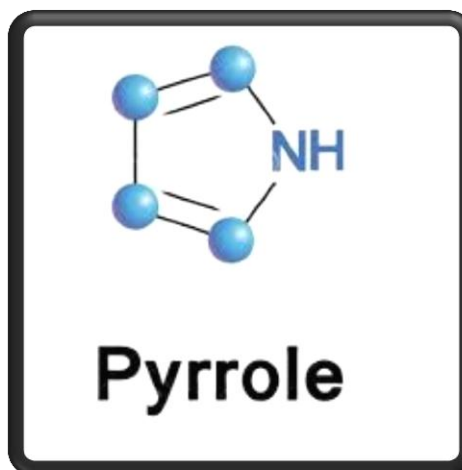




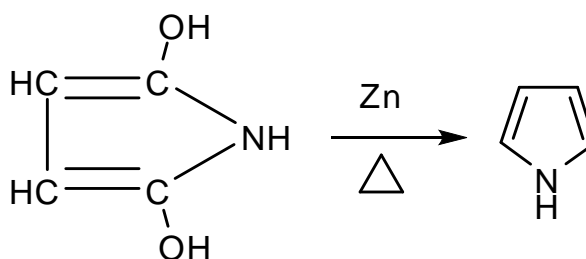
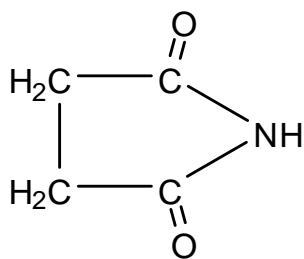
# Heterocyclic Compounds



