

B. Sc. III Year

Alkaloids

Presented by :

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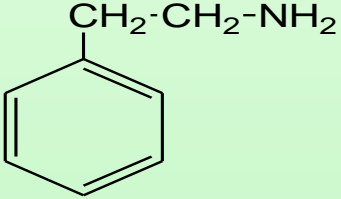
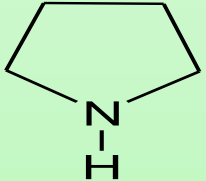
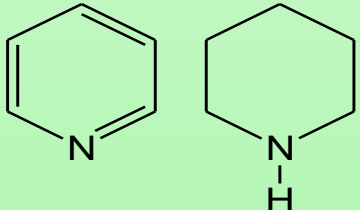
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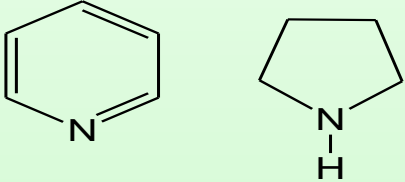
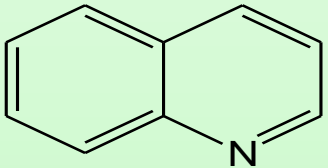
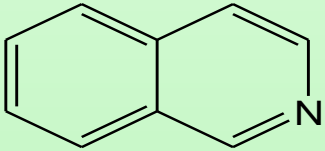
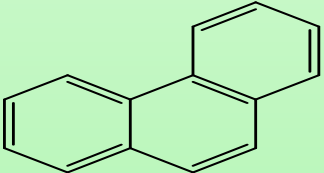
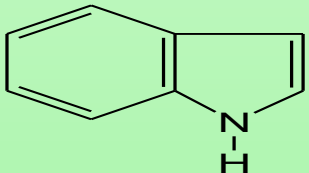
Alkaloids

- Alkaloids are physiologically active basic nitrogenous compound containing at least one nitrogen atom.
- Alkaloids are plant originated and most of the alkaloids contain nitrogen atom is a part of heterocyclic ring but some alkaloid like ephedrine and adrenaline it is a part of side chain.
- The name alkaloid is due to alkali like substance.
- **General properties of alkaloids :**
- i) Most of the alkaloids are colourless, crystalline and non volatile solids.
- ii) Alkaloids are insoluble in water and soluble in organic solvent.
- iii) They have bitter taste and optically active leavo rotatory compounds.
- iv) Alkaloids are basic in nature.
- v) They contain at least one nitrogen atom.

Classification of Alkaloids

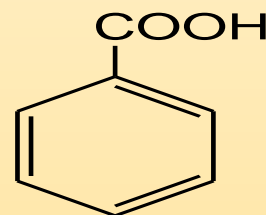
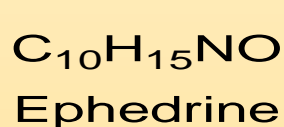
- Alkaloids are classified on the basis of nature of ring system present in the alkaloid structure as follows.

S.No.	Name of the alkaloid group	Ring system present	Examples
1	Phenyl-ethylamine group	 <chem>CCNc1ccccc1</chem>	Ephedrine, adrenaline.
2	Pyrrolidine group	 <chem>C1CCNC1</chem>	Hygrine, gramine,
3	Pyridine-piperidine group	 <chem>C1=CC=NC=C1</chem> <chem>C1CCNCC1</chem>	Piperine

S.No.	Name of the alkaloid group	Ring system present	Examples
4	Pyridine-pyrrolidine group	 <p>The image shows two chemical structures side-by-side. On the left is a pyridine ring, a six-membered aromatic heterocycle with one nitrogen atom. On the right is a pyrrolidine ring, a five-membered saturated heterocycle with one nitrogen atom bonded to a hydrogen atom.</p>	Nicotine
5	Quinoline group	 <p>The image shows the quinoline ring system, which consists of a benzene ring fused to a pyridine ring.</p>	Quinine, chinchonine
6	Isoquinoline group	 <p>The image shows the isoquinoline ring system, which consists of a benzene ring fused to a pyridine ring at the 2-position.</p>	Papaverine
7	Phenanthrene group	 <p>The image shows the phenanthrene ring system, which consists of three fused benzene rings in an angular arrangement.</p>	Morphine, codeine
8	Indole group	 <p>The image shows the indole ring system, which consists of a benzene ring fused to a pyrrole ring.</p>	Reserpine

