

Difference Between Homocyclic and Heterocyclic Compounds

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Key Difference - Homocyclic vs Heterocyclic Compounds

Organic compounds are widely classified into two sections based on their carbon framework, namely open-chain compounds, and closed chain or cyclic compounds. Open chain compounds are again subdivided into two groups; unbranched chain and branched chain compounds. Closed chain or cyclic compounds are also subdivided into two groups; homocyclic and heterocyclic compounds. The **key difference** between homocyclic compounds and heterocyclic compounds is that in homocyclic compounds, **the ring of homocyclic compounds is made up of carbon atoms only, whereas that of heterocyclic compounds is made up of more than one kind of atoms.** This article elaborates more on the difference between homocyclic and heterocyclic compounds.

What are Homocyclic Compounds?

Homocyclic compounds are also known as carbocyclic or isocyclic compounds as their rings are formed with only one type of atoms, mainly carbon. Homocyclic compounds can be further classified into alicyclic compounds and arenes or aromatic compounds. Alicyclic compounds are the compounds that behave more like aliphatic compounds, hence the name alicyclic. Alicyclic compounds can be saturated or unsaturated. Examples of alicyclic compounds include cyclopropane and cyclohexane.

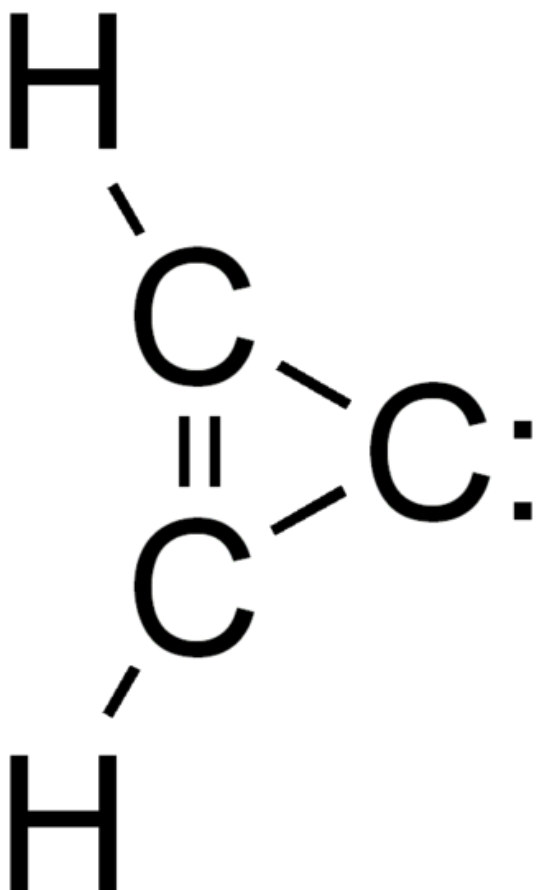


Figure 01: Cyclopropenylidene

Aromatic compounds consist of a cyclic structure with double and single bonds arranged alternately. [Benzene](#) is the simplest aromatic compound with the formula of C_6H_6 and it has three single and double bonds. Due to the presence of double bonds, aromatic compounds are considered as [unsaturated hydrocarbons](#), even though these compounds do not undergo addition reactions, unlike typical unsaturated linear hydrocarbons. The name aromatic was assigned to these compounds as most of these compounds have a pleasant smell (aroma is the Greek word for pleasant smell). Some examples of aromatic compounds include [phenol](#), [toluene](#), naphthalene, and anthracene.

What are Heterocyclic Compounds?

Heterocyclic compounds are the cyclic compounds in which the rings contain at least two different types of atoms (including a carbon atom). The atoms other than the carbon atoms present in the ring are known as heteroatoms. Usually, the rings of these compounds consist of a larger portion of carbon. The most common heteroatoms present in heterocyclic compounds include [nitrogen](#), [sulphur](#), and [oxygen](#).

Heterocyclic compounds can be either aromatic or aliphatic. The rings of heterocyclic compounds may be fused or bridged with another heterocyclic ring or homocyclic ring. A large number of natural compounds and drugs consist of heterocyclic compounds, namely vitamin B group (thiamine, riboflavin etc.), [antibiotics](#) ([penicillin](#), griseofulvin, etc.), [steroids](#) (cardiac glycosides), [amino acids](#) (tryptophan, histidine etc.), and alkaloids (reserpine, pilocarpine etc).

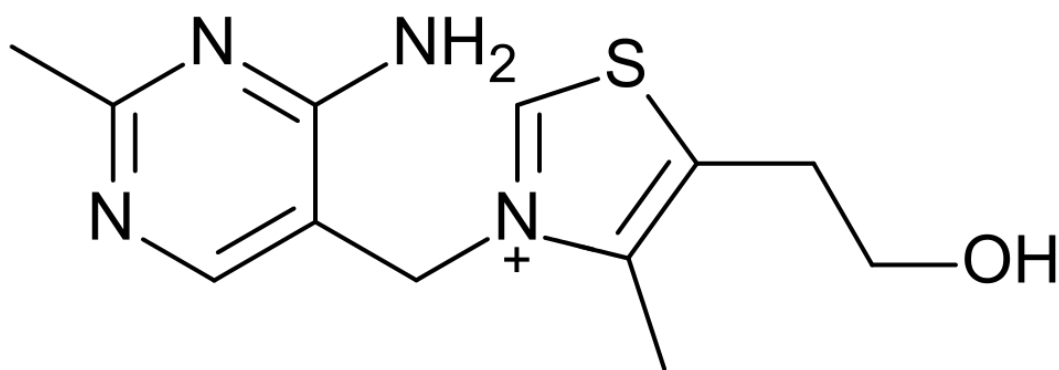


Figure 2: Heterocyclic Compounds - Thiamine

Heterocyclic compound may be aliphatic or aromatic in nature. Based on that, heterocyclic compounds are classified into two groups; (a) alicyclic heterocyclic compounds that resemble the properties of typical aliphatic compounds, and (b) aromatic heterocyclic compounds that resemble the properties of most of the aromatic compounds including benzene. Examples for alicyclic heterocyclic compounds are tetrahydrofuran and piperidine. Examples of aromatic heterocyclic compounds include pyridine, furan, and pyrrole.

What is the Difference Between Homocyclic and Heterocyclic Compounds?

Homocyclic vs Heterocyclic Compounds	
Homocyclic Compound ring contains only one types of atom.	Heterocyclic Compound ring contains at least two different types of atoms including carbon.
Atomic Composition of the Ring	
Homocyclic Compounds have 100% carbon atoms in their ring.	Heterocyclic Compounds have mainly carbon, in addition, heteroatoms such as nitrogen, oxygen, and sulphur are found in their ring.
Sub Divisions	
alicyclic homocyclic and aromatic homocyclic	alicyclic heterocyclic and aromatic heterocyclic
Examples	

phenol, toluene, naphthalene,
and anthracene

tetrahydrofuran, piperidine, pyridine, furan, and pyrrole

Summary - Homocyclic vs Heterocyclic Compounds

Based on the nature of the ring structure, cyclic organic compounds are classified as homocyclic compounds, in which the ring consists of only one type of atom, and heterocyclic compounds, in which the ring consists of at least two different types of atoms including carbon. In heterocyclic compounds, carbon atoms make the major portion of the ring, while the rest is made by heteroatoms, which often includes nitrogen, oxygen, and sulphur. This is the difference between homocyclic compounds and heterocyclic compounds.

Reference:

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