



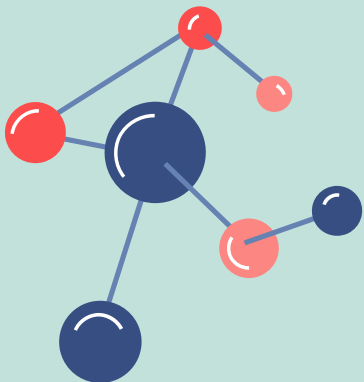
# Pyrrole, Furan and Thiophene

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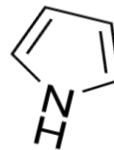


# Introduction

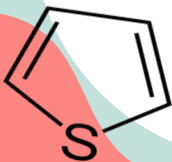
- The most common heterocycles are those having five membered rings containing heteroatoms of Nitrogen (N), Oxygen (O), Sulphur(S).
- They obey Huckel's rule and are aromatic compounds
- The six pi electrons are provided from the  $4sp^2$  carbon atoms and the lone pair of electrons of the  $sp^2$  heteroatoms.



01

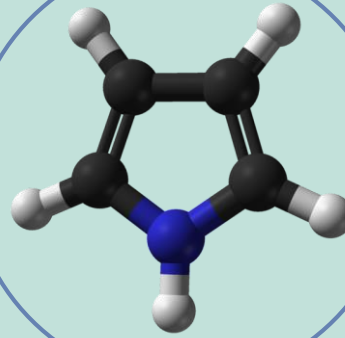


**Identify Pyrrole, Furan  
and Thiophene.**




0

# Pyrrole

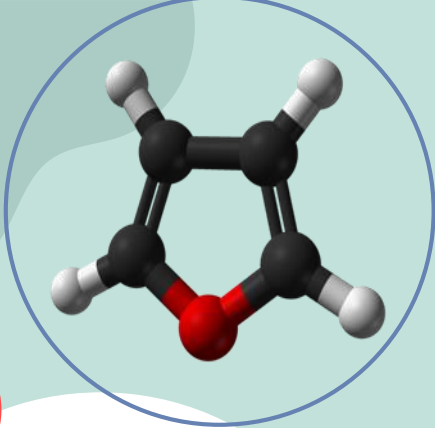


<sup>N</sup>  
is a nitrogen-containing unsaturated five-membered heterocycle aromatic compound with the formula  $C_4H_4NH$ .


The pyrrole derivatives alkaloids are found in plants like Opium, coffee and in marine.

  
Pyrrole is found in collagen as proline and hydroxyproline.






# Furan

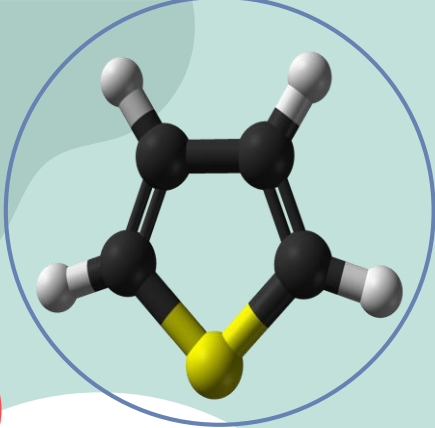


Furan, is an oxygen-containing five-membered aromatic heterocyclic compound, with the formula  $C_4H_4O$ .

The highly electronegative oxygen holds on the electron density tightly.



Furan is a volatile compound formed mostly during the thermal processing of foods.



# Thiophene

S

Thiophene is a Sulphur-containing five membered unsaturated heterocycle, with the formula  $C_4H_4S$ .

Thiophene is considered less aromatic than benzene.

The thiophene ring is present in many important pharmaceutical products.