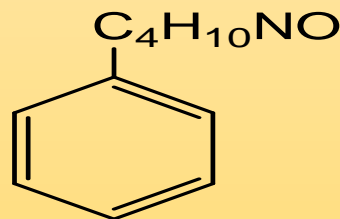
Constitution of Ephedrine

- i) Qualitative analysis shows ephedrine contains C, H, N and O elements.
- ii) Quantitative analysis shows molecular formula of ephedrine is $C_{10}H_{15}NO$
- iii) Ephedrine on oxidation with oxidizing agent gives benzoic acid.

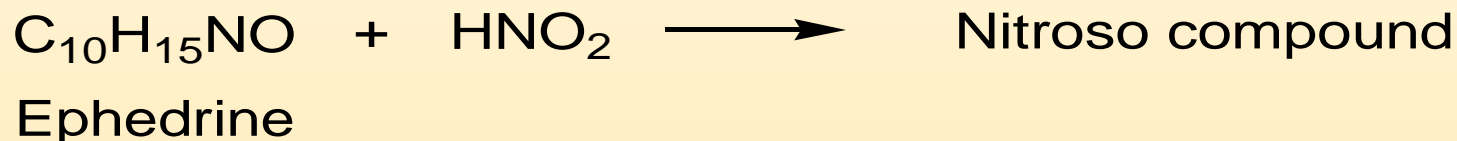


Benzoic acid

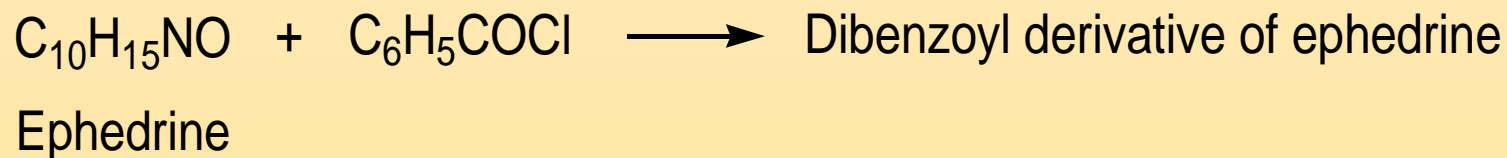
- It indicates that, ephedrine contains at least one benzene ring with one side chain $C_4H_{10}NO$



- iv) Ephedrine on treatment with nitrous acid gives nitroso compound.

