

Saturated Heterocycles ::



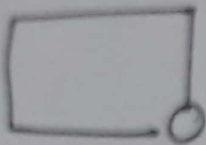
Oxa + irane
Oxirane



Thia + irane
Thirane



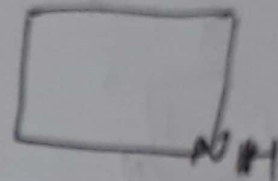
Aza + iridine
Aziridine



Oxa + etane
Oxetane



Thia + etane
Thietane



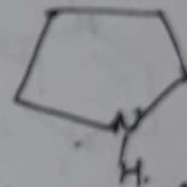
Aza + etidine
Azetidine



Oxa + olane
Oxolane



Thia + olane
Thiolane



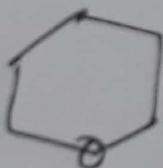
Aza + olidine
Azolidine

Common name

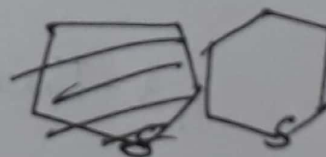
Tetrahydrofuran (THF)

Tetrahydrothiophene

Pyrrolidine



Oxa + inane
Oxinane



Thia + inane
Thiane



Aza + inidine
Piperidine

Common name

Tetrahydropyran

Piperidine

Unsaturated



Common Name: Pyrrole

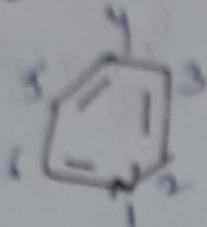
IUPAC Name: Azole



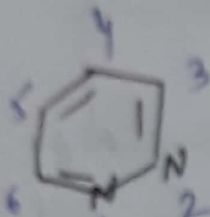
Common Name: Furan
IUPAC Name: Oxole



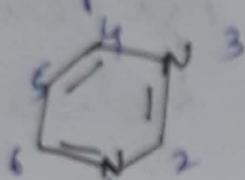
Common Name: Thiophene
IUPAC Name: Thiole



azine
Pyridine (Common Name)



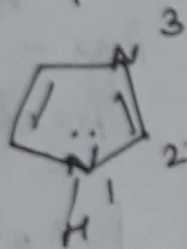
Pyridazine (Common Name)
1,2-diazine



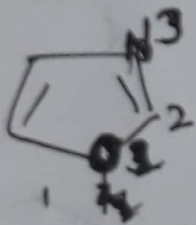
Pyrimidine (Common Name)
1,3-diazine



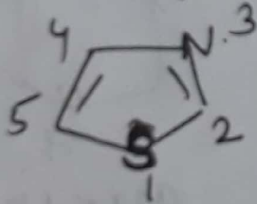
Pyrazine (Common Name)
1,4-diazine



Imidazole (Common Name)
1,3-diazole



1,3-oxazole (IUPAC)



1,3-Thiazole

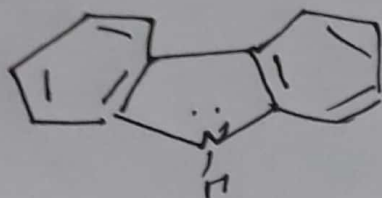
B.Sc III Year Sec D (2020-21)



Indole

Benzazole

Benzopyrrole



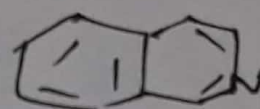
Carbazole



Quinoline

Benzopyridine

1-Benzazine



Isoquinoline

2-Benzazine

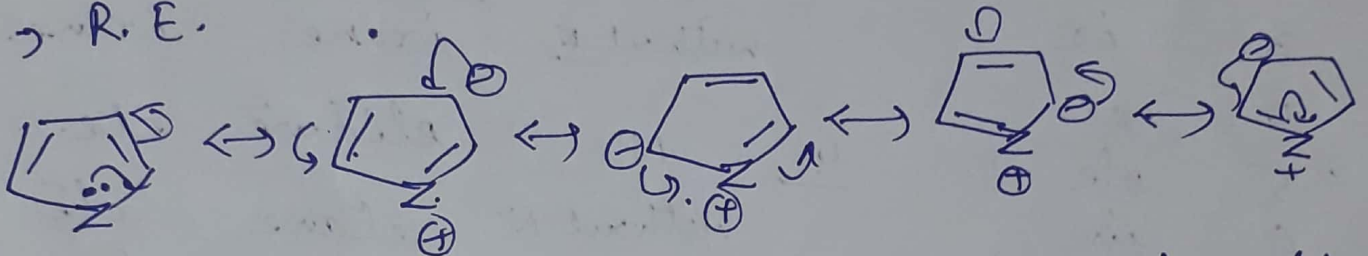
General Characteristics:

1. Colourless liquids

2. B.P. Pyrrole 131°C, Furan 32°C, Thiophene 84°C

3. Aromatic Character:-

→ R.E.