S

02

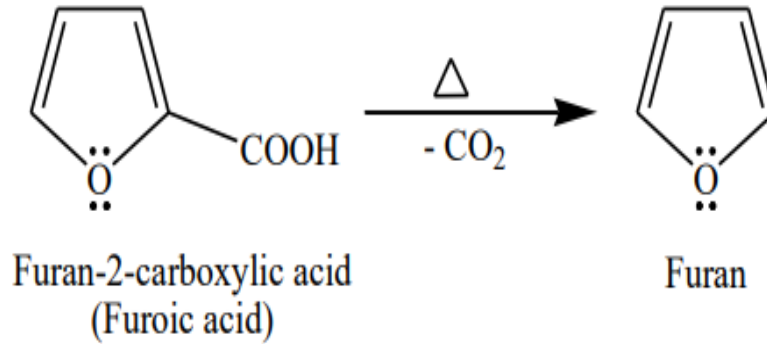
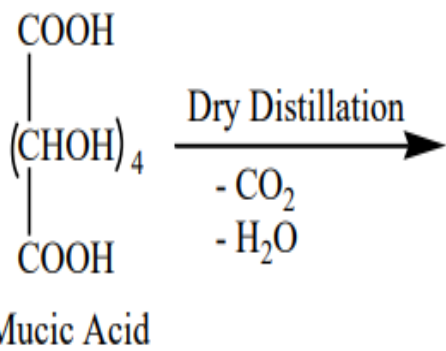
# **METHODS OF PREPARATION**

N

S



# FURAN