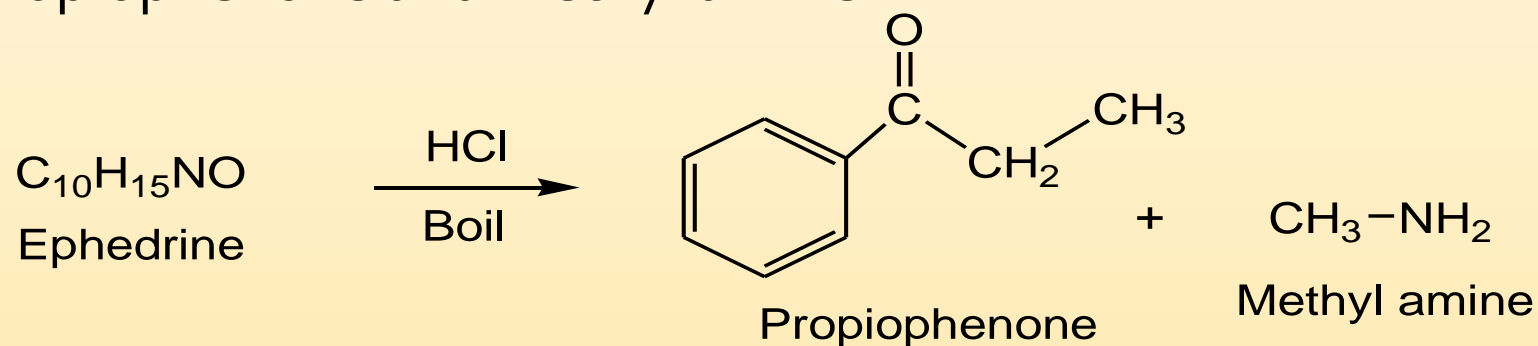


- It indicates that, ephedrine is a secondary amine.
- v) Ephedrine on benzylation with benzoyl chloride gives dibenzoyl derivative.

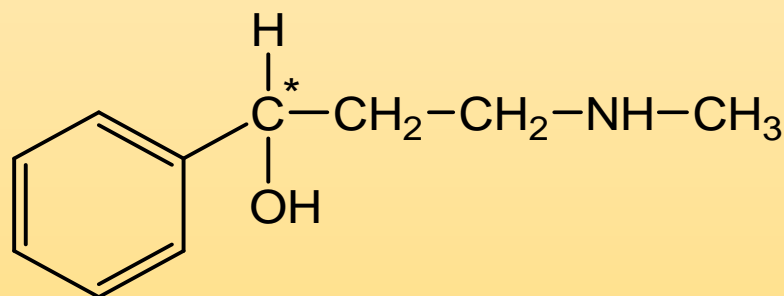


- It indicates that, one molecule of benzoyl chloride is utilized for benzylation of one –NH group and second molecule of benzoyl chloride must be utilized for benzylation of one –OH group.
- Therefore, ephedrine contains one –NH and one –OH group.

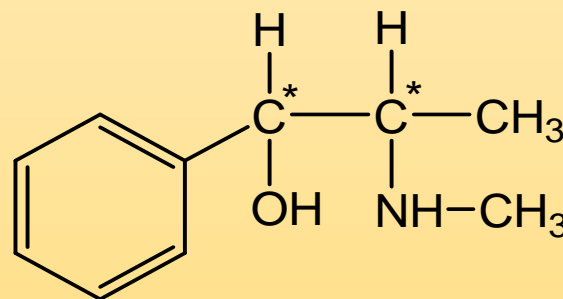
- vi) Ephedrine on boiling with HCl gives mixture of propiophenone and methyl amine.



- It indicates that, formation of propiophenone and methyl amine is possible only when the ephedrine possesses one of the following structures.

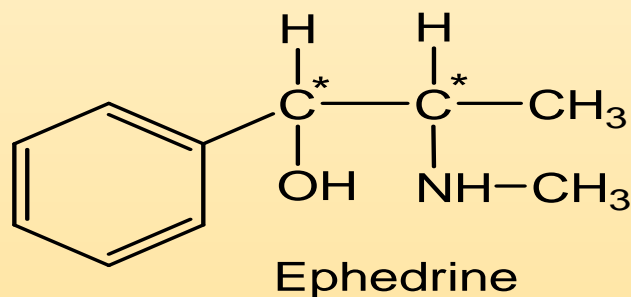


(Structure- A)



