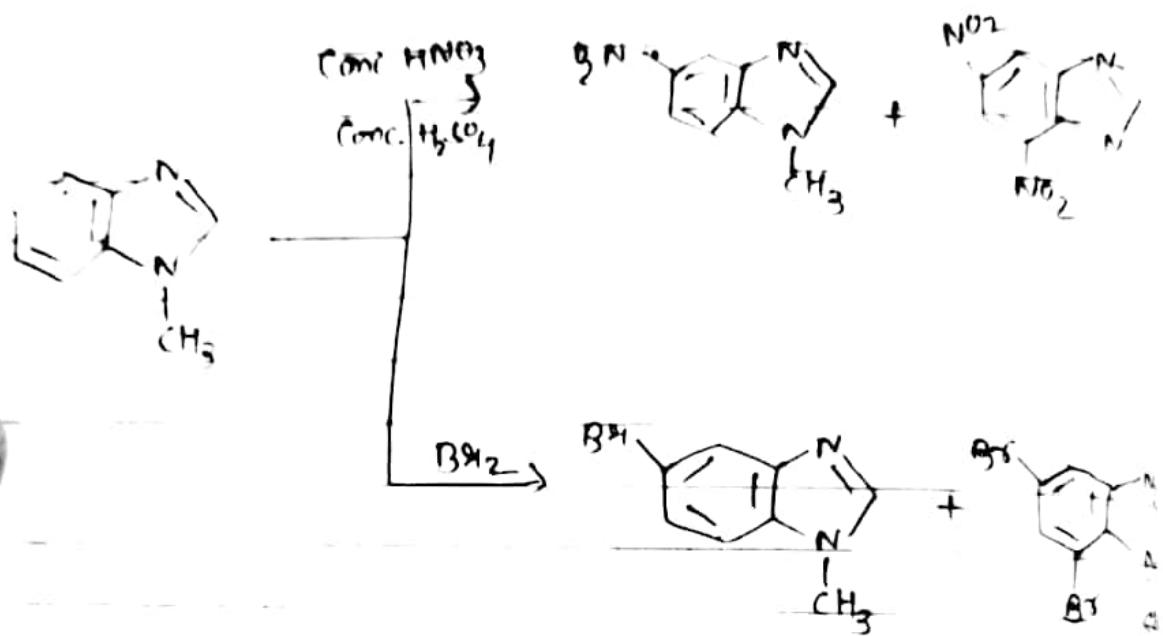
N-phenylimidine

- ① Electrophilic Substitution Reactions
- Electrophilic substitution reaction occurs at C-5 position
- Nucleophilic Substitution reaction occurs at C-2 position.
- * Electrophilic Substitution at "N" position

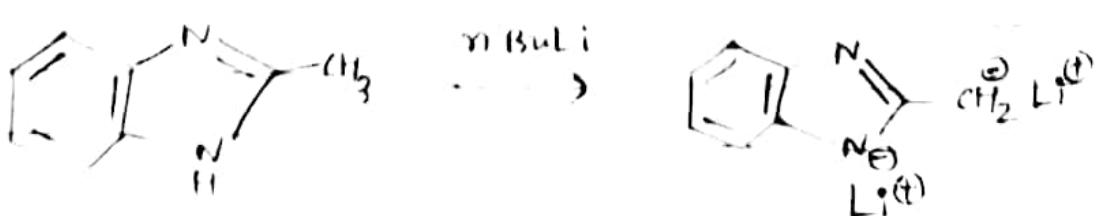
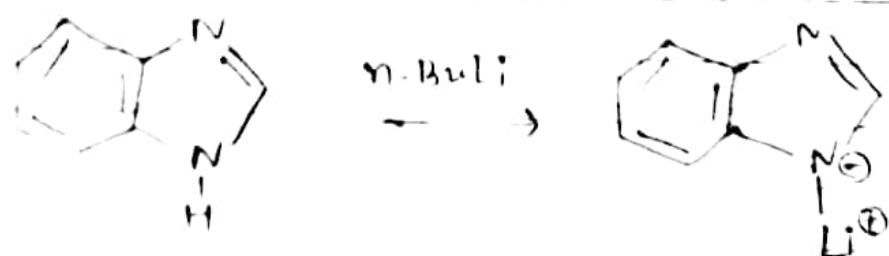


N(CCO)C1=CC=C1
N-(1-hydroxyethyl)benzimidazole

* Electrophilic Substitution at carbon
(5th position)



2 Nucleophilic Substitution Reaction
(2nd position)



2 Lithiomethyl - 1-Litho
benzimidazole

Divide Mem

Reaction of oxazanes P.P

Reactions

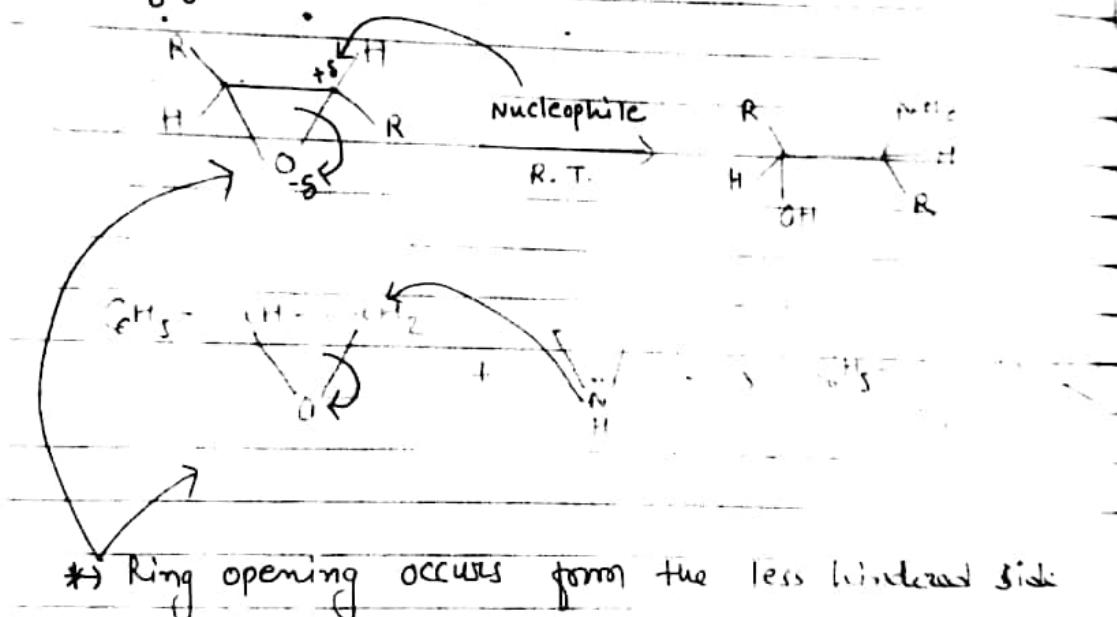
→ Q. 17 Explain nucleophilic, electrophilic and other ring opening Reaction of oxazane

(1) Ring opening reactions

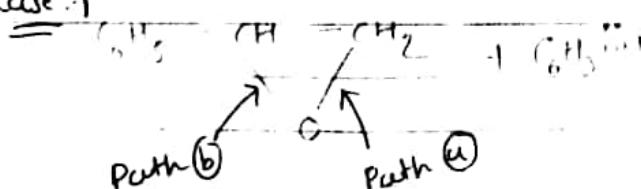
In oxazanes, the carbon-oxygen bond is more readily cleaved due to the enhanced reactivity to the high degree of ring strain.