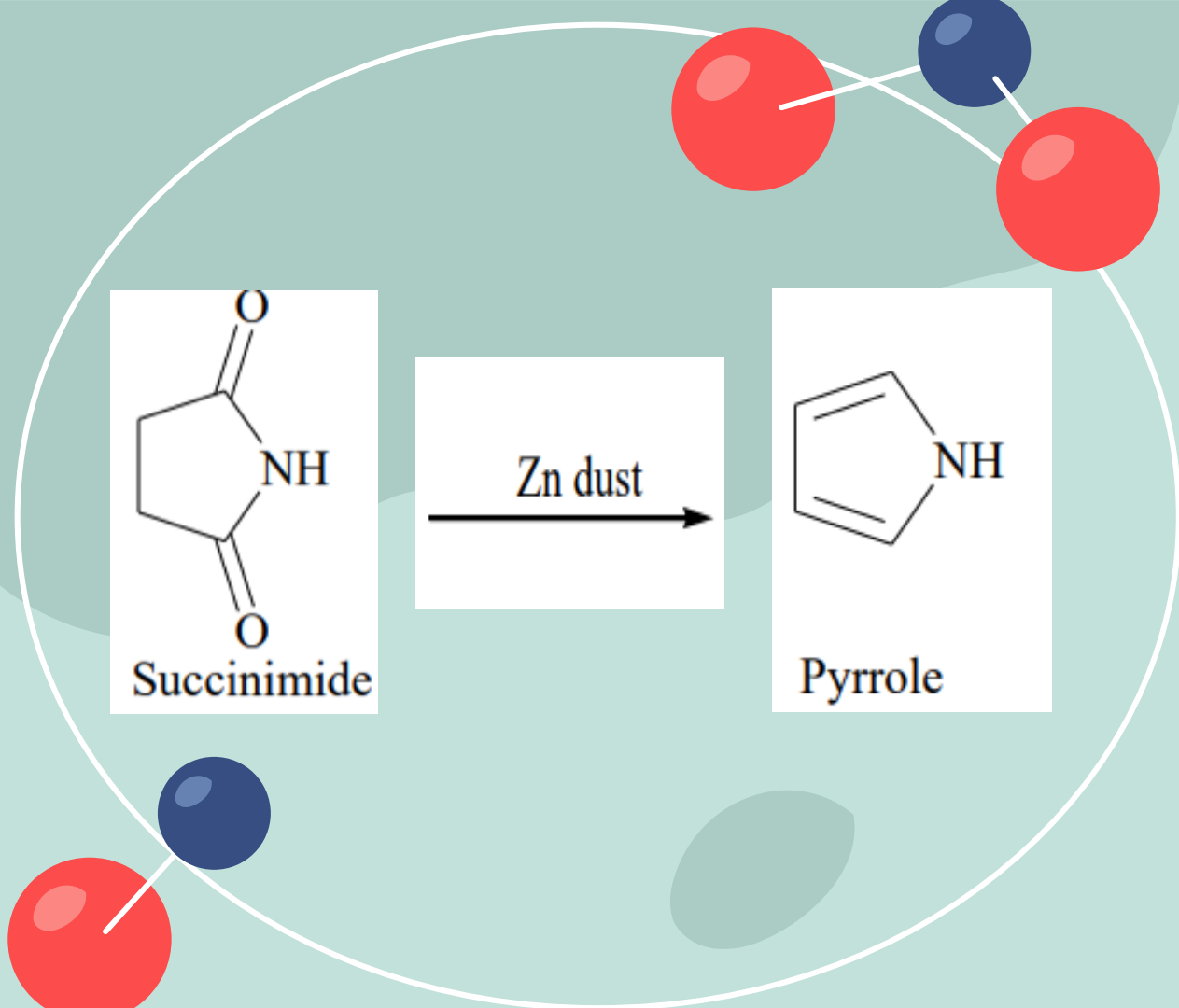
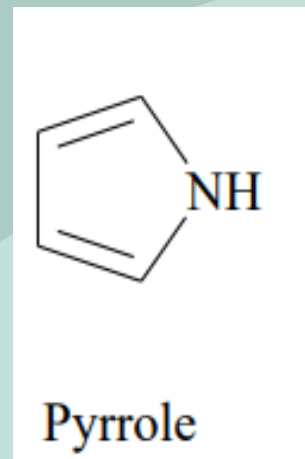
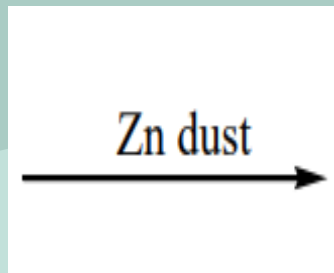
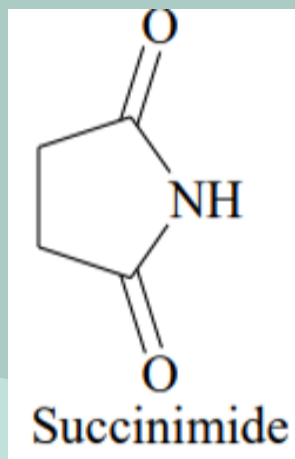