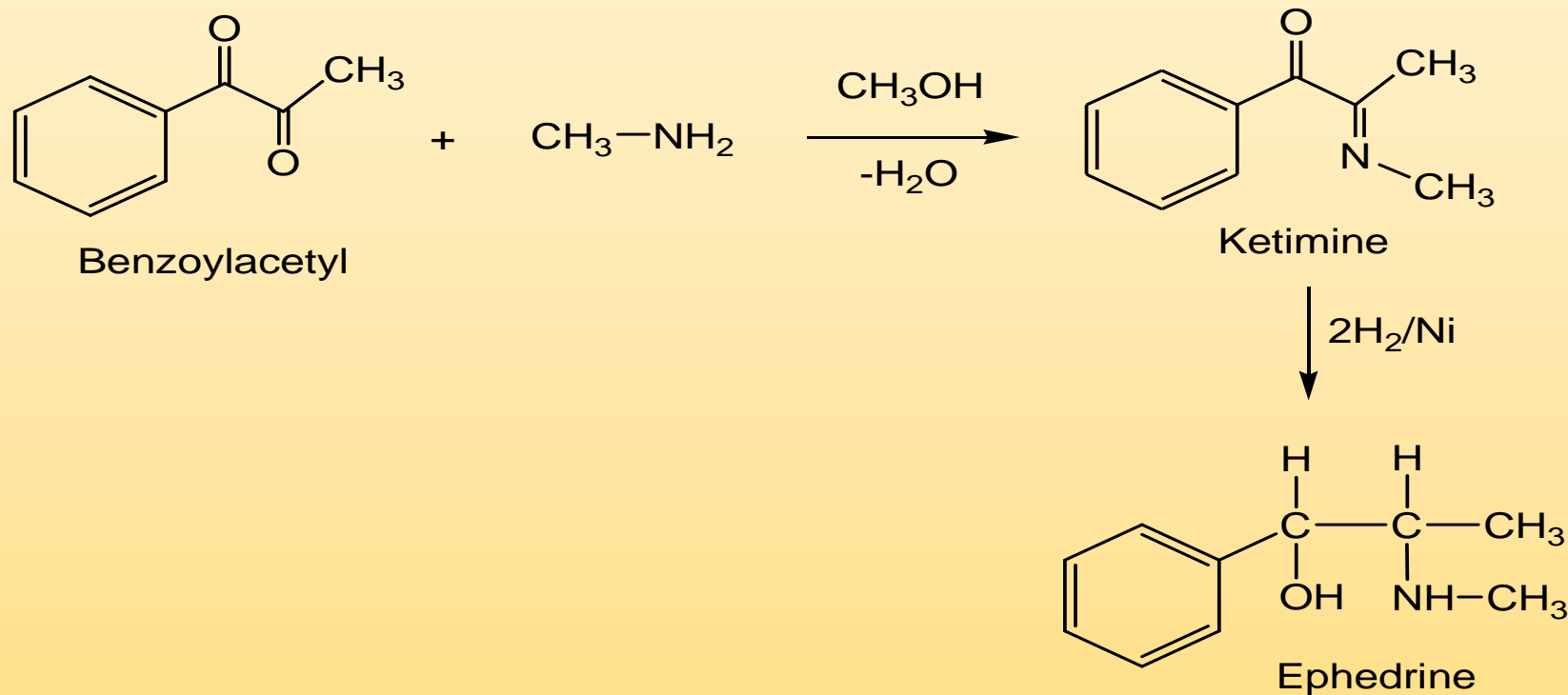
(Structure- B)

- Out of these two structures, only Structure-B undergo hydramine fission on boiling with HCl to produce propiophenone and methyl amine. Hence Structure-B is more possible structure of ephedrine as follows.



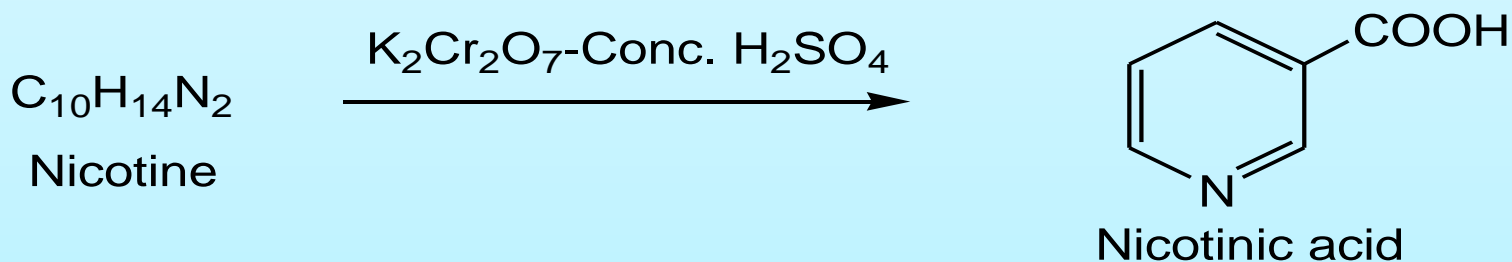
Synthesis of Ephedrine from 1-phenyl propane-1,2-dione (Benzoylacetyl)