(4) Nucleophilic Ring opening reactions:

Nucleophile attacks at the side opposite to the heteroatom with the inversion of configuration.



case. 1



(A)

(B)

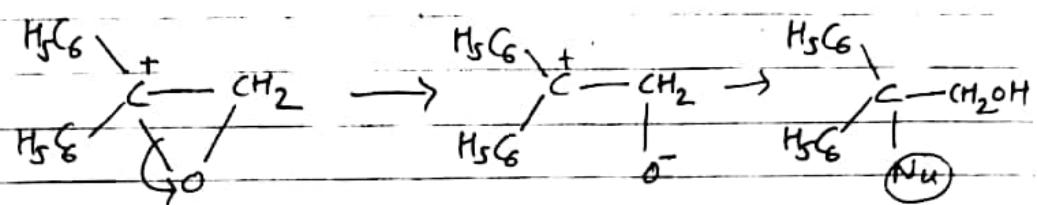
* $\text{NaOM}/\text{H}_2\text{O}$ { A: 25% } B: 65%

* 61.0 mg / diisopropyl ether
A: 41%
B: 36%

- Nucleophile attacks on more hindered side, when we have more stable carbocation on the more hindered side.

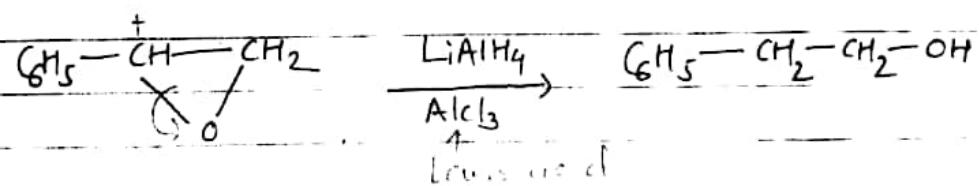
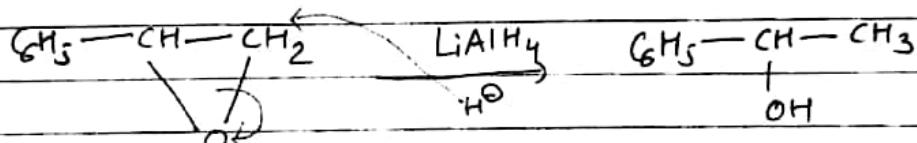
Examples :-

(1)



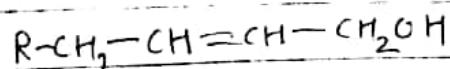
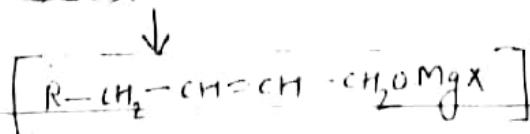
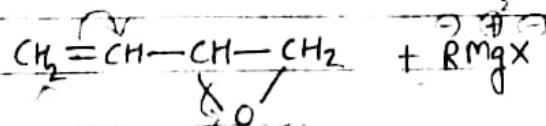
More stable carbocation at more hindered side

(2)

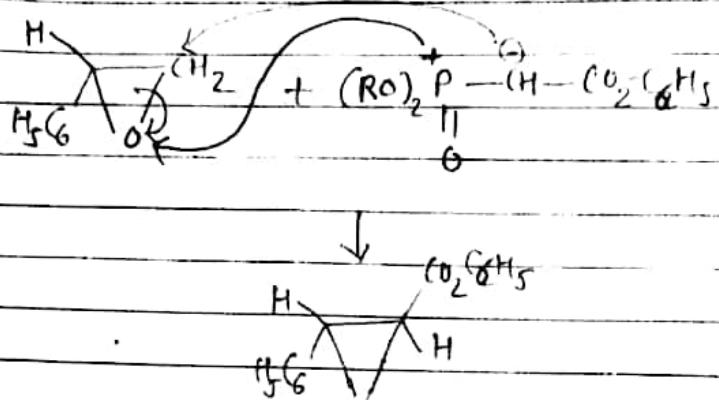


Note: When Lewis acid is present with LiAlH_4 , it (nucleophile) will attack from more hindered side.

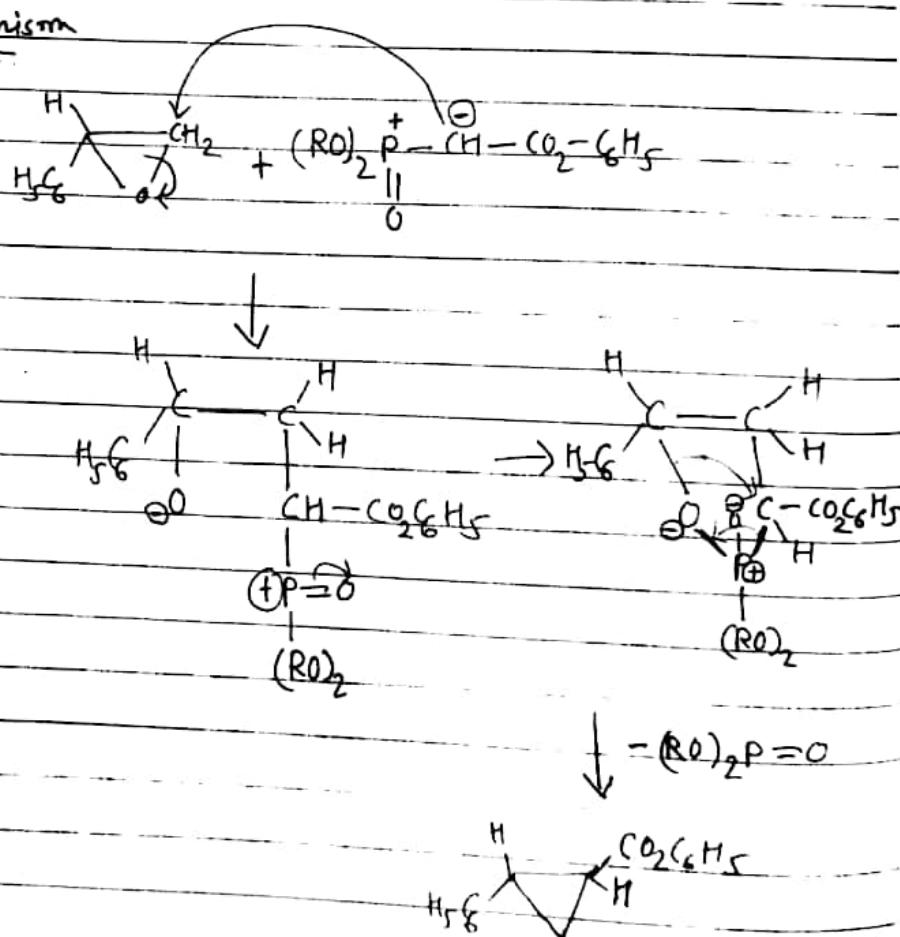
$\boxed{\text{SN}^2}$



*→ The reaction of oxigunes with phosphorous ylides of phosphoranes, phosphonates, convert oxigunes to cyclopropanes. The reaction proceed with Inversion in configuration.