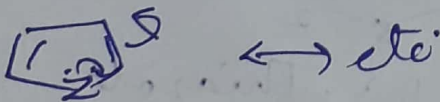
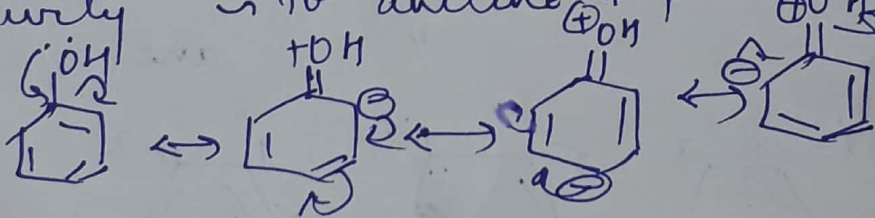


→ aromatic behaviour \rightarrow to benzene so hardly give e^- philic addⁿ rxn & easily e^- philic sub. rxn.

4. Reactivity

\rightarrow to aniline & phenol

(heteroatom partic; pale in delocalization)



react at position 2 \rightarrow to aniline & phenol

⑤

Benzene < Thiophene < furan < pyrrole.

(1000 times
reactive than
benzene)

Furan more reactive to thiophene because
+M effect by O atom in the ring is more than S.

Furan less reactive than pyrrole b'coz O has less
capacity to ~~have~~ bear +ve charge than N.

\rightarrow \therefore these compds are aromatic like benzene but
reactivity more to benzene, thus c/a superaromatic
compounds.

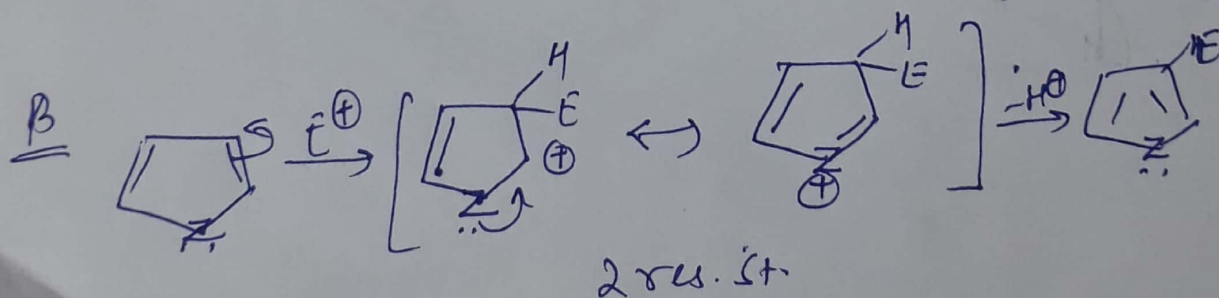
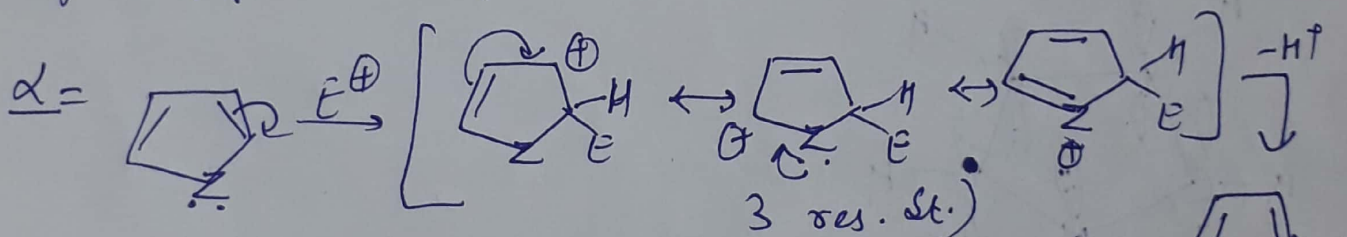
5. Substitution Rxs:-

α or β position. but takes place on α b'coz.

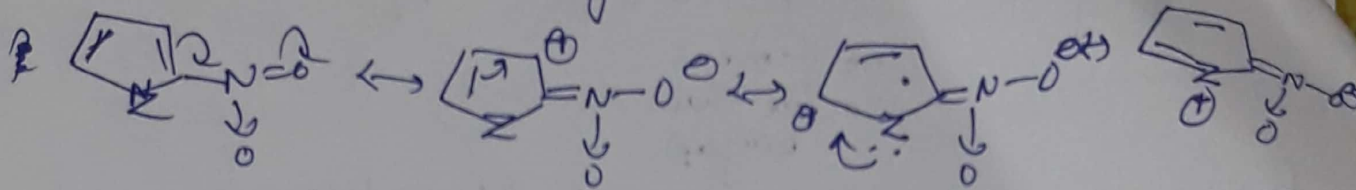
(2 or 5) (3 or 4).

Carbocation int. in case of e^- attack, more res. st. is
more stable.

If any gp already put at α , then sub. at β position.



In + nce of e^- with drawing of $(-NO_2) \rightarrow SO_3H, -COOR$
 Stability \uparrow & reactivity \downarrow es.



If e^- donating gp (NH_2, OH, OR) \rightarrow then stability \downarrow es due to high reactivity.
 Due to the reason, such het. compounds undergo e^- sub. rx. under mild conditions.