- Benzoylacetyl on condensation with methyl amine in methanol to give ketimine, which on reduction with H_2/Ni gives ephedrine.

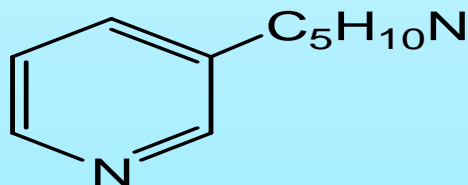


Constitution of Nicotine

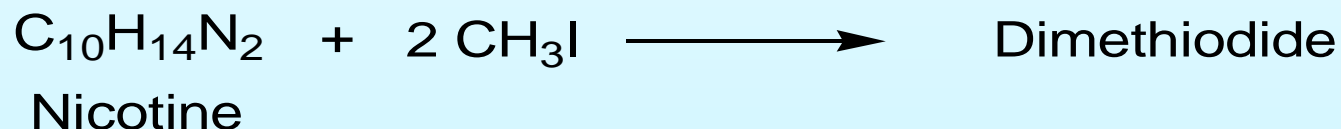
- i) Qualitative analysis shows nicotine contains C, H and N elements.
- ii) Quantitative analysis shows molecular formula of ephedrine is $C_{10}H_{14}N_2$
- iii) Nicotine on oxidation with chromic acid gives nicotinic acid.



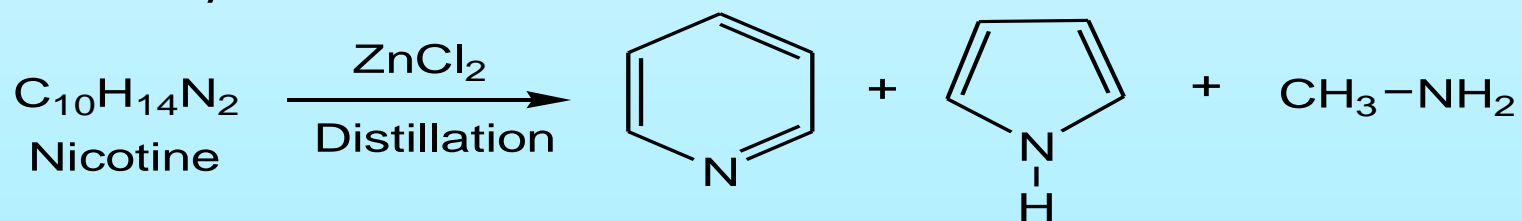
- It indicates that, nicotine is a pyridine ring with one side chain at 3-position.



- iv) Nicotine on treatment with methyl iodide gives dimethiodide.

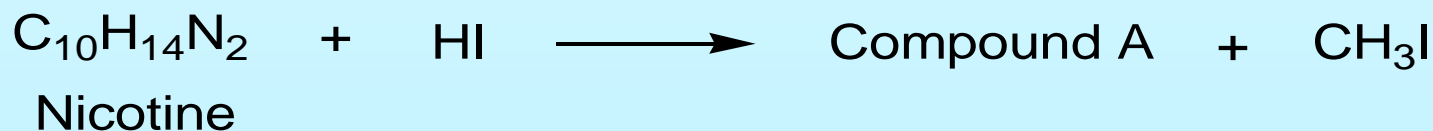


- It indicates that, two nitrogen atoms in nicotine are tertiary. One nitrogen atom is present in the pyridine ring and other nitrogen atom may be present in side chain.
- v) Nicotine is distilled with zinc chloride gives pyridine, pyrrole and methyl amine.