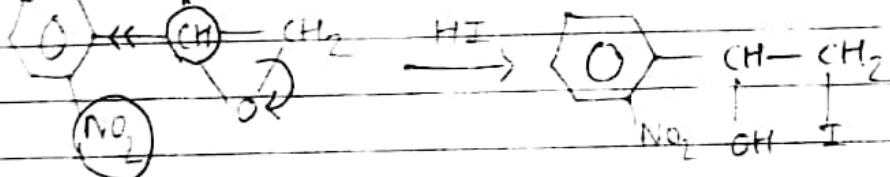
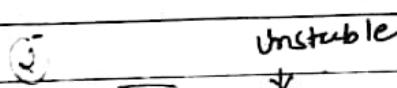
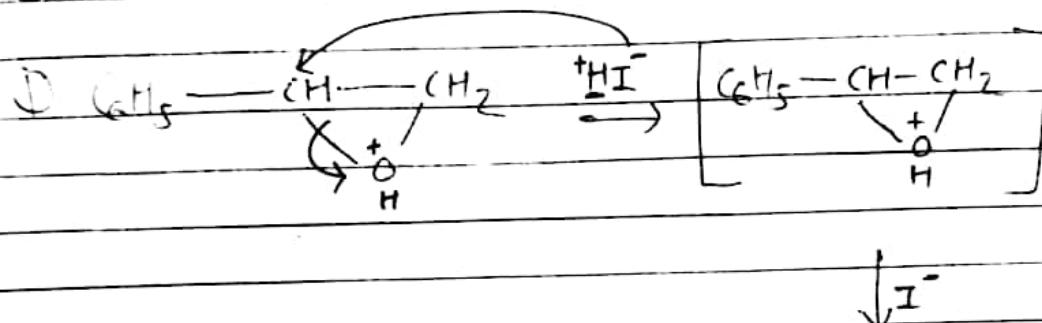


Mechanism



(b) Electrophilic ring opening reactions:

Electrophilic reagents react with oxides most readily with the cleavage of bond between oxygen and the least substituted carbon atom.

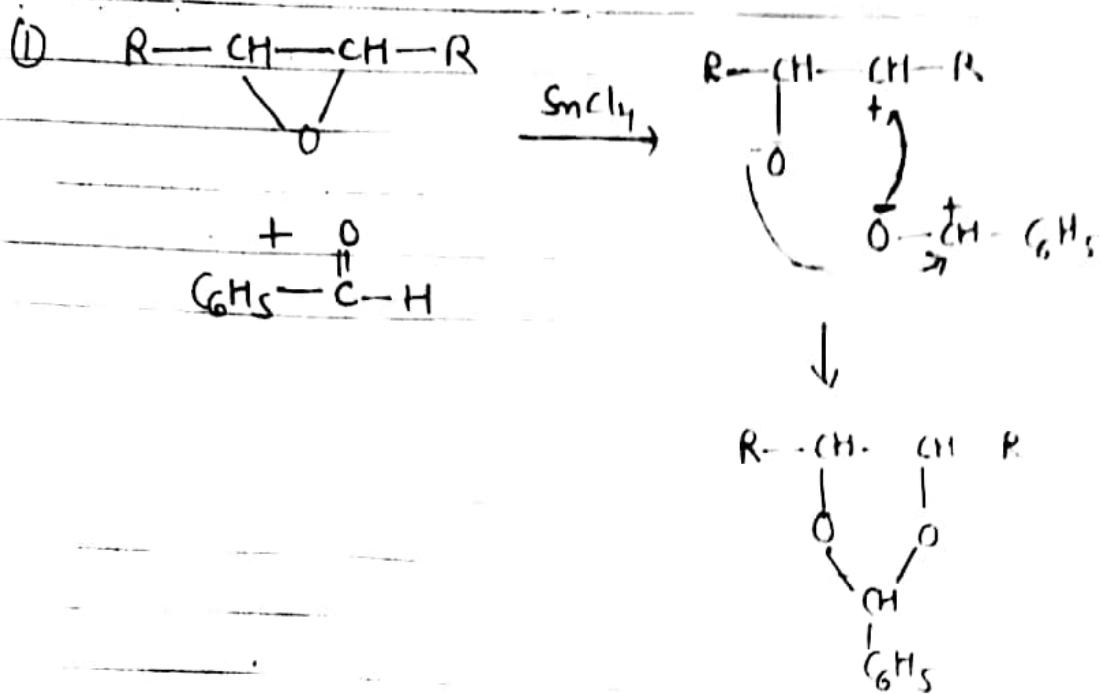


E.W.G.

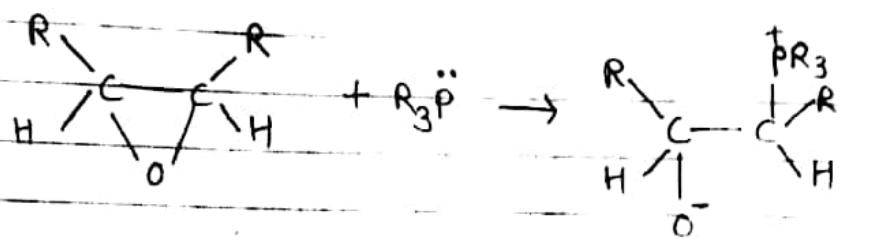
C Other song opening sections:

* Reactions with Carbonyl Compounds:

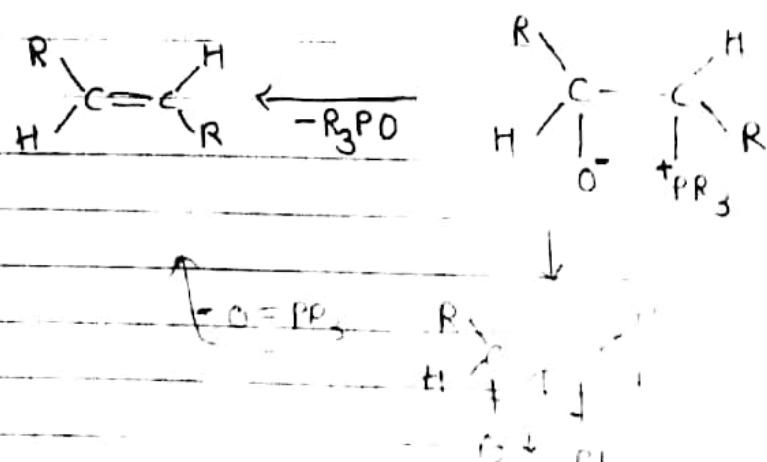
→ Oxigenes react with carbonyl compound
cleaving C=O bond and undergo ring expansion to form Dioxolenes.

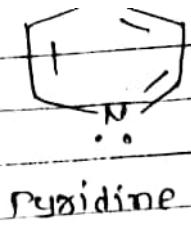
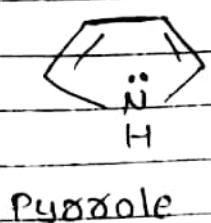


(2) Thermal reaction:



\downarrow
Rotation
 180°





$K = 10^{-7.4}$

aliphatic amine

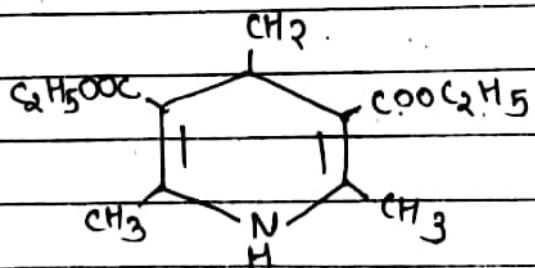
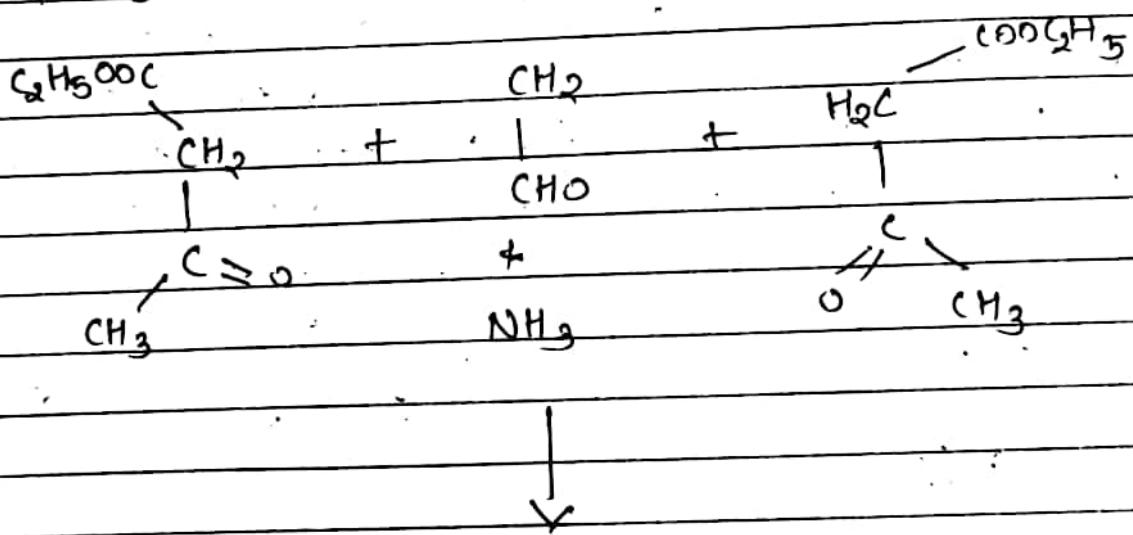
↑
Order of basicity (increasing)

Q. 18
for
Synthesis.

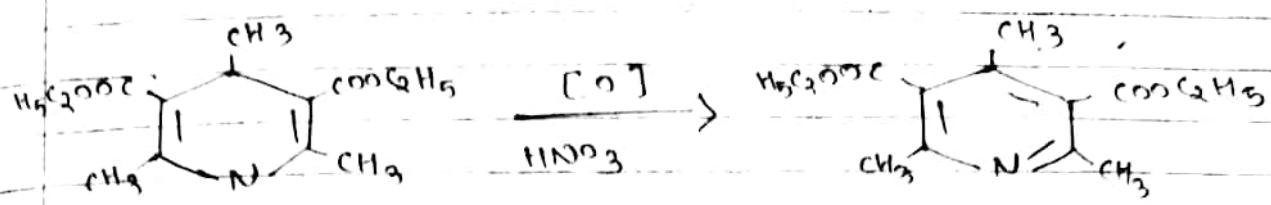
Synthesis of Pyridine

I Hantzsch Pyridine synthesis

→ Condensation of 2 moles of B - carbonyl compounds | B keto esters with aldehyde + ammonia.

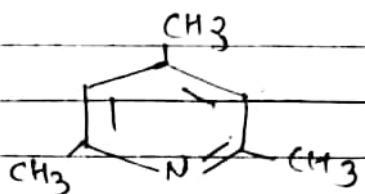
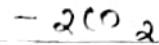


dihydropyridine derivative



pyridine derivative

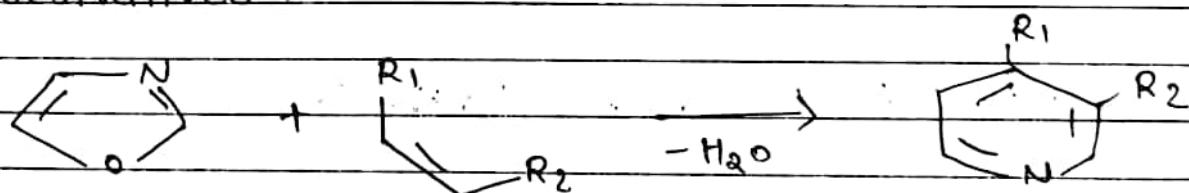
- i) KOH, EtOH
- ii) CaO, Δ



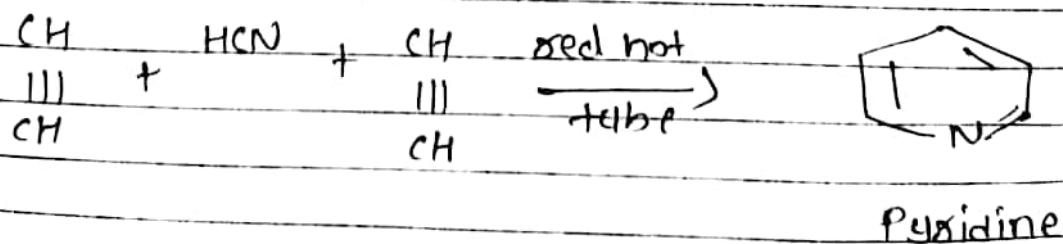
2,4,6-trimethyl pyridine

2 Pyridine from Diel's Alder cyclo addition reaction

→ Diel's Alder cycloaddition of oxazole (conjugated diene) and dienophile produce pyridine derivatives.

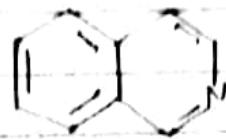


3 Pyridine from HCN + acetylene



Quinolines

* Structure:



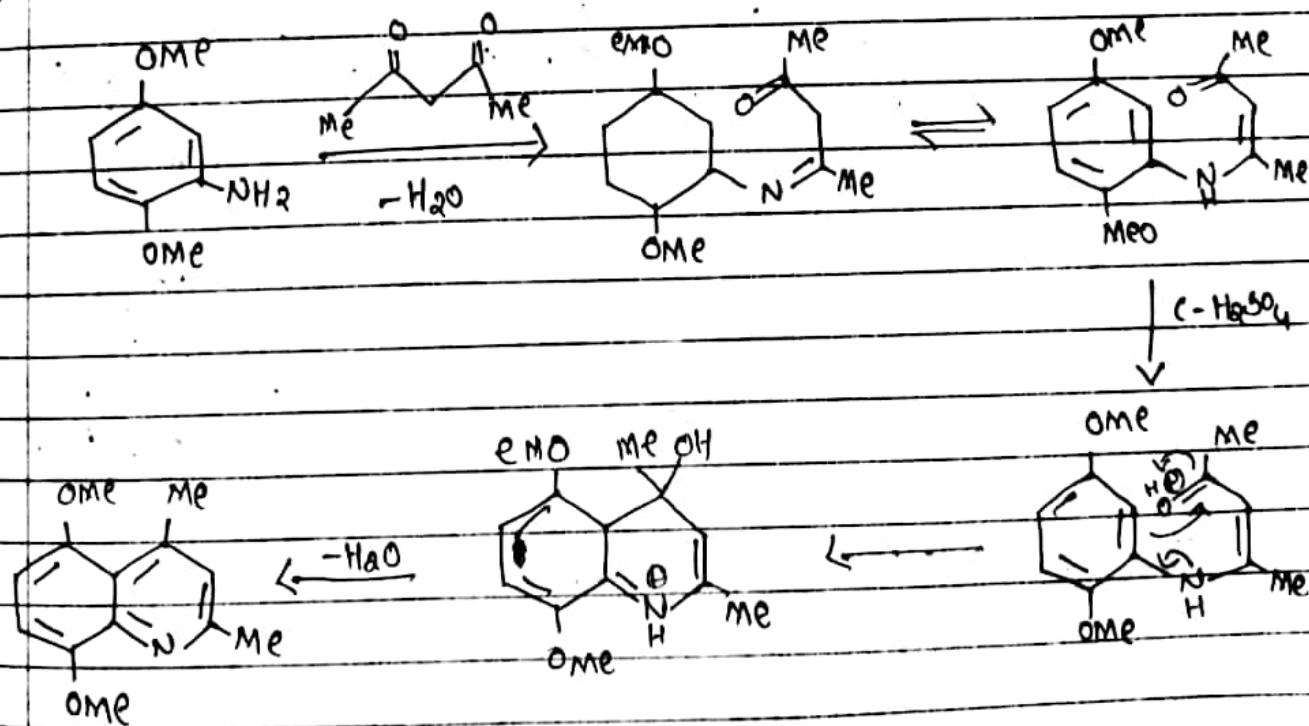
o Pka values (4.9 and 5.4) are similar to that of Pyridine

o Possess aspects of pyridine and naphthalene reactivity e.g. from N-oxides and ammonium salts.