From Mucic  
acid

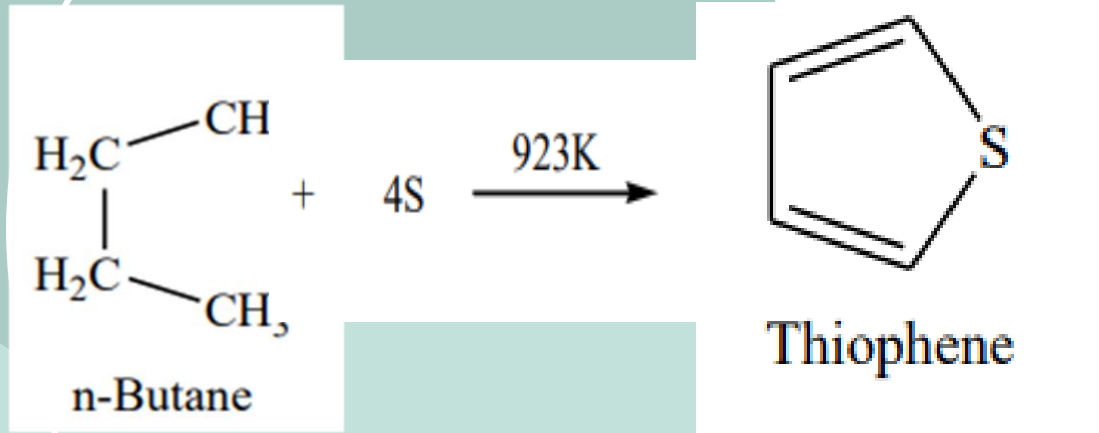
# PYRROLE



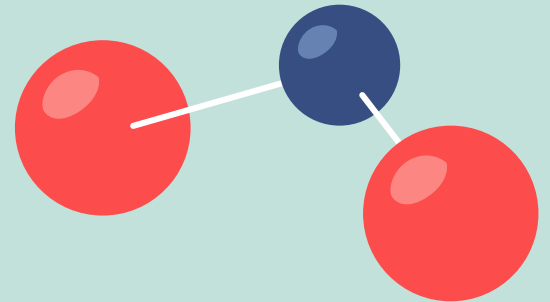
**From  
succinimide**

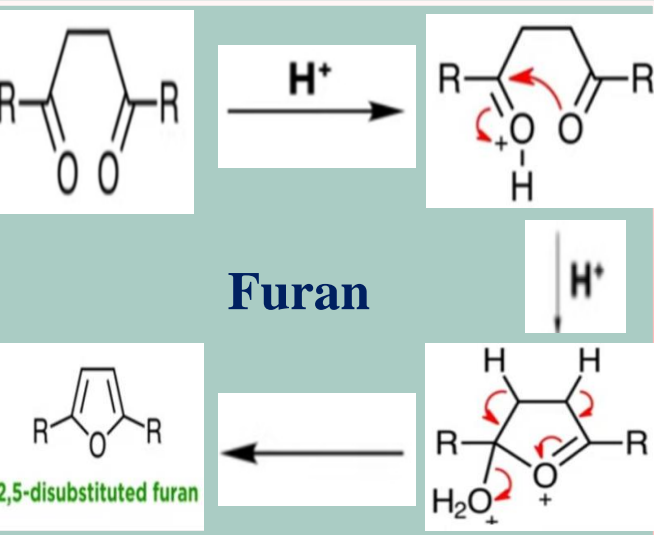


# THIOPHENE

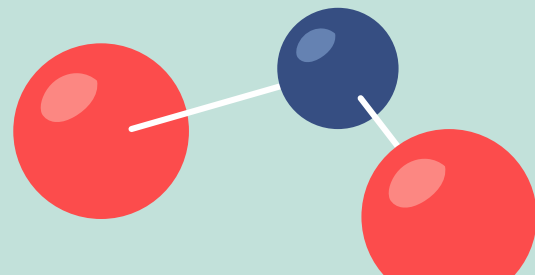
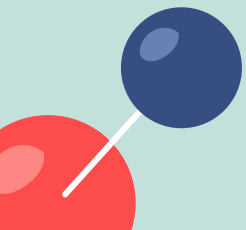
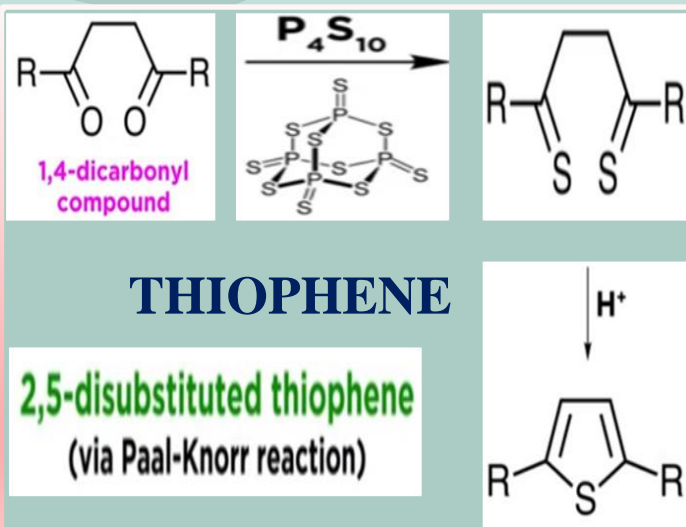
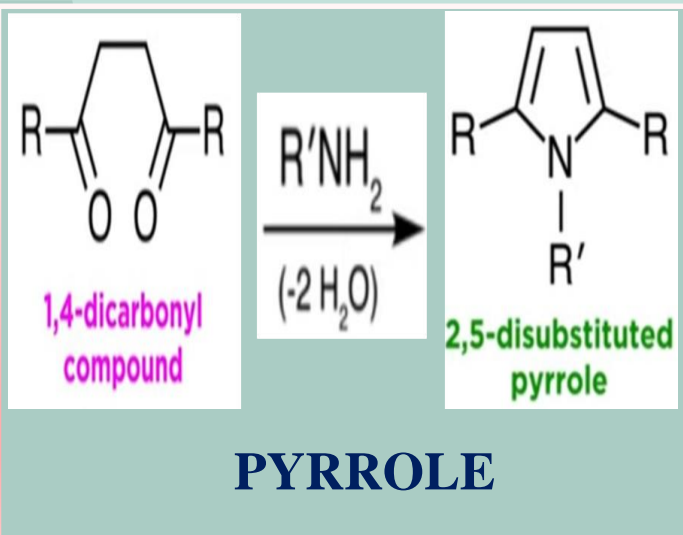