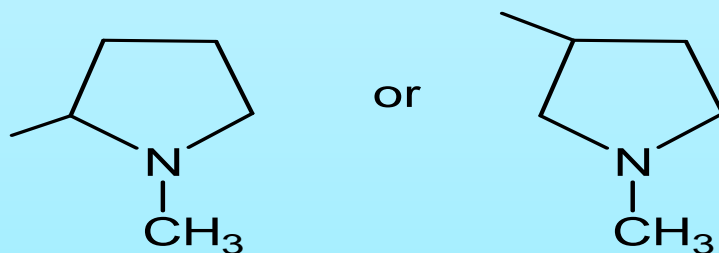


- It indicates that, nicotine contain pyridine ring with side chain pyrrole containing nitrogen atom may be tertiary.

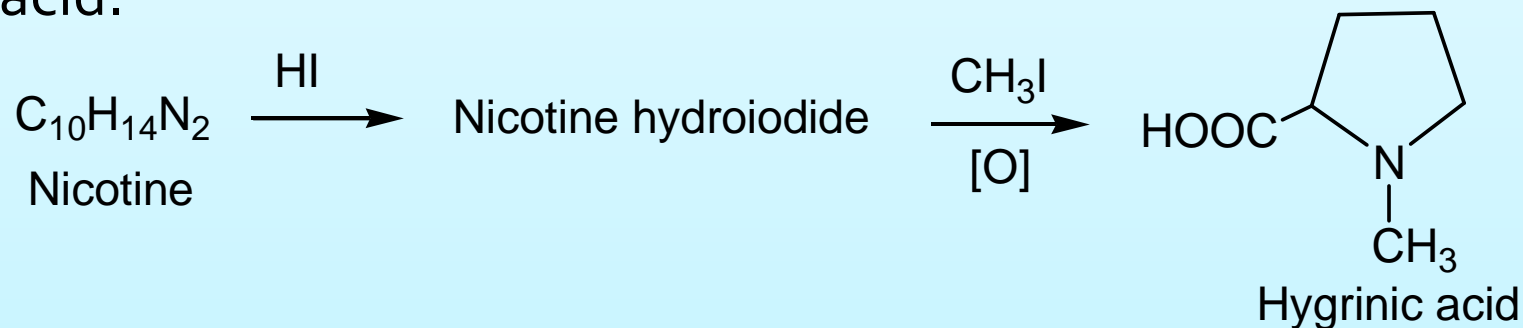
- vi) Nicotine on reduction, it utilize three H₂ molecule for reduction.
- It indicates that, nicotine contain pyridine ring with side chain is saturated.
- vii) Nicotine on heating with HI gives compound A and methyl iodide.



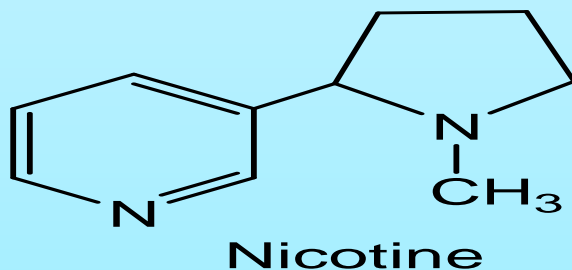
- It indicates that, side chain contain pyrrolidine ring with –NCH₃ group and the attachment of this side chain may be either at 2 or 3 position.



- viii) Nicotine on treatment with HI gives nicotine hydroiodide. Which on again methylation and then oxidation gives hygrinic acid.