Synthesis

①. 1R topo synthesis

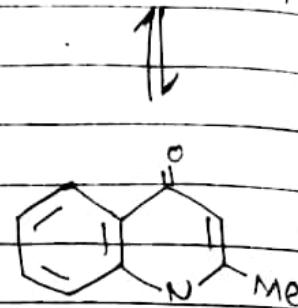
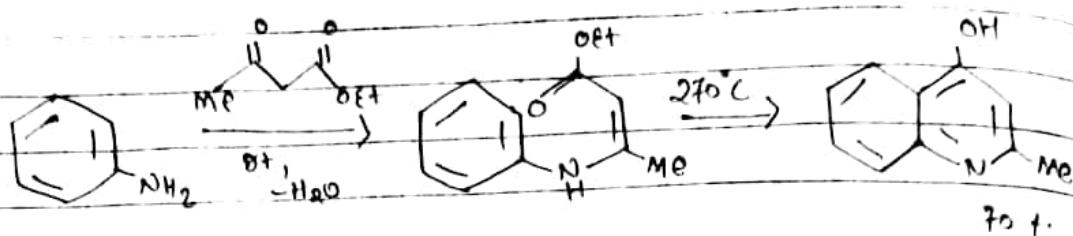
① Combes Synthesis ("3 + 3")



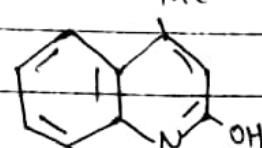
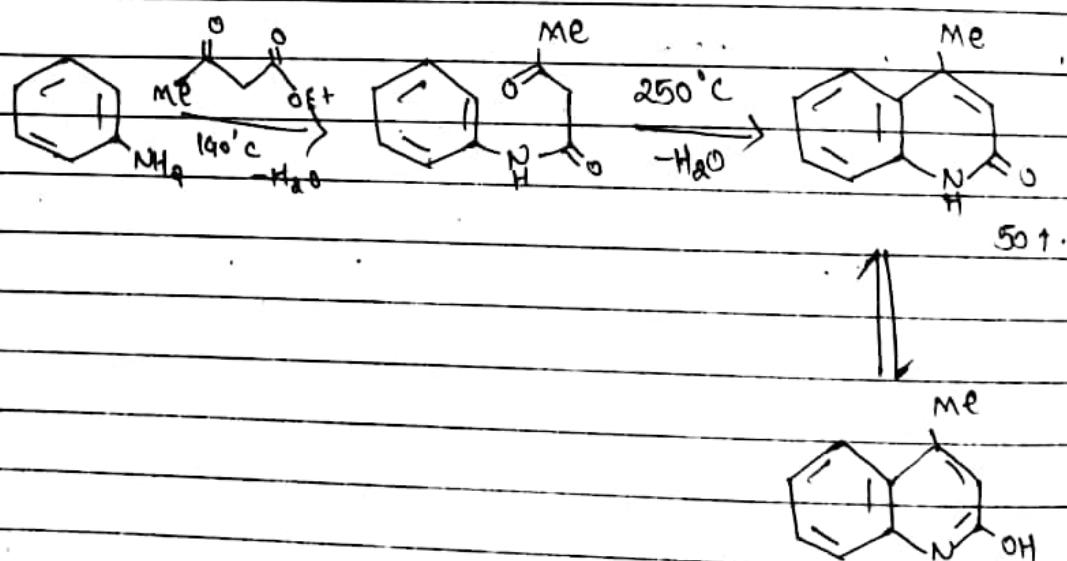
23-1.



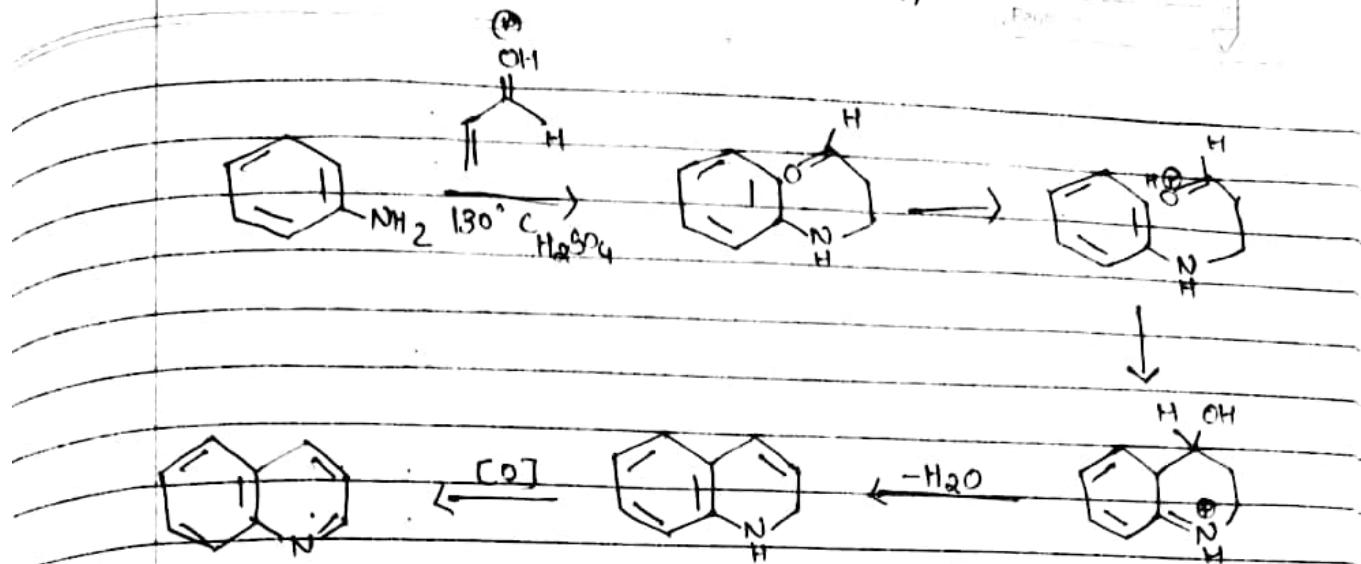
2. Conrad - Limpeach - Knorr Synthesis.