Pyrrrole :-

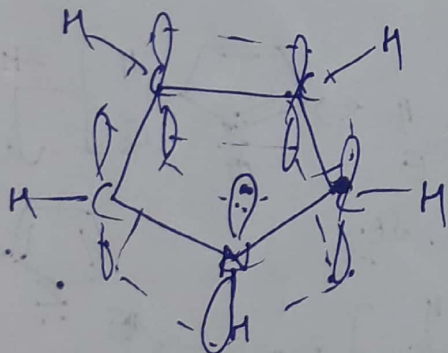
Properties :-

Colourless liq. (B.P. $131^\circ C$)

\rightarrow Change to brown after in open air access.

\rightarrow less soluble in water but soluble in alcohol & ether

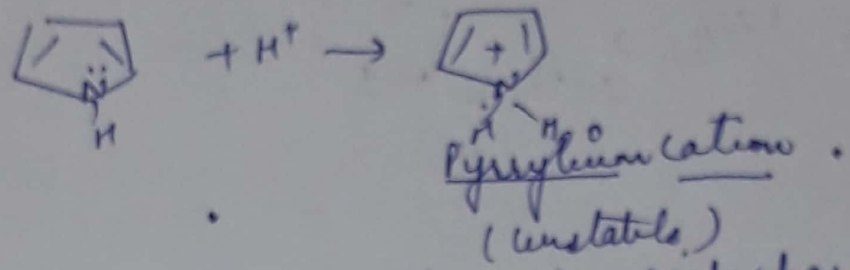
Test \Rightarrow pine tree piece wood dipped in HCl , when come in contact with pyrrrole vapors, convert to red colour



basic character of pyrrole:-

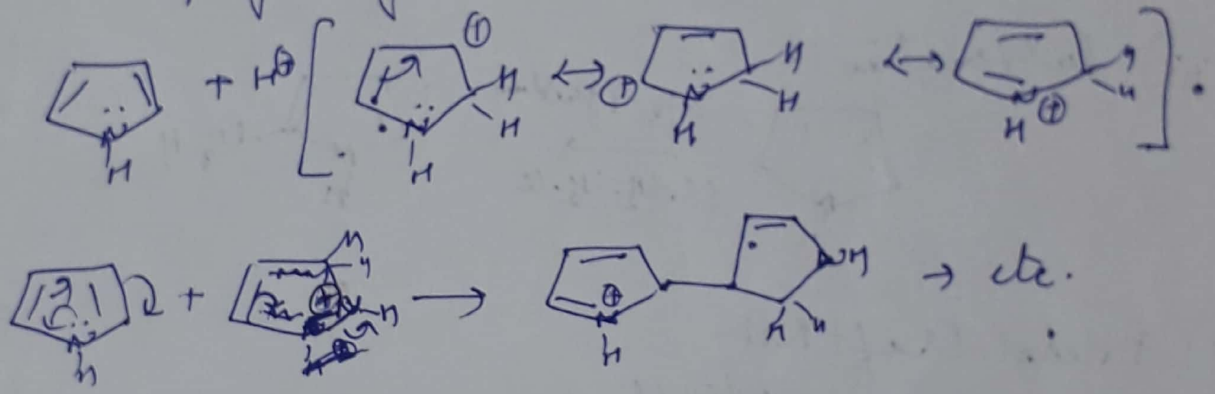
weak base as the lone pair is not available for proton
pK_b = 13.6. • while for NH₃ pK_b = 4.8.

Attack by acid:-



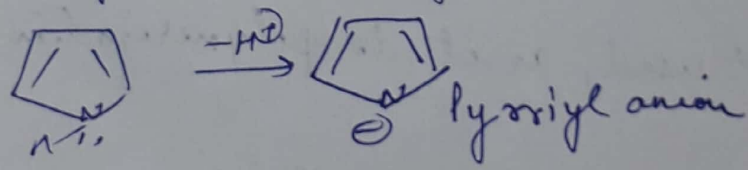
b'coz in +vely charged pyrrole, no factor for providing stability by resonance.

In +ve of strong acids, fast rx takes place & dark coloured polymer form

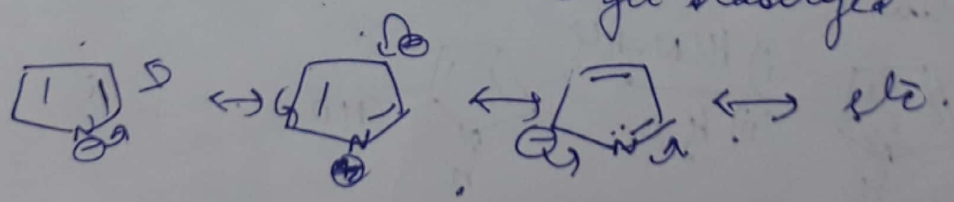


Acidic nature:-

→ due to +ve of imino hydrogen atom, act as weak base.