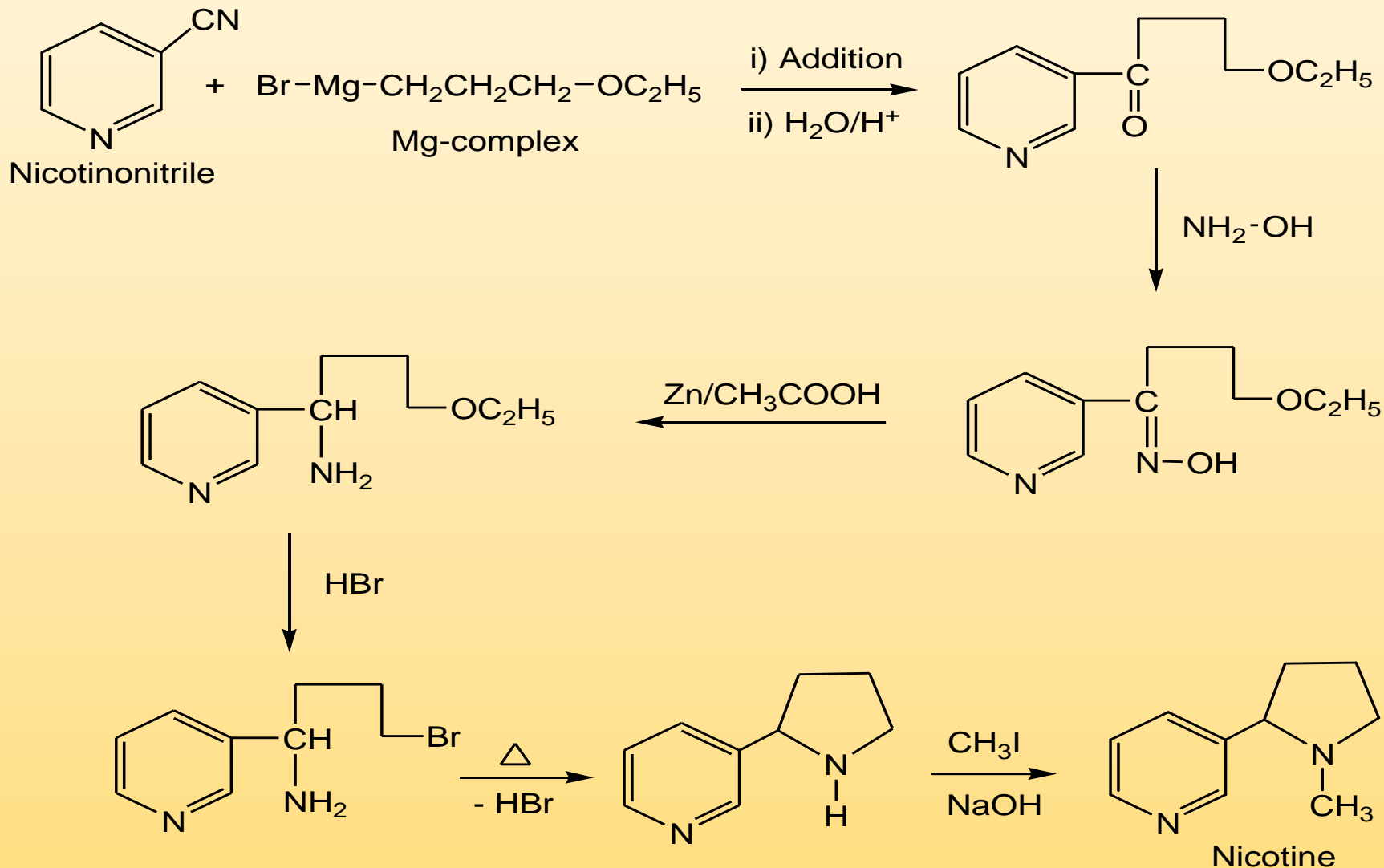


- It indicates that, attachment of -N methyl pyrrolidine ring (side chain) at 2-position to pyridine ring at 3-position in nicotine structure.
- Therefore possible structure of nicotine is as follows.



Synthesis of Nicotine from Nicotinonitrile

- Synthesis of nicotine from nicotinonitrile as follows.



Thank you