- Very similar to the Combes synthesis by a β -keto ester is used instead of a β -diketone
- Altering the reaction conditions can completely alter the regiochemical outcome

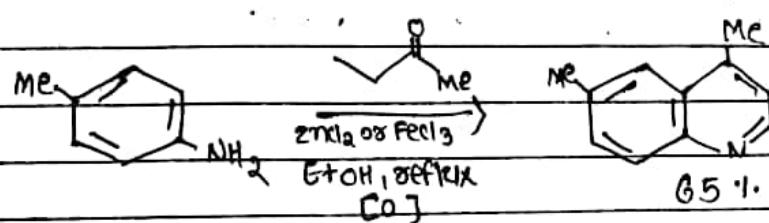


3. Skraup Synthesis:

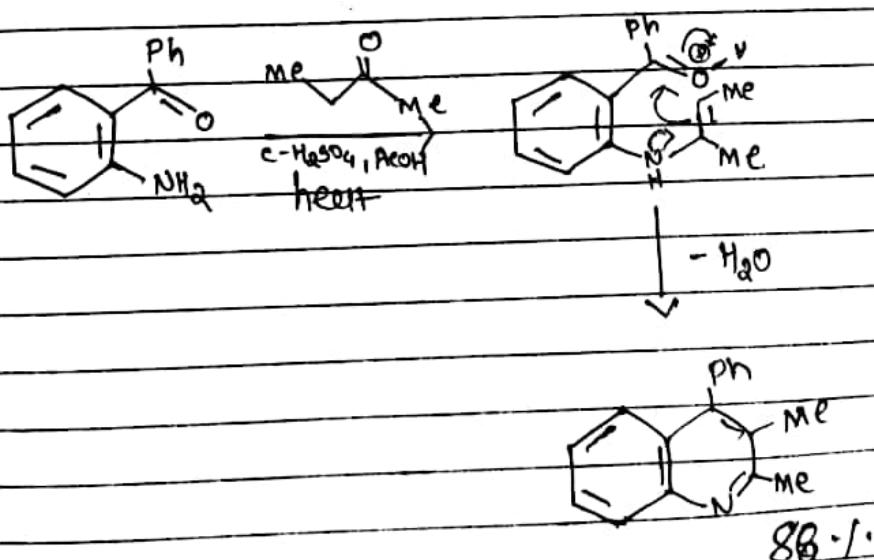


o Acacoline can be generated in situ by treatment of glycerol with conc. sulfuric acid.

o A mild oxidant required to form the fully aromatic system from the dihydrazinoline



4 Friedlander Synthesis [4+2]



II "Terpenoids are the hydrocarbons of plant origin of the general formula $(\text{C}_5\text{H}_8)_n$, as well as their oxygenated, hydrogenated and dehydrogenated derivatives".

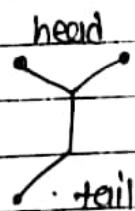
Q.21 Describe Isoprene Rule with its fission.

II. Isoprene Rule:

- Thermal decomposition of terpenoids give isoprene as one of the product. Otto Wallach pointed out that terpenoids can be built up of isoprene unit.
- Isoprene rule states that terpenoid molecules are constructed from two or more isoprene unit.



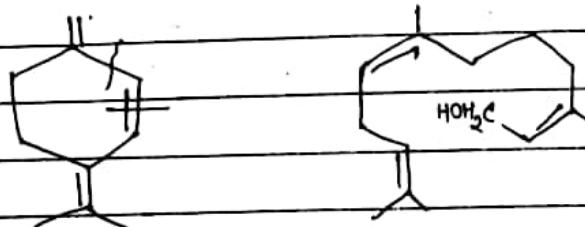
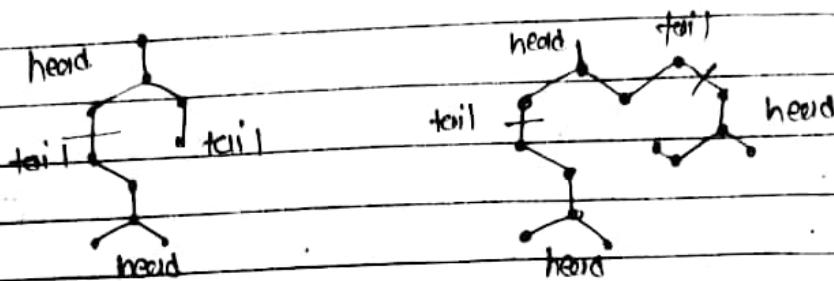
Further Ingold suggested that isoprene units are joined in the terpenoid via "head to tail" fashion. Special isoprene rule state that the terpenoid molecule are constructed of two or more isoprene units joined in a "head to tail" fashion.



- But this rule can only be used as guiding principle and not as a fixed rule. For example carotenoids are joined tail to tail at their central and there are also some terpenoids whose

carbon content is not a multiple of five.

→ In applying isoprene rule we look only for the skeletal unit of carbon. The carbon skeletons of open chain mono terpenoids and sesqui terpenoids are



Exaggero)

(Monoterpene)

(Sesquiterpene)

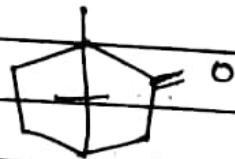
→ Ingold (1921) pointed that a gem alkyl group affects the stability of terpenoids. He summarized these results in the form of a rule called gem dialkyl rule which may be stated as "Gem dialkyl group tends to render the cyclohexane ring unstable whereas it stabilize the three, four and five membered rings."

→ This rule limit the number of possible structures in closing the open chain to a ring structure. Thus the monoterpene open chain give rise to only possibility for a monocyclic monoterpene i.e. the p-cymene structure.

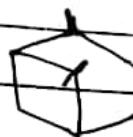


P-Cymene Structure

→ Bicyclic monoterpenoids contain a six membered and a three membered ring. This closure of the ten carbon open chain monoterpenoid give three possible bicyclic structures.



Camphor
(6+5) system



Pinane
(6+4) system



Curzene
(6+3) system

Classification of Terpenoids

+ Most natural terpenoids hydrocarbons have the general formula $(C_5H_8)_n$

→ They can be classified on the basis of value of n or number of carbon atoms present in structure.



No.	Number of carbon atoms	Value of n	class
1.	10	2	Monoterpeneoids ($C_{10}H_{16}$)
2.	15	3	Sesquiterpenoids ($C_{15}H_{20}$)
3.	20	4	Diterpenoids ($C_{20}H_{32}$)
4.	25	5	Sesterpenoids ($C_{25}H_{40}$)
5.	30	6	Triterpenoids ($C_{30}H_{48}$)
6.	40	8	Tetraterpenoids ($C_{40}H_{64}$)
7.	>40	>8	Polyterpenoids (C_5H_8) _n

→ Each class can further subdivided into
Subclass according to the number of rings
Present in the structure.

- i Acyclic Terpenoids: They contain open structure
- ii Monocyclic terpenoids: They contain ~~two~~^{one} rings in the structure
- iii Bicyclic terpenoids: They contain two rings in the structure
- iv Tricyclic terpenoids: They contain three rings in the structure
- v Tetra cyclic terpenoids: They contain four rings in the structure.

Some examples of Mono, sesqui and diterpenoids.

Q.28 write a note on vitamin B₂ and vitamin H

9

Vitamin B₂ (Riboflavin)

Date _____
Page No. _____

O Properties

- Water soluble
- Promotes good eyesight
- Helps to break down fats, proteins & carbs
- Play vital role in maintaining the body energy supply.
- Offers protection against anaemia
- Essential for human health
- Promotes the well functioning of the reproductive system.

O Deficiency

- Redness of tongue
- tiredness
- difficulty in the formation of blood

O Sources

- Asparagus, Avocados, Sweet Potatoes, Nuts, Meat, egg, fish, milk, veggies, mushrooms, Pumpkins, grain, beef, kidneys & liver of Animals

* In the body Riboflavin transformed in the form of co-enzyme that is called as Flavin - Adenine dinucleotide (FAD)

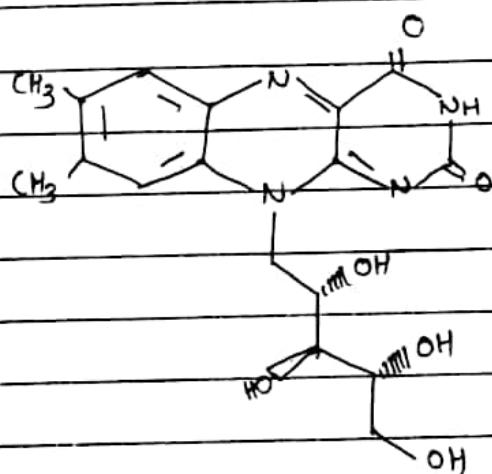
* Active in citric acid cycle.