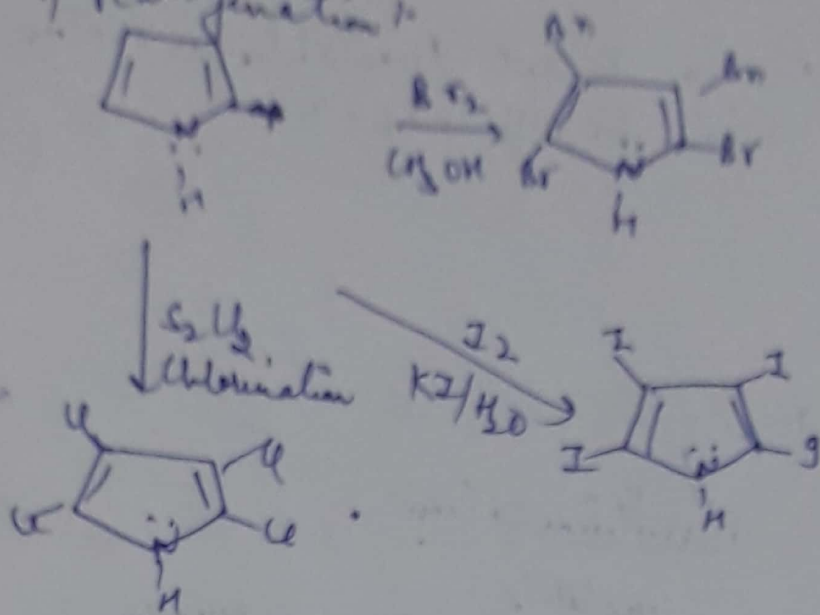


↓ get stabilized by res.

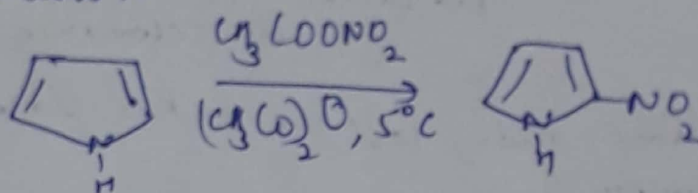


Electrophilic Substitution

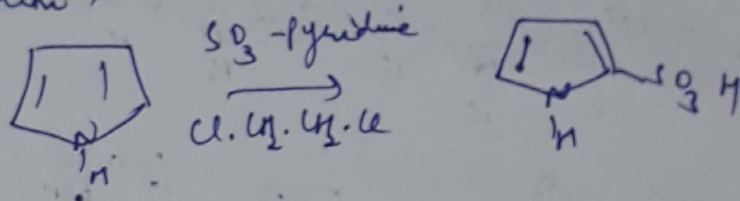
i) Halogenation



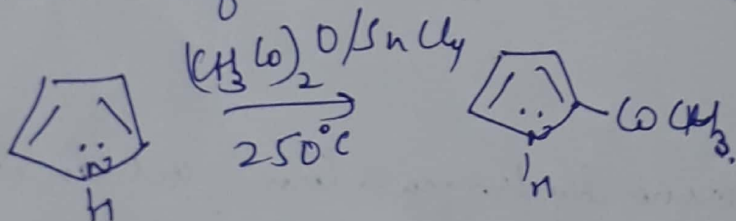
ii) Nitration



iii) Sulfonation

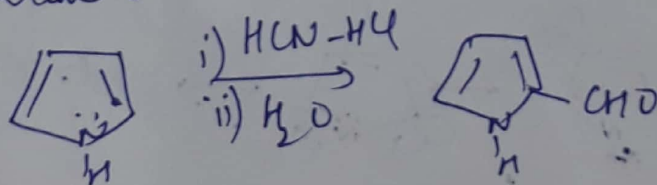


iv) Friedel-Crafts Rxn



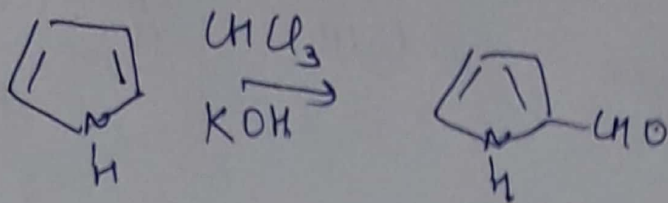
⚠ AlCl_3 not used, as it does polymerization of pyrrole

v) Formylation (Vilsmeyer Rxn)

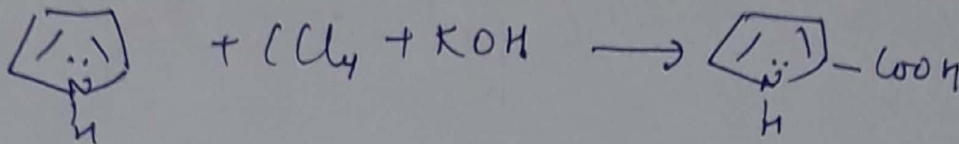


Reimer Tiemann Rx:-

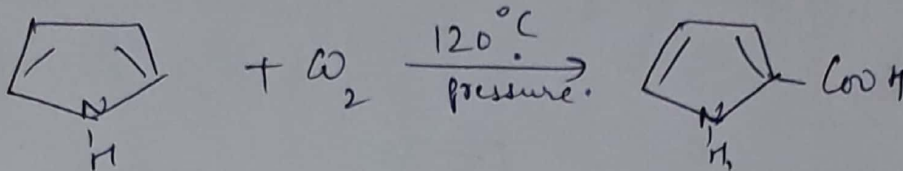
(4)