**3<sup>rd</sup> Year Students**  
**Special Chem, Chem-Phys, Geo-chem, Zoo-Chem, Bot-Chem,**

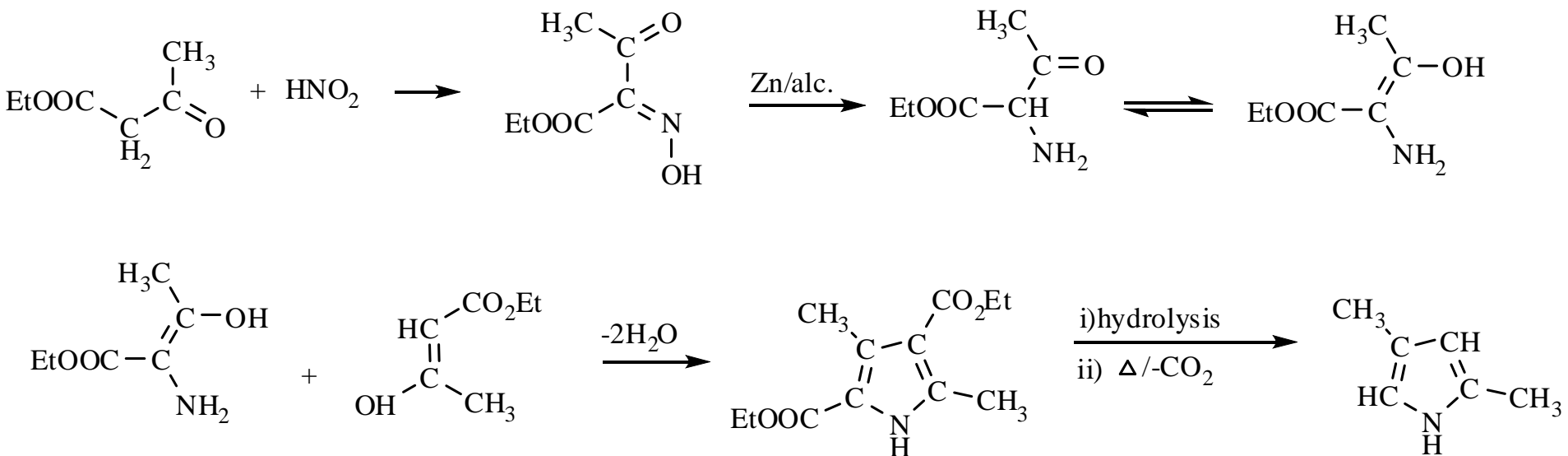


## 1. Distillation of succinimide with zinc dust



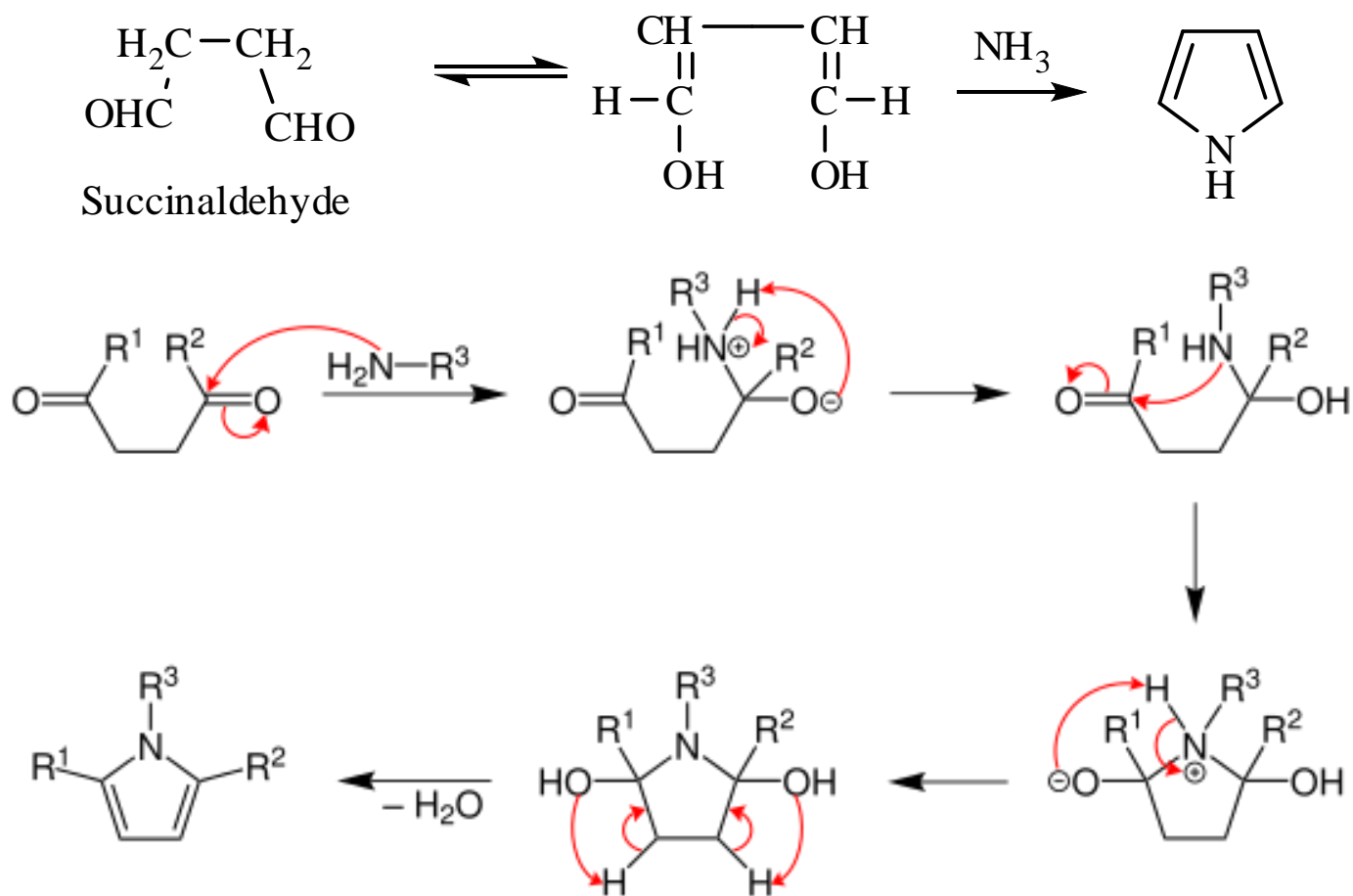


## 2. From knorr-pyrrole synthesis





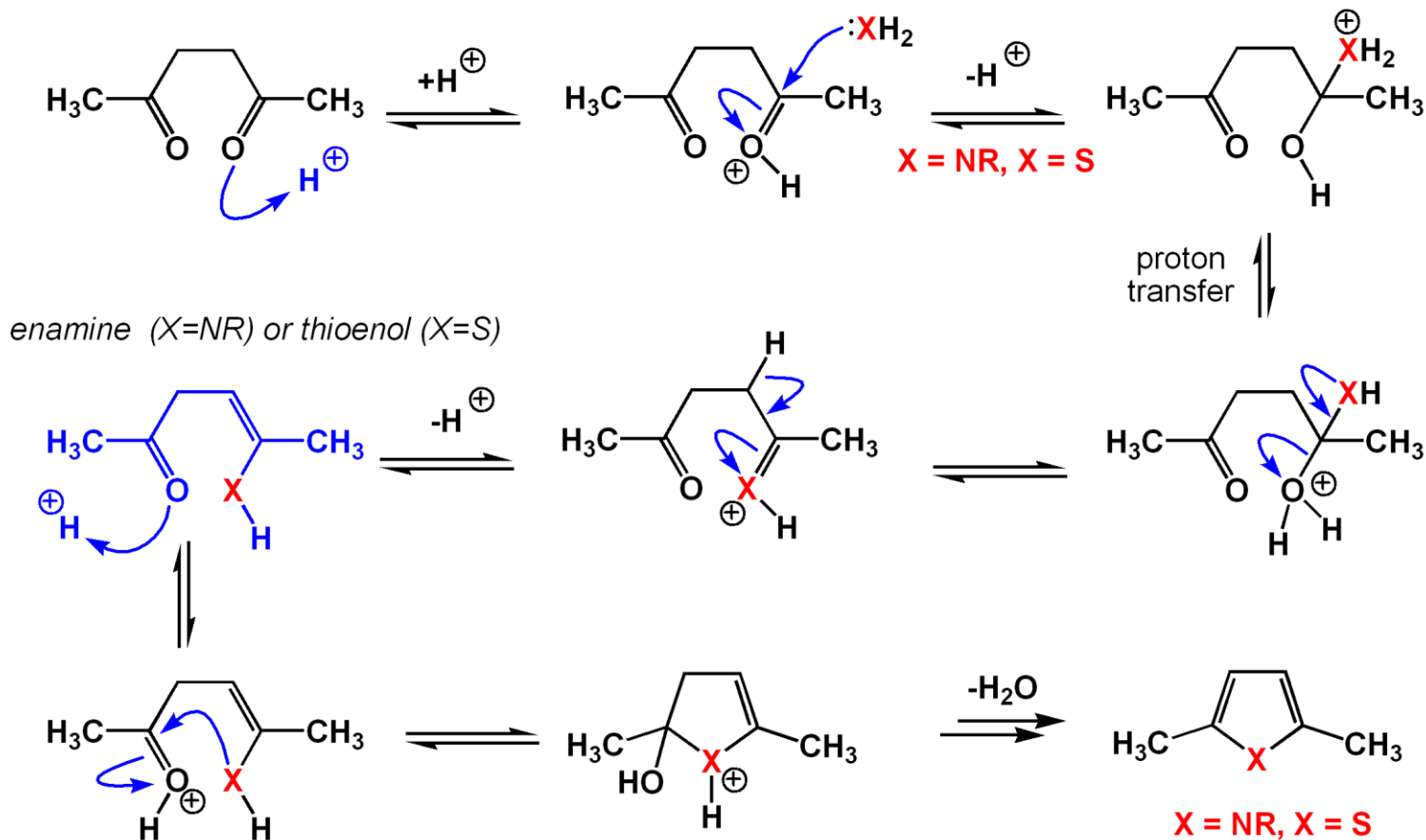