From n-Butane






# Paal-Knorr synthesis



03

## **Physical properties of Pyrrole, Furan and Thiophene.**



Properties	Furan	Thiophene	Pyrrole
<b>Condition</b>	Colorless liquid	Colorless liquid	Color less liquid
<b>Boiling point</b>	31.4°C	83.85°C	131°C
<b>Odor</b>	Ethereal odor	Benzene odor	Nutty odor
<b>Toxicity</b>	Highly toxic and can be carcinogenic	Non toxic	Slightly toxic
<b>Solubility</b>	Insoluble in ether but soluble in most of the organic solvent	Soluble in alcohol and ether but insoluble in water	Slightly soluble in water and miscible in ether and ethanol
<b>Dipole moment</b>	Negative end is at the heteroatom	Negative end is at the heteroatom	Positive end is at the heteroatom

Table 1.1 shows the physical properties of Pyrrole, Furan and Thiophene

04

# **Chemical properties of Pyrrole, Furan and Thiophene.**



Pyrrole, Furan, and Thiophene are aromatic compounds and more reactive than benzene. Because of their aromatic nature, they undergo characteristic reactions (electrophilic substitution reactions) at position 2 of aromatic compounds such as halogenation, nitration, sulphonation, Friedel-Crafts reactions etc.

**Pyrrole > Furan > Thiophene > Benzene**

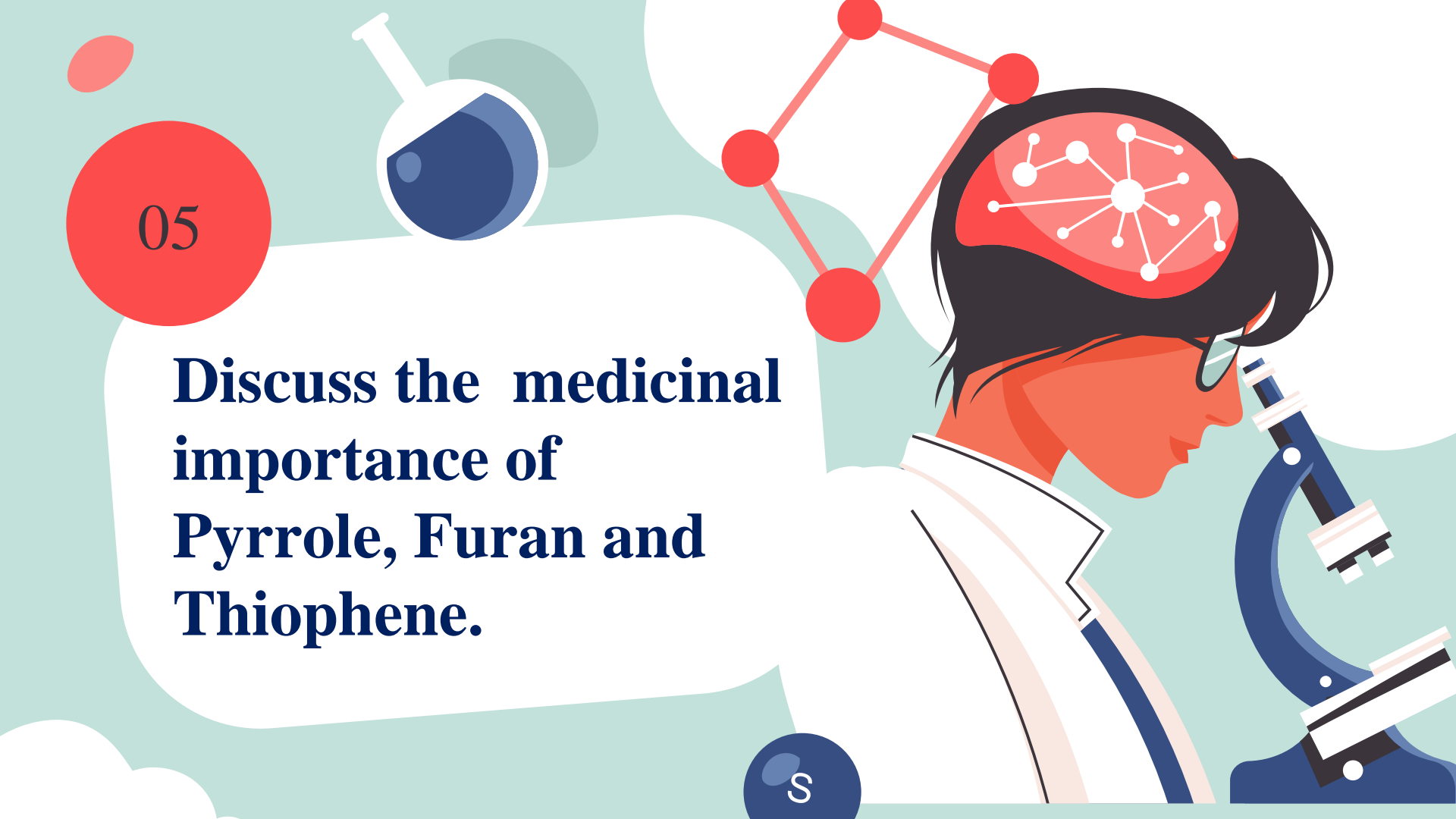




05

**Discuss the medicinal importance of Pyrrole, Furan and Thiophene.**

S



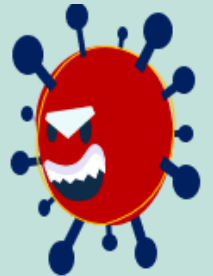
# Pyrrole

Pyrroles are found in several drugs, including atorvastatin, ketorolac.



Another example : antiviral agent remdesivir, which is nowadays in clinical trials as promising drug for the treatment of patients affected by COVID-19..

Atorvastatin is used along with a proper diet to help lower "bad" cholesterol and fats.