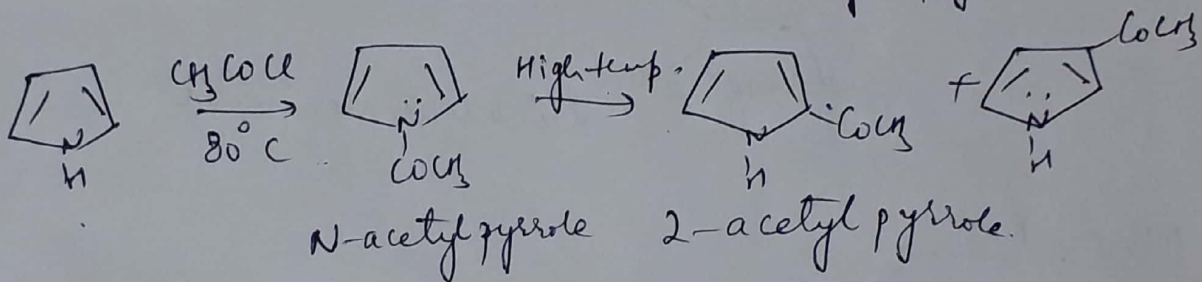
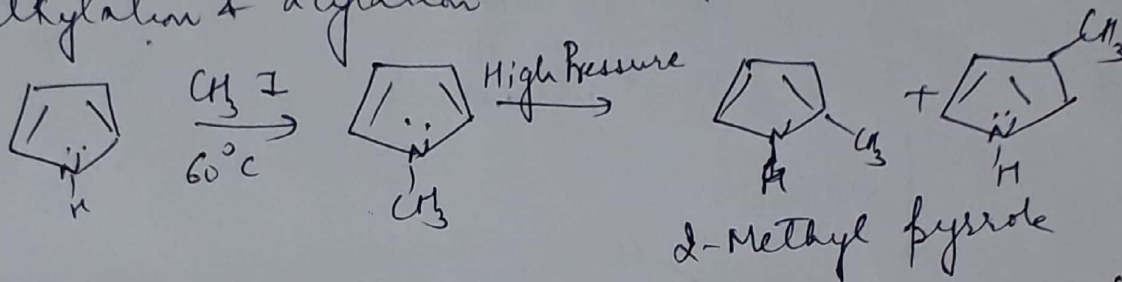
vii) Carboxylation:-



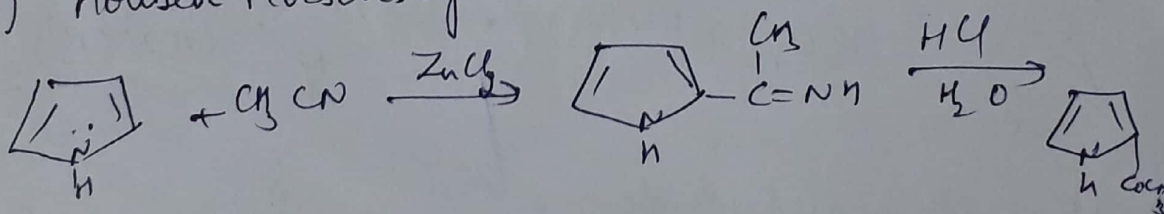
viii) Kolbe-Schmidt reaction:-



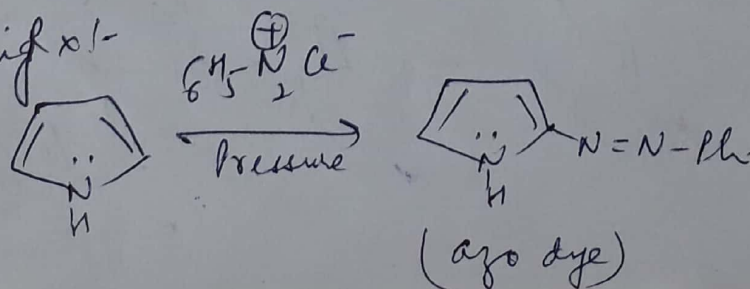
(ix) alkylation & acylation



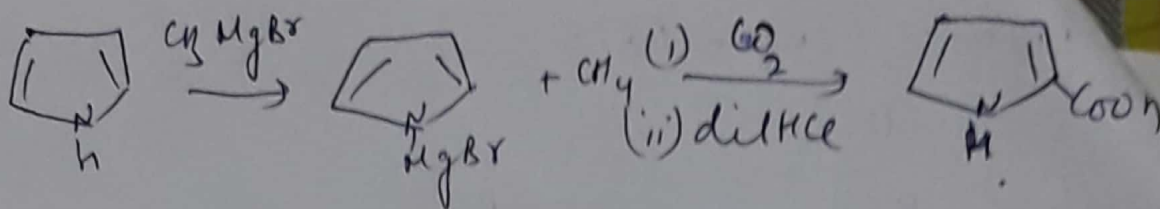
x) Houben Hoesch synthesis:-



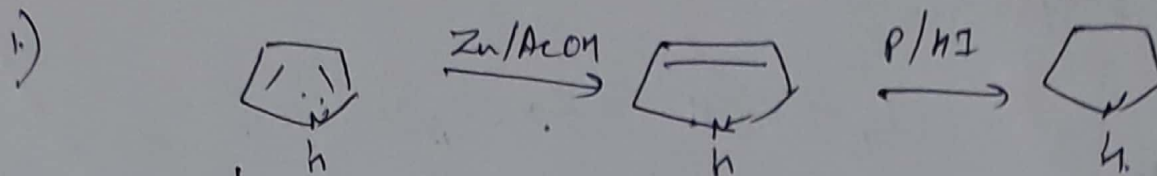
xi) Coupling:-



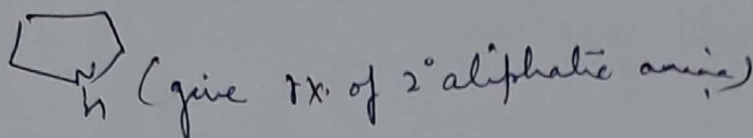
(xii)