## 3. From Paal-Knorr synthesis





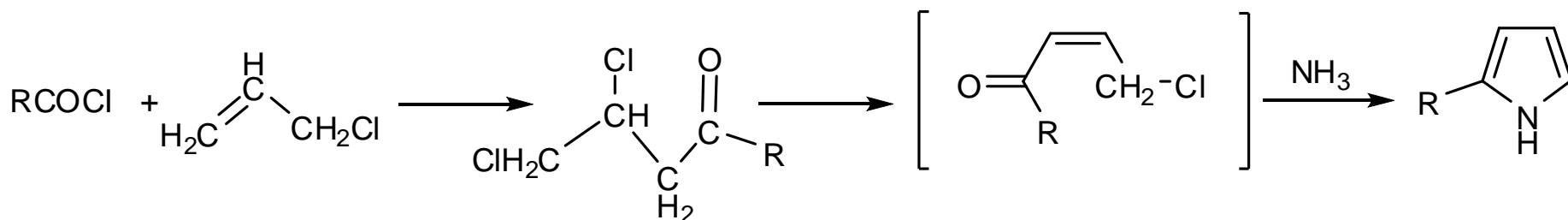
## Paal-Knorr synthesis: pyrroles and thiophenes

The chemistry involved here is essentially the same as the furan example before, but an enamine or thioenol intermediate is needed.