N

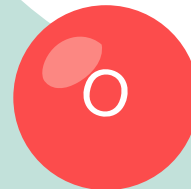
N

# Furan



Darunavir : A HIV protease inhibitor used in the treatment of human immunodeficiency virus (HIV) infection in patients with history of prior antiretroviral therapies.

Nigericin polyether antibiotic which affects ion transport and ATPase activity in mitochondria. It is produced by Streptomyces hygroscopicus.

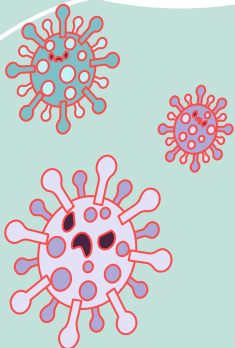


# Thiophene

Thiophene derivatives show high antimicrobial activity against various microbial infections.

Ketotifen : A histamine H1 receptor blocker and mast cell stabilizer used to treat mild atopic asthma and allergic.

Clopidogrel An antiplatelet agent used to prevent blood clots in peripheral vascular disease, coronary artery disease, and cerebrovascular disease.



# Question 1

Molecular formula of furan is

**A**

C<sub>5</sub>H<sub>4</sub>O

**C**

C<sub>4</sub>H<sub>4</sub>O

**B**

C<sub>4</sub>H<sub>5</sub>O

**D**

C<sub>5</sub>H<sub>5</sub>O

## Question 2

Thiophene can be prepared from n-Butane

**True**

**False**

## Question 3

Furan, pyrrole & thiophene undergoes electrophilic substitution at ..... Position.

A

2

B

3

C

4

# Summary

- **Pyrrole, furan and thiophene are organic compounds. These are five membered ring structures in which one carbon atom is replaced with a different group such as an amine group, an oxygen atom or a sulfur atom.**
- **Pyrrole furan and thiophene are color less liquids , have different boiling point and different odor.**
- **These compounds undergo electrophilic substitution reaction and they are also used in medicines.**



# Reference

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**Thank  
you!**