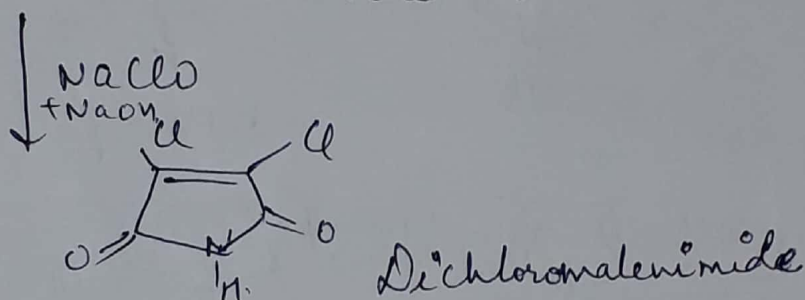
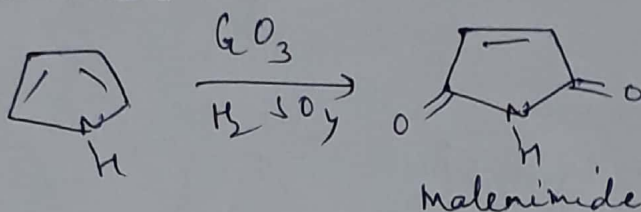
Redⁿ & Oxidⁿ:-



