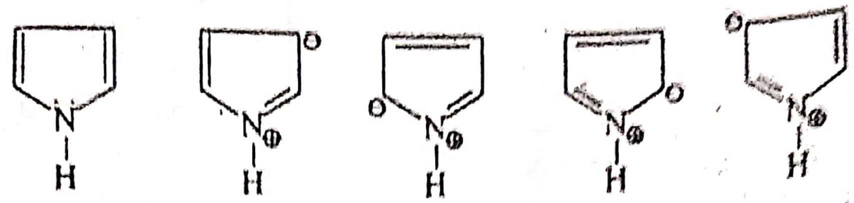
(b) it obeys Huckel's $(4n + 2)$ π-electron rule. It has six π-electrons $(n = 1)$ which come from 2π bonds (4e) and 2e (lone pair) present on N-atom.

(c) it is resonance stabilised—



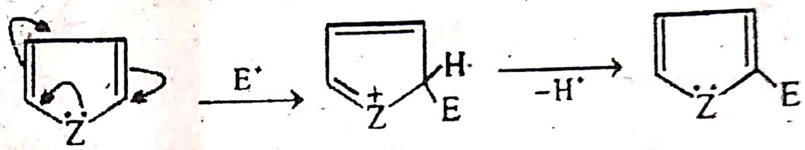
(d) it has π-electron cloud above and below the planar molecule.

Q.13. Why pyrrole is more readily substituted by electrophiles than furan ?

Ans. : Furan is less reactive than pyrrole because O-atom can accommodate a positive charge less readily than N-atom as oxygen (3.5) is more electronegative than nitrogen (3.0). The positive charge is developed on the hetero atom i.e. O- or N-atom in the intermediates during electrophilic substitution.

Pyrrole Furan

The electrophilic substitution in pyrrole / furan is shown below—



Intermediate

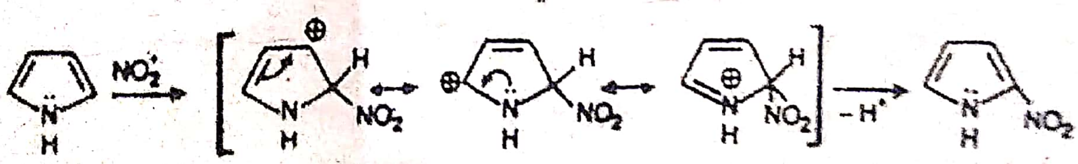
where Z = N- or -O-atom.

Hene pyrrole is more readily substituted by electrophiles than furan.

Q.14. Nitration (electrophilic substitution) occurs principally at position-2 in pyrrole—Explain.

Ans. : Resonance structures for the intermediates of 2 & 3-nitration are drawn as—

2. Nitration :



Pyrrole 2-nitropyrrole

3. Nitration :

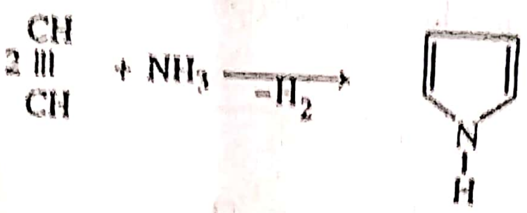
3-nitropyrrole

We see that 2-intermediate has three resonating structures whereas 3-intermediate has only two resonating structures. Greater the delocalisation of positive charge in the intermediate, greater is stability. Hence nitration in pyrrole occurs principally at position-2.

Q.15. Discuss the methods of preparation of pyrrole.

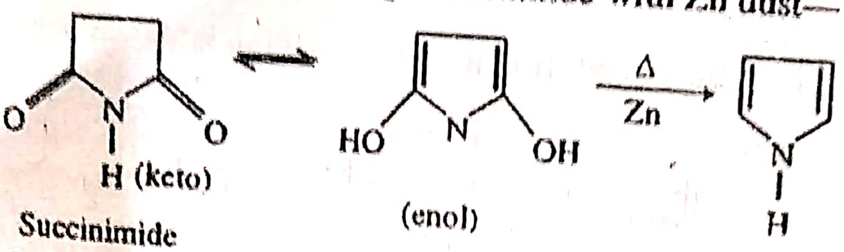
Ans. : Preparation of pyrrole :

1. It is prepared by passing a mixture of acetylene and ammonia through a red hot tube—



Pyrrole

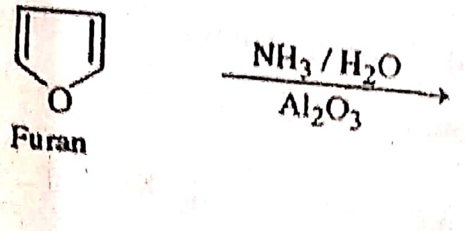
2. It is prepared by distilling succinimide with Zn dust—



Succinimide

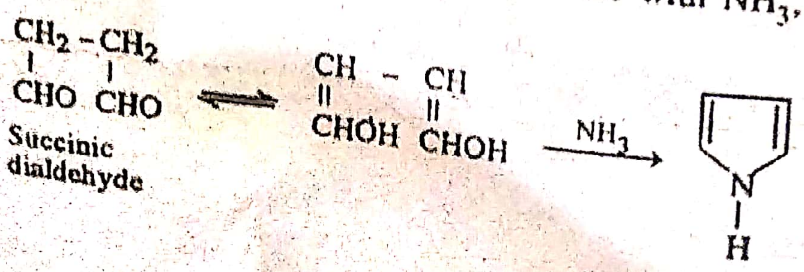
Pyrrole

3. It is prepared by passing a mixture of furan, ammonia and steam over heated alumina at 450°C—



Pyrrole

4. It is prepared by heating 1, 4 diketone with NH_3, 1° amine or hydrazine—



Pyrrole