* Also helps to convert carbohydrates into Adenosine triphosphate (ATP) which the Human body introduces ATP from food.

* People needs to consume Vit B₂ everyday because body can only store small amount & supplies go down rapidly

* Toxicity: Poisonous in very high dose

* Structure:



Molecular formula: C₁₇H₂₀O₆N₄

Biotin (Vitamin-H)

Date /
Page No.

Q. 23

(vit-B7)

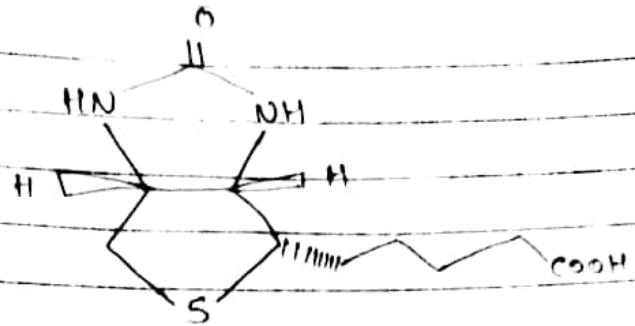
Functions:

- Co-enzyme in carboxylation reactions in glycogenesis and fatty acid synthesis.
- It is involved in a wide range of metabolic processes, both in humans & in other organisms, primarily related to the utilization of fats, carbohydrates and amino acids.
- Biotin is heterocyclic comp. with sulfur containing ring fused oxazole and tetrahydros thiophene group.
- A C₅ carboxylic acid side chain is appended to one of the rings. The ureido ring, containing the -N=CO-N- group, serves as the carbon dioxide carrier in carboxylation reactions.
- Biotin is a coenzyme for five carboxylase enzymes, which are involved in the digestion of carbohydrates, synthesis of fatty acids, and gluconeogenesis.

Chemical Structure: C₁₀H₁₆N₂O₃S



Structure:



Sources:

→ Animal based: chicken liver, Beef liver, Eggs, Egg white, Egg yolk, Pork chop, Turkey, Tuna

→ plant based: Peanuts (roasted), sunflower Seeds, Almonds (roasted), sweet Potato, Broccoli, tomato, strawberry, Avocado, cereals, oat meals, etc.

→ Dairy Products: cheese, Milk,

8.2 DEFINITION AND CHARACTERISTICS OF ENZYMES

Enzymes are protein catalyst produced by a cell and responsible for the high rate and specificity of one or more intracellular or extracellular biochemical reactions. Enzymes are biological catalysts responsible for supporting almost all of the chemical reactions that maintain animal homeostasis. Enzyme reactions are always reversible. The substance, upon which an enzyme acts, is called as substrate. Enzymes are involved in conversion of substrate into product. Almost all enzymes are globular proteins consisting either of a single polypeptide or of two or more polypeptides held together (in quaternary structure) by non-covalent bonds. Enzymes do nothing but speed up the rates at which the equilibrium positions of reversible reactions are attained. In terms of thermodynamics, enzymes reduce the activation energies of reactions, enabling them to occur much more readily at low temperatures - essential for biological systems. The basic characteristics of enzymes includes

- (i) Almost all the enzymes are proteins and they follow the physical and chemical reactions of proteins
- (ii) Enzymes are sensitive and labile to heat
- (iii) Enzymes are water soluble
- (iv) Enzymes could be precipitated by protein precipitating agents such as ammonium sulfate and trichloroacetic acid.

Q.28 Short Note RNA

O Ribonucleic Acids (RNA)

- RNA is a polymer of ribonucleotides.
- The individual ribonucleotides are linked together by phosphodiester bonds.
- The attachment of the phosphate is at the 3' position in the ribose molecules.
- Common base in RNA are adenine, guanine uracil and cytosine

According to the source of nucleic acid these are three types of nucleic acid

Ribosomal RNA (r RNA)

Transfer RNA (t RNA)

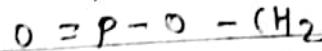
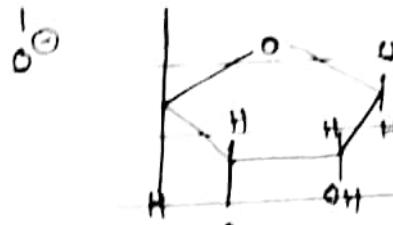
Messenger RNA (m RNA)

→ The secondary structure of RNA has been investigated and it appears that RNA exist as a single stem strands which contain in helical segments established by hydrogen bond.

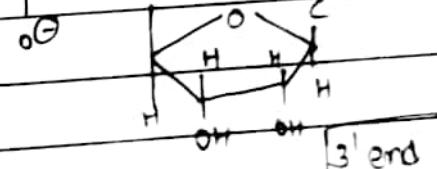
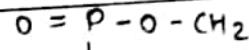
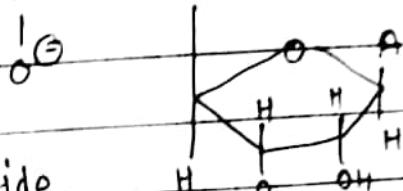
Primary structure of RNA:

5' end

O^\ominus [5' end]



Tetra nucleotide



[3' end]

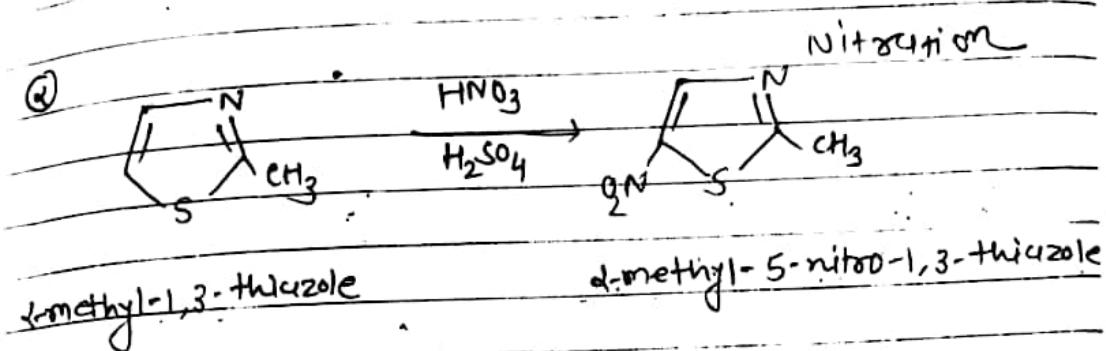
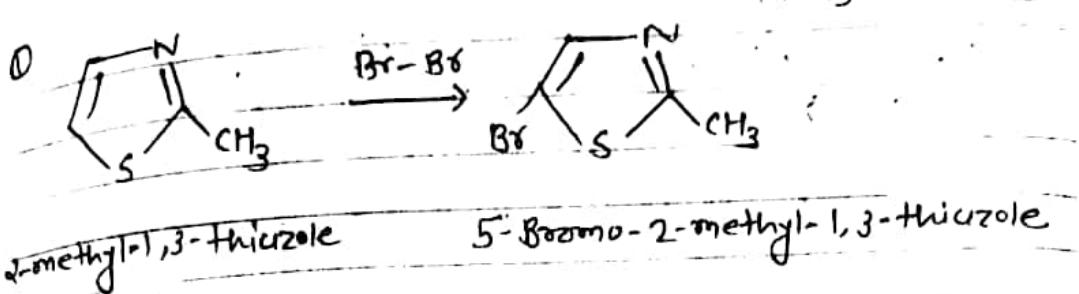
Reaction