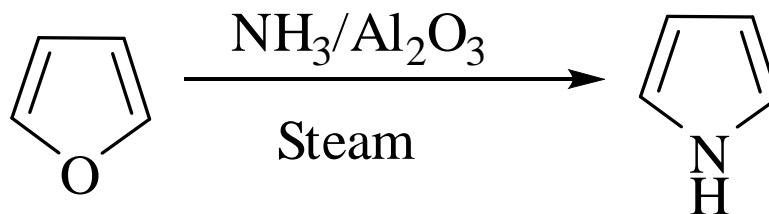




## 4. Electrophilic addition of acyl halides to allyl chloride followed by heating with ammonia



## 5. Pyrrole is prepared commercially by passing furan, ammonia, and steam over a heated $\text{Al}_2\text{O}_3$ (catalyst)





# Reactions Of Pyrrole

## 1. Ring opening pyrrole

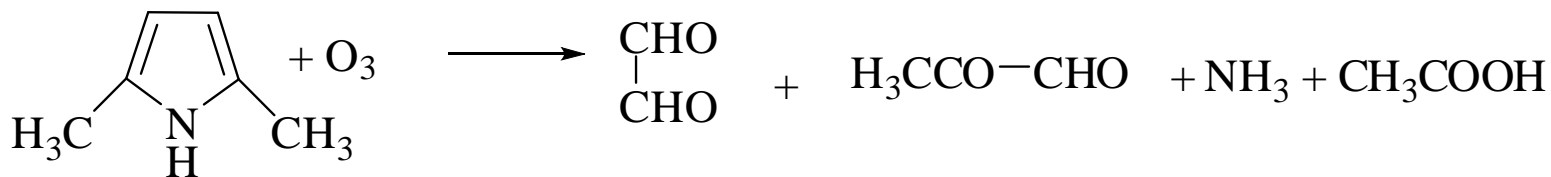
### a) Action of alkalies

Pyrrole is stable towards acid or alkalies, but on boiling with ethanolic hydroxylamine hydrochloride causes opening of the ring with formation of succinaldehyde dioxime.



### b) Ozonolysis:

The ozonolysis of pyrrole and its derivatives breaks the ring. Ozonolysis of 2,5-dimethylpyrrole gives glyoxal and methylglyoxal

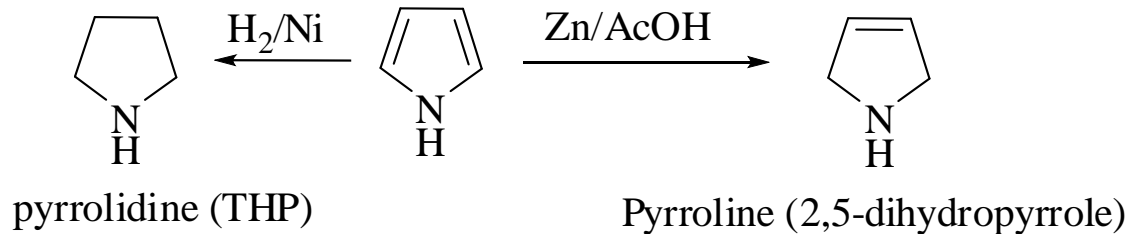




## Reactions Of Pyrrole

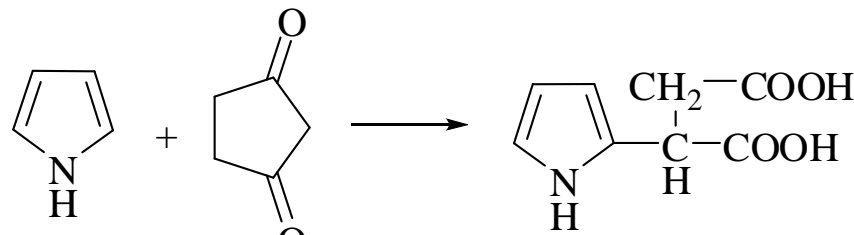
### 2. Addition reaction:

#### a) addition of hydrogen

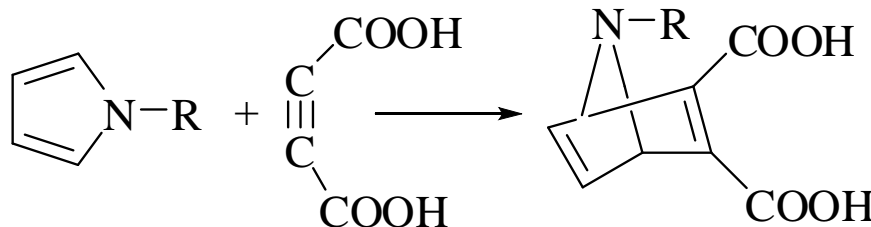


#### b) Diels-Alder reaction

i. Pyrrole reacts with maleic anhydride, like Michael addition



ii. N-alkylated pyrrole behaves as normal dienes toward activated dienophile via 2,5-addition to pyrroles

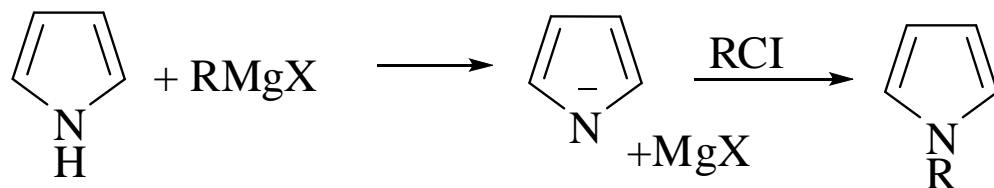
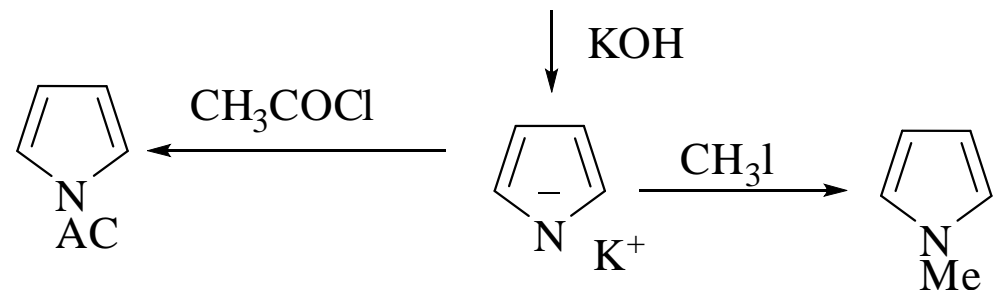
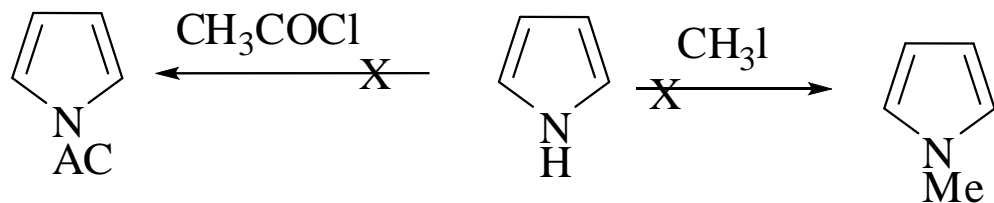






