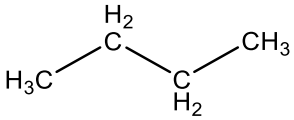
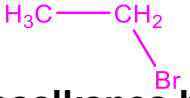
H1- Functional Groups Theory Sheet

A functional group is a specific group of atoms or bonds that form part of an organic molecule. A certain type of functional group will undergo similar chemical reactions even when attached to different sized molecules; however neighbouring groups may affect this reactivity. A molecule can have multiple functional groups which lead to its overall

Alkane

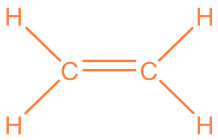


Alkanes are the simplest type of functional group. They contain only carbon hydrogen with strong single bonds. Halogenoalkane



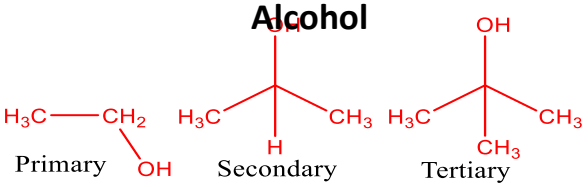
Halogenoalkanes have halogens (F, Cl, Br, I) replacing a one or more H atoms in an alkane.

Alkene



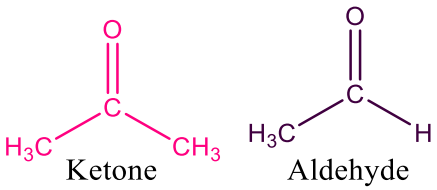
Alkenes contain carbon to carbon double bonds. They contain a π-bond caused by overlap of p-orbitals.

Alcohol



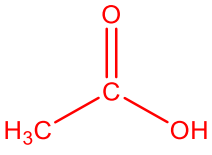
An alcohol group contains an oxygen with a single bond to a hydrogen. One or more of the H atoms in the alkane is replaced by OH. Ethanol is the alcohol contained in alcoholic drinks and is shown in the diagram above. Alcohols can be primary secondary or tertiary, depending on how many carbons are attached to the alcohol carbon. (1 C= Primary 2 C= Secondary 3 C= Tertiary)

Aldehydes + Ketones



Aldehydes and ketones contain the C=O carbonyl group (C O double bond). Aldehydes have hydrogen atom attached to the carbonyl carbon and ketones have 2 carbon groups.

Carboxylic Acid



Carboxylic acids contain a carbonyl group similar to an aldehyde with a OH group instead of a hydrogen.

Be careful when assigning aldehydes, ketones and carboxylic acid groups! Make sure you look at the groups attached to the carbonyl as this will distinguish the functional group.

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Produced by Steven Carman at Newcastle University as part of an MChem project.

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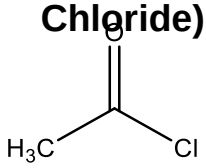
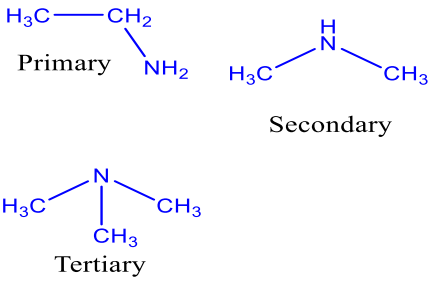
Extension Functional groups

Acyl Chloride (Acid Chloride)



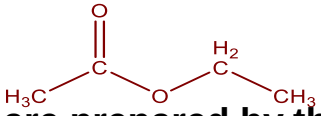
Acyl Chlorides are carbonyl groups with a Cl atom attached. They are very sensitive and reactive.

Amines



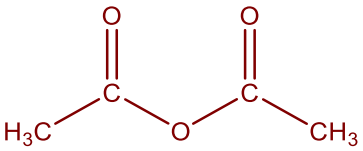
Amines are alkanes with NH_2 groups replacing one or more H atoms. They can be primary secondary or tertiary dependant on how many carbons are attached to the nitrogen. (1 C= Primary 2 C= Secondary 3 C= Tertiary)

Ester



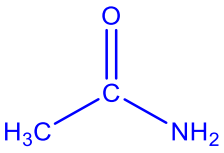
Ester groups are prepared by the condensation reaction of a carboxylic acid and an alcohol. It is similar to a carboxylic acid with the H atom (on the OH) replaced by an alkane.

Acid Anhydride



An acid anhydride is a group containing 2 carbonyls linked by oxygen. Imagine two carboxylic acids attached by the OH groups with the loss of H_2O with a single O remaining.

Amides



Amides are carbonyl groups attached to NH_2 groups. They can also be like esters where the nitrogen can have alkane groups instead of the H groups.

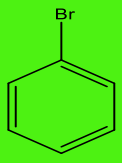
The previous examples are aliphatic, meaning that they are not attached to a benzene/arene. If these groups are attached to a benzene/arene ring they are known as aromatic. In the green box below, there is an example of specific aromatic functional groups.

Aromatic Functional Groups

Arenes (benzene/phenyl)

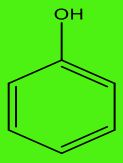
Aromatic hydrocarbons with delocalised electrons (more detail in aromatic sheets)

Aryl Halides



Arenes/Aromatics with halogens substituted for H in one or multiple position.

Phenol



Arenes with OH groups substituted for H atoms. This leads to unusual reactivity.

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