Q. 30

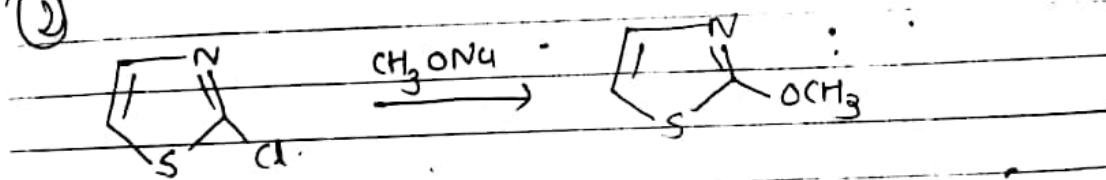
4

① Electrophilic Substitution Reactions :-

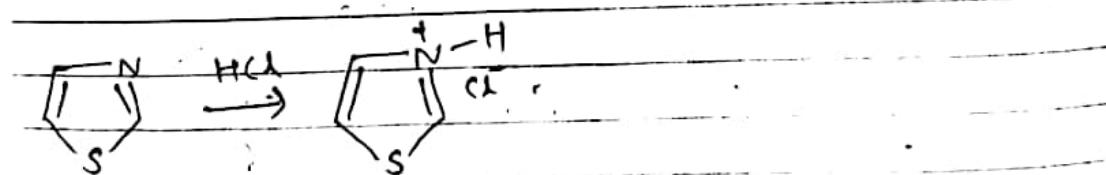
[Take place at position 5 in presence of electron releasing groups]



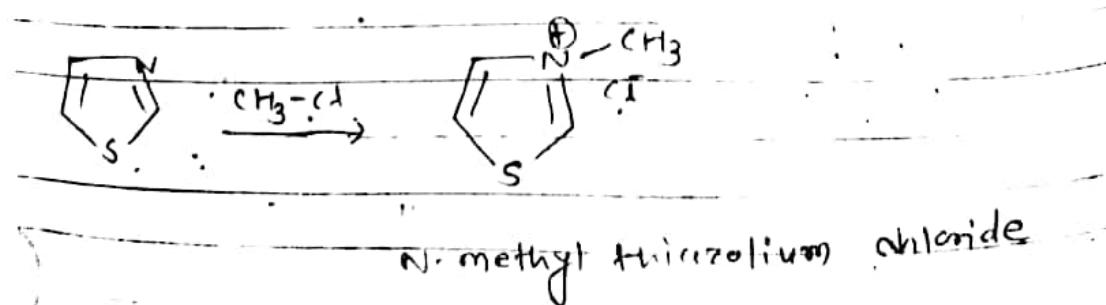
② Nucleophilic Substitution Reactions



Quaternisation



Thioulium chloride

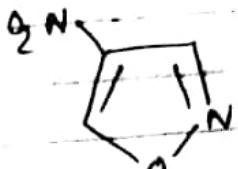
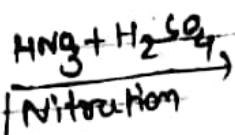


REACTIONS

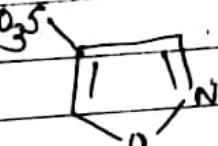
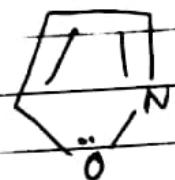
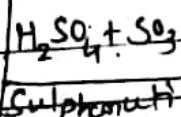
Q. 30

8

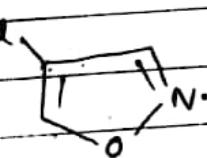
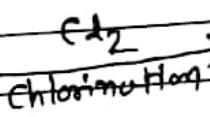
(1) Electrophilic Substitution Reactions (4th position)



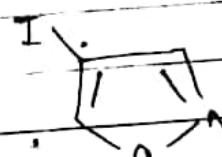
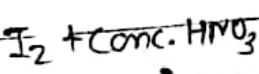
4-nitro isoxazole



4-Sulphoisoxazole

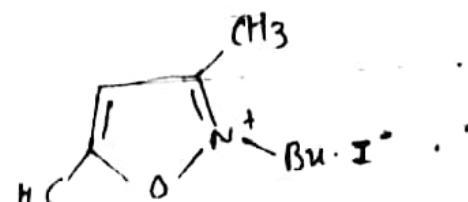
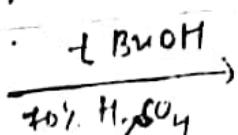
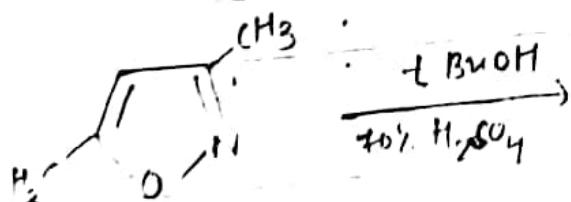


4-chloroisoxazole



4-iodoisoxazole

(2) Electrophilic substitution at "N":



N-oxazolium Salt

ISOMERIE

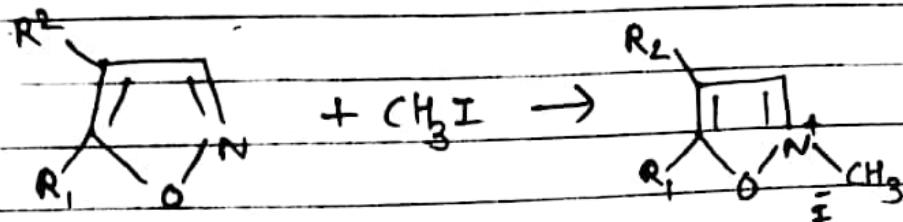
Imidazole

PYRAZOLE

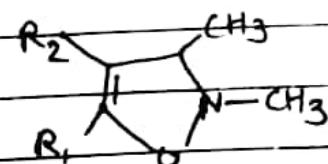
Thiazole

OXAZOLE

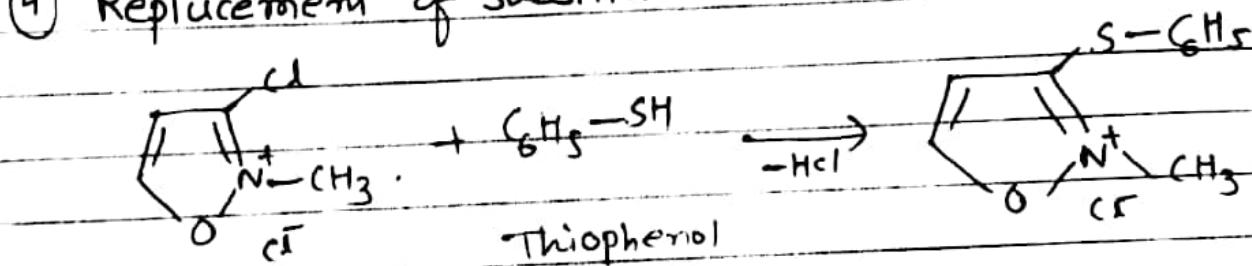
③ Addition Reactions:



$\text{HOH} \downarrow \text{CH}_3\text{MgI}$



④ Replacement of substituents:



Quaternized
isoxazole

⑤ Deprotonation at C3