## 3. Substitution reactions of pyrrole:

### a) Substitution at the nitrogen atom

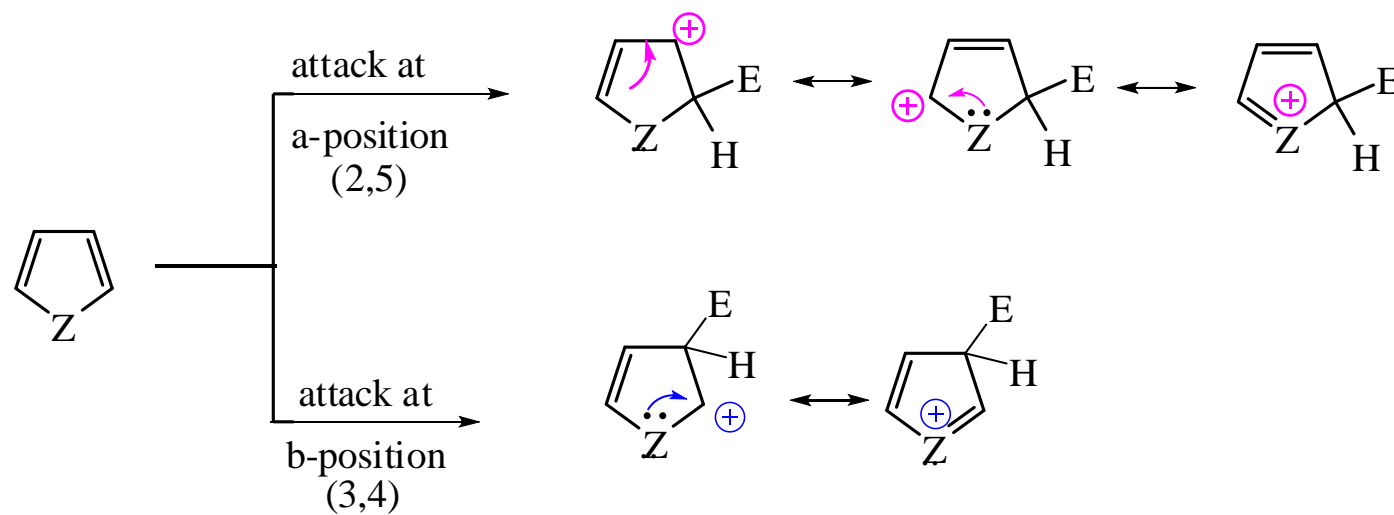


Act a weak acid and gives an anion which stabilized by delocalization of the negative charge

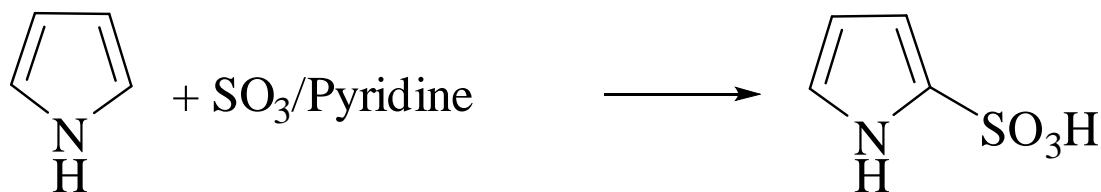
Pyrrole gives pyrrolemagnesium halide. The latter compound is an intermediate in preparation of N-alkyl or N-acylpyrrole



b) Substitution at carbon atom:

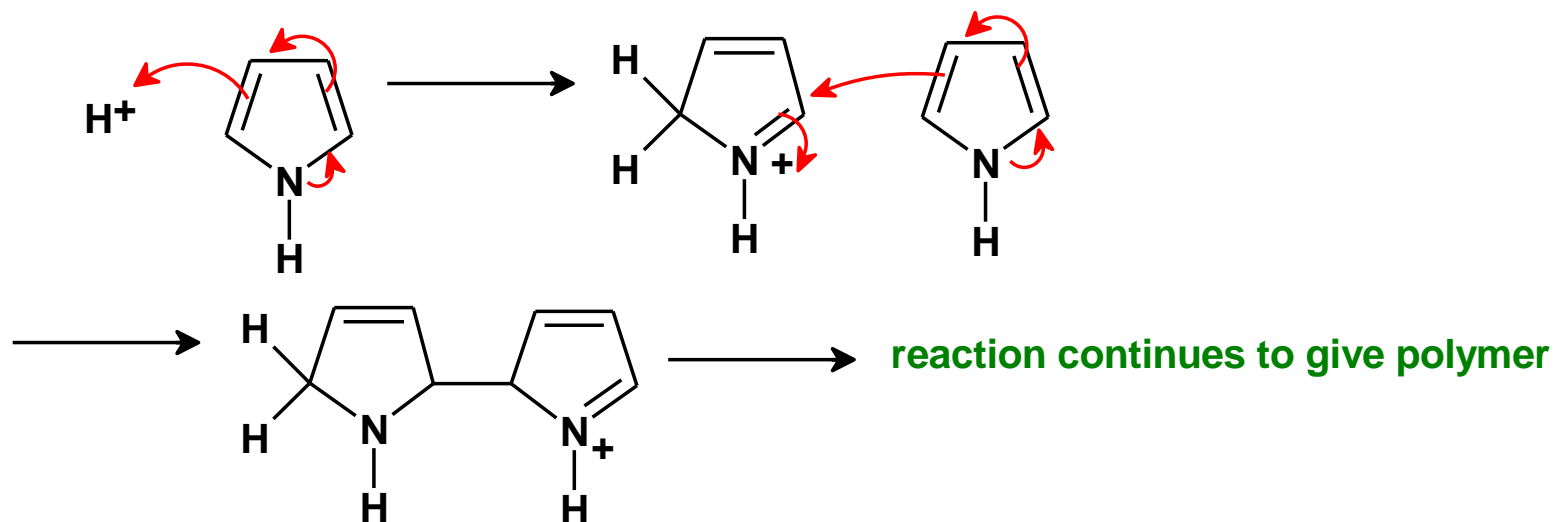


## 1. Sulphonation



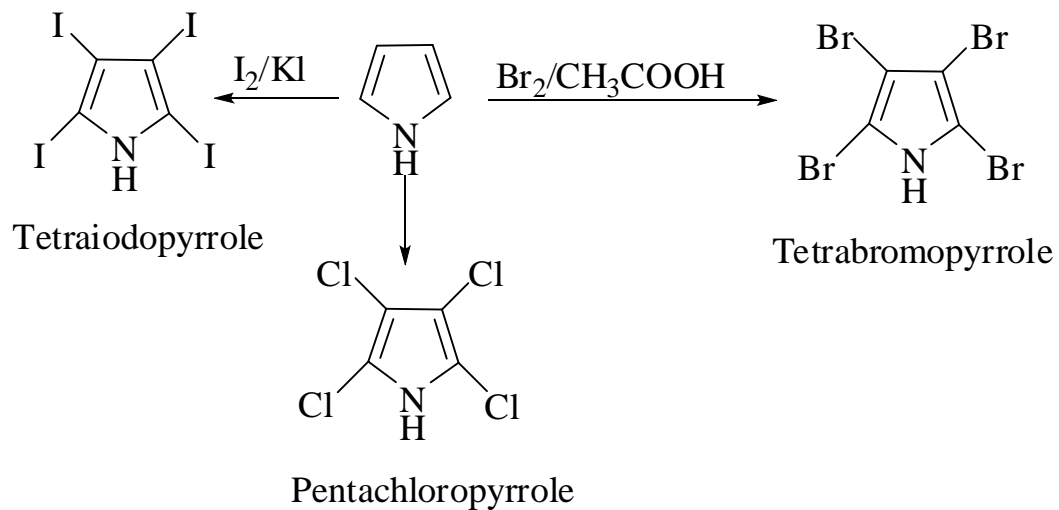


Pyrrole cannot be sulphonated under ordinary conditions due to polymerization, but with pyridine/SO<sub>3</sub> gives the 2-sulphonic acid.

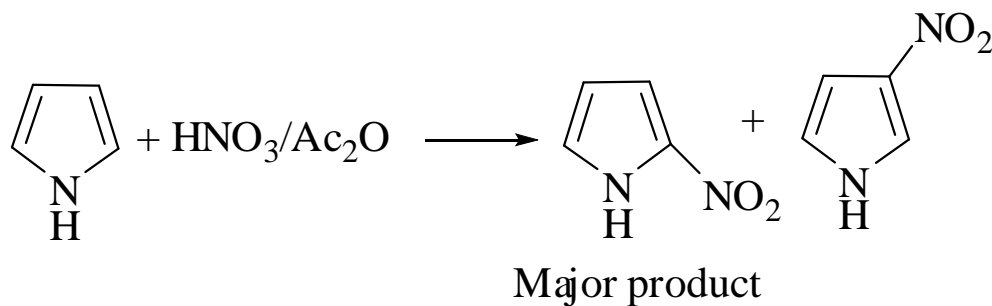




## 2. Halogenation:



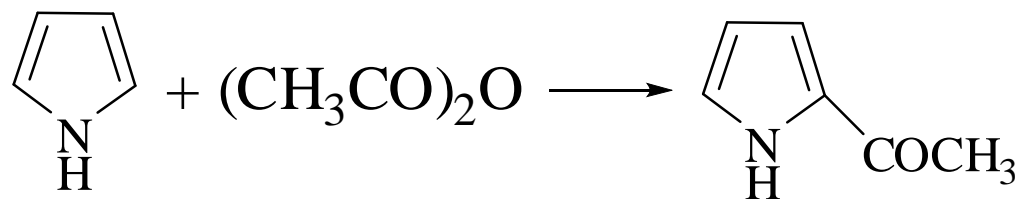
## 3. Nitration:





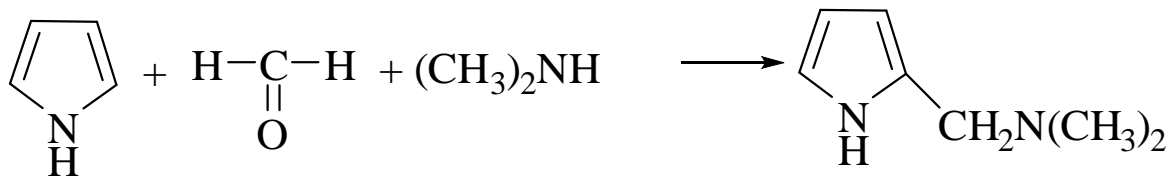
## 4. Friedel-Crafts:

Pyrrole is more reactive towards Friedel-Crafts reactions, which reacts with acid anhydrides in absence of catalyst to give 2-acyl derivatives



## 5. Mannich reaction:

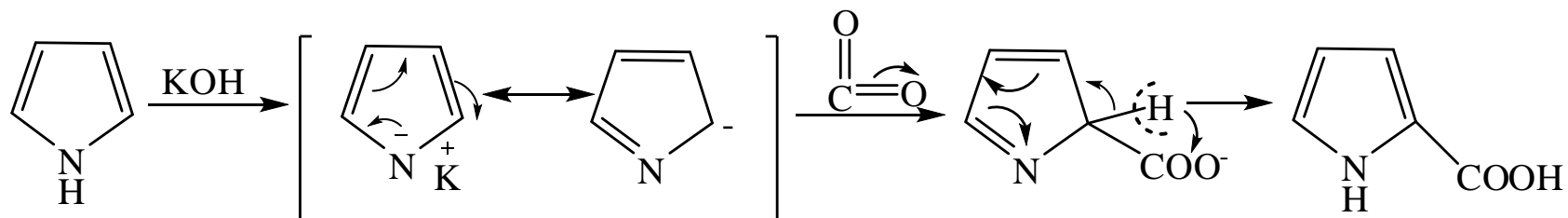
Pyrrole reacts with formaldehyde and dimethyl amine yielding the Mannich bases



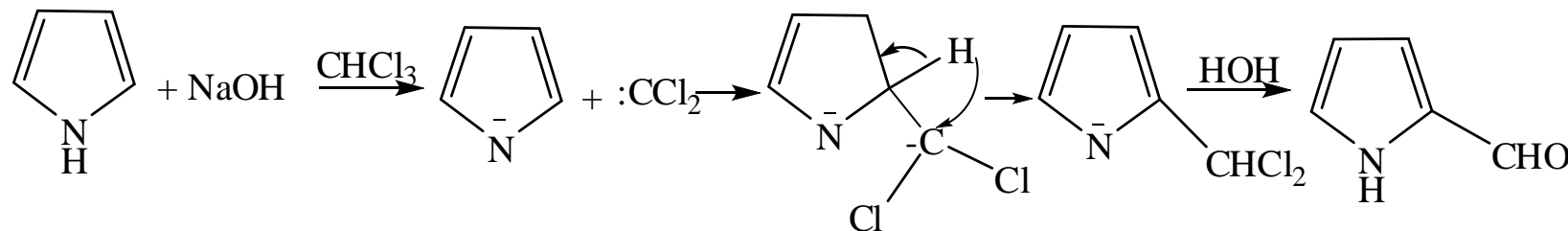


## Similarities between Pyrrole and Phenol

### 1. Kolb' synthesis:



### 2. Reamer-Tiemann reaction:



### 3. Pyrrole reacts with benzenediazonium and gives color compounds