20°C ↓ Ni-H₂

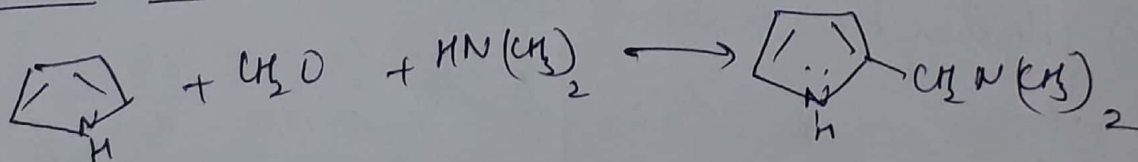


ii) Oxidation:-

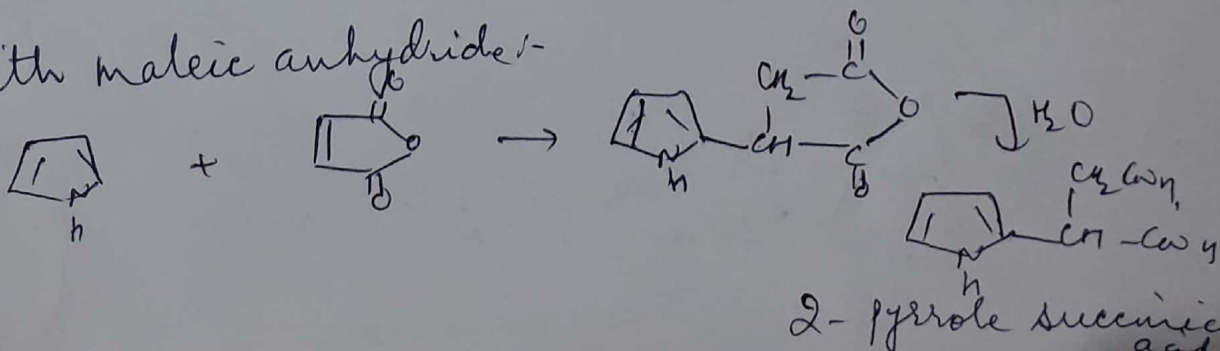


Other Rxs:-

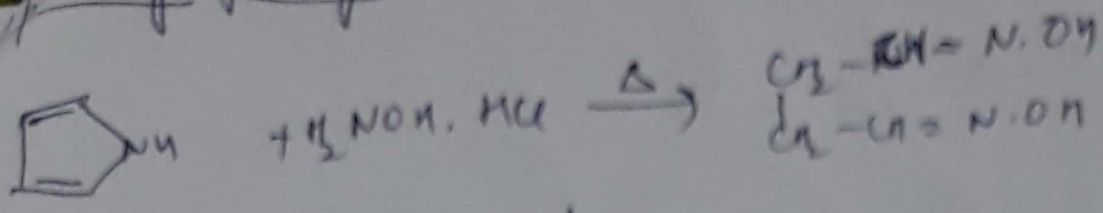
a) Mannich Rx :-



b) With maleic anhydride:-

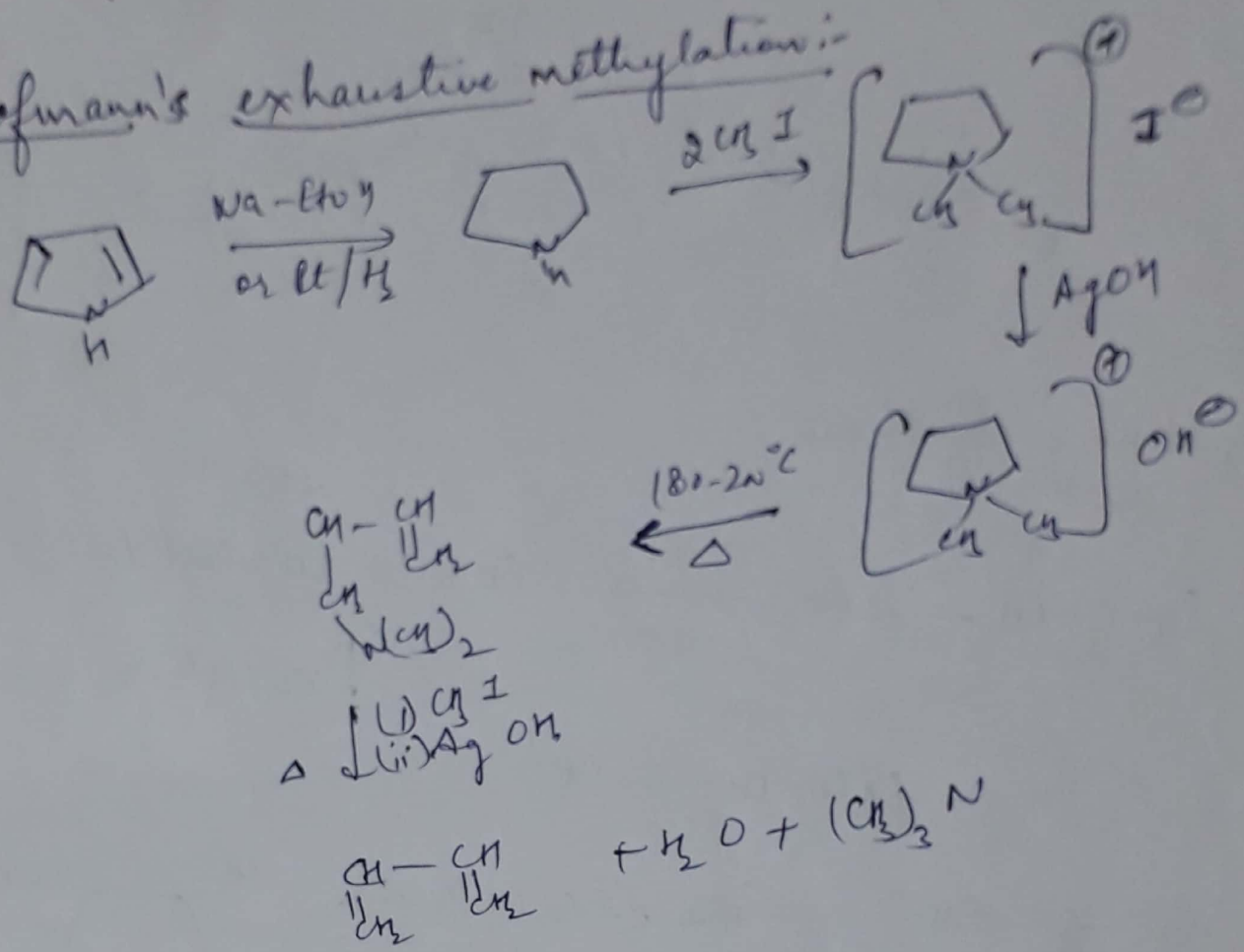


Opening of ring:-

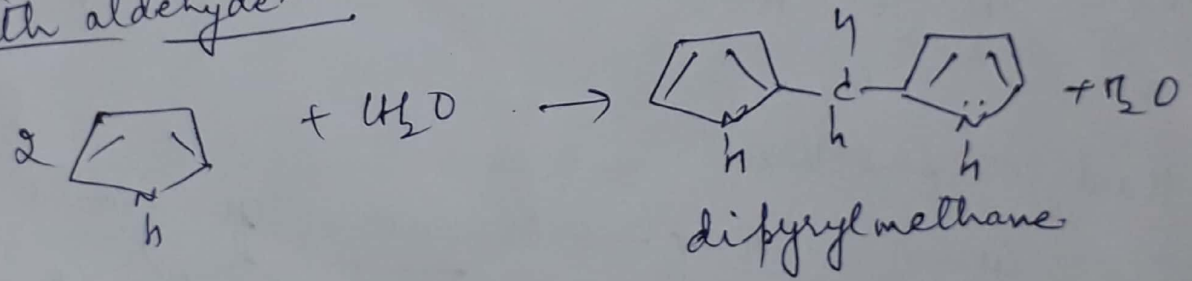


do not easily open by acid or base

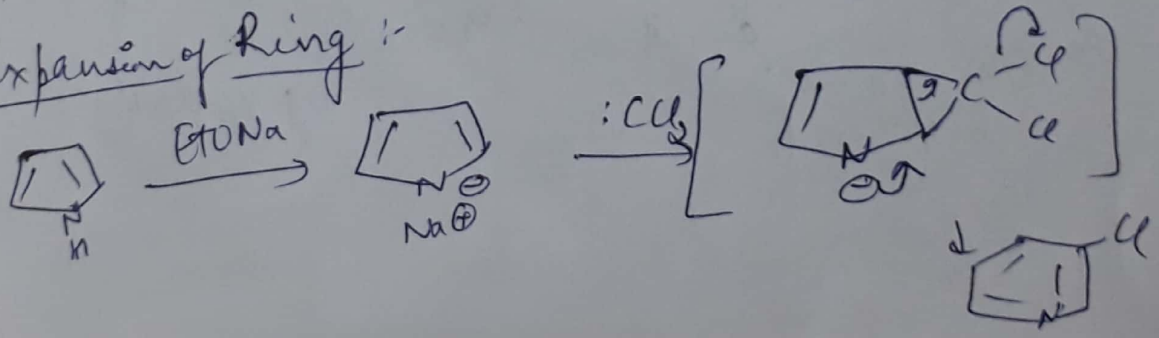
Hofmann's exhaustive methylation:-



With aldehyde:-

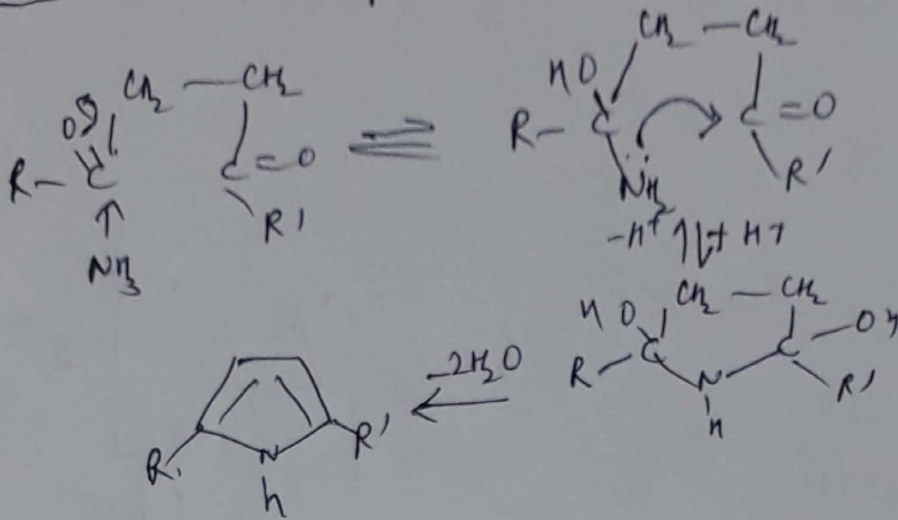


Expansion of Ring:-

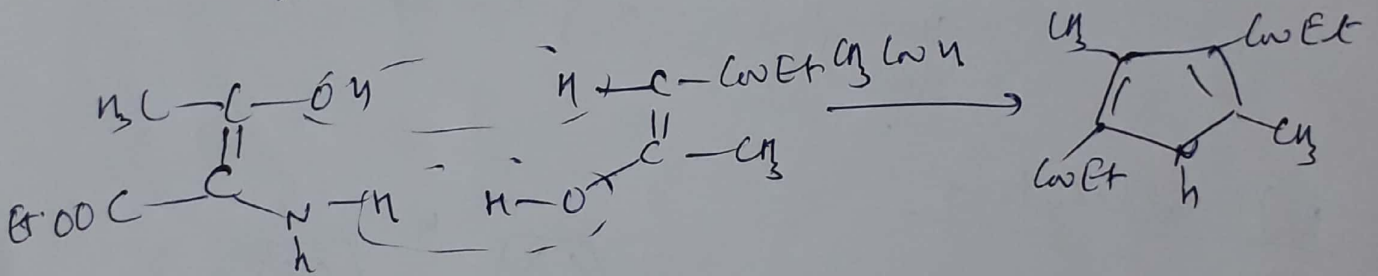
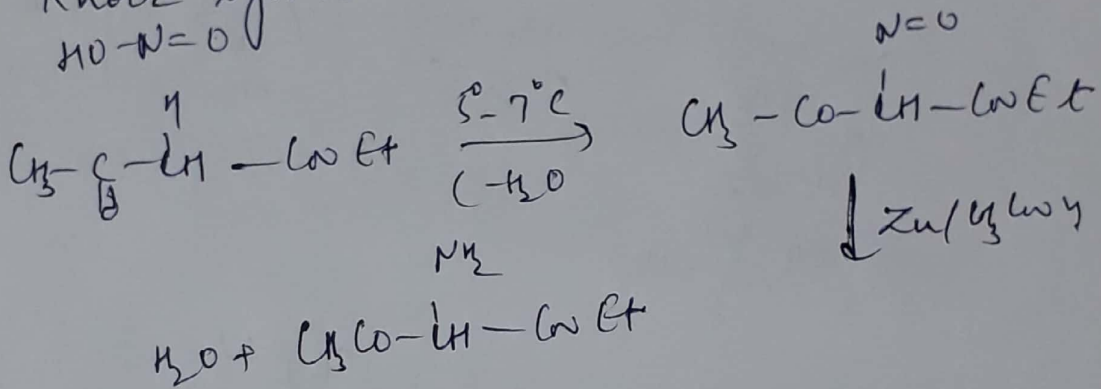


Synthesis :-

1) Paul Karrer Synthesis :-



2) Knorr Synthesis 1-



3) Hantzsch Synthesis :-

