

Functional Groups

Chapter 3.1

Organic Chemistry, *8th Edition*

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Functional Groups

A functional group is an atom or a group of atoms all or in part \neq than C with specific and well defined physico-chemical properties.

Functional Groups

Organic Residue
(Radical)

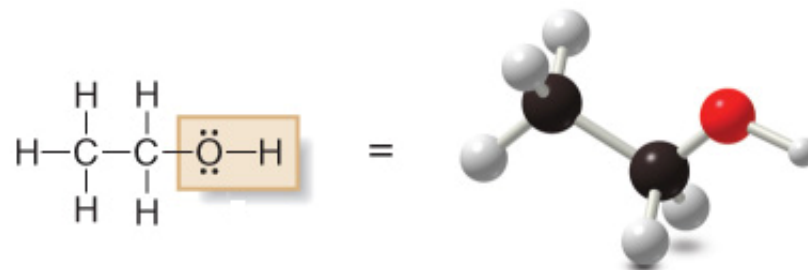
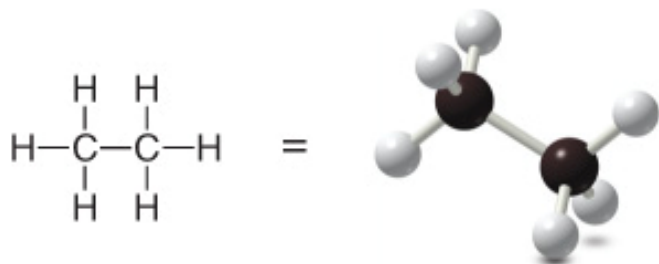
(from a hydrocarbon)



Functional Group

(heteroatom or group of atoms
containing one or more heteroatoms)

Functional Groups



- Only C–C and C–H bonds
- No functional groups
- Does not possess polar bond or π bonds: very unreactive.
- Insoluble in water

- OH functional groups
- Polar C–O and O–H bonds
- Lone pair on O
- Reacts with electrophiles
- Reacts with strong bases
- Soluble in water

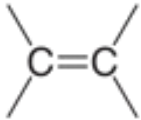
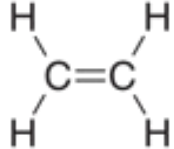
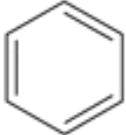
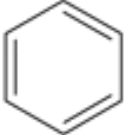
Functional Groups

1. Defines a class of compounds
 - Compounds belonging to the same class have **similar properties and reactivity**.
2. Is frequently the **reaction site**
 - Defines the **reactivity** of a molecule
3. Determines the name
 - For example all chetones have the suffix **–one**:
 - » acet**one**
 - » cyclopropan**one**
 - » cortis**one**

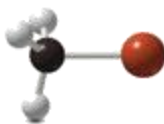


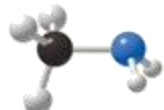


Hydrocarbons

Hydrocarbons possess only C–C e C–H bonds.

aliphatic (alkanes, alkenes, alkynes) and **aromatic**.

Hydrocarbon	General structure	Example	Functional Group
Alkanes	$R-H$	CH_3CH_3	-----
Alkenes			Double bond
Alkynes	$-C\equiv C-$	$H-C\equiv C-H$	Triple bond
Aromatics			Aromatic ring

Functional Groups Containing C–Y σ bonds

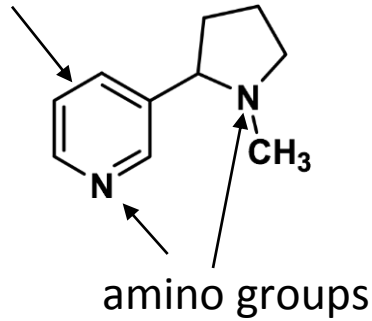
Class Name	Structure	Example	3D Structure	Functional Group
Alkyl Halide	$\text{R}-\ddot{\text{X}}:$ (X=F, Cl, Br, I)	$\text{CH}_3-\ddot{\text{Br}}:$		-X halo
Alcohol	$\text{R}-\ddot{\text{O}}\text{H}$	$\text{CH}_3-\ddot{\text{O}}\text{H}$		-OH hydroxy
Ether	$\text{R}-\ddot{\text{O}}-\text{R}$	$\text{CH}_3-\ddot{\text{O}}-\text{CH}_3$		-OR alcoxy
Amine	$\text{R}-\ddot{\text{N}}\text{H}_2 \text{ or } \text{R}_2\ddot{\text{N}}\text{H} \text{ or } \text{R}_3\ddot{\text{N}}$	$\text{CH}_3-\ddot{\text{N}}\text{H}_2$		-NH ₂ amino
Thiol	$\text{R}-\ddot{\text{S}}\text{H}$	$\text{CH}_3-\ddot{\text{S}}\text{H}$		-SH mercapto
Sulfide	$\text{R}-\ddot{\text{S}}-\text{R}$	$\text{CH}_3-\ddot{\text{S}}-\text{CH}_3$		-SR alkylthio

Functional Groups Containing The C=O Bond

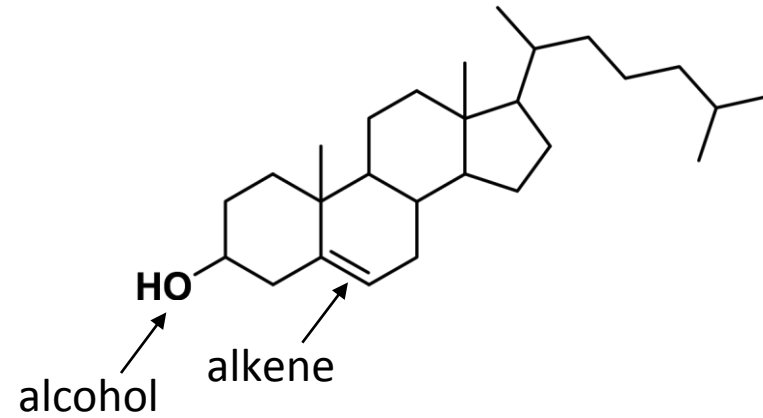
Class Name	Structure	Example	3D Structure	Functional Group
Aldehyde	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{R}-\text{C}-\text{H} \end{array}$	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{CH}_3-\text{C}-\text{H} \end{array}$		H-C=O formyl
Ketone	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{R}-\text{C}-\text{R} \end{array}$	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{CH}_3-\text{C}-\text{CH}_3 \end{array}$		C=O carbonyl
Carboxylic Acid	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{R}-\text{C}-\ddot{\text{O}}\text{H} \end{array}$	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{CH}_3-\text{C}-\ddot{\text{O}}\text{H} \end{array}$		-COOH carboxylate
Ester	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{R}-\text{C}-\ddot{\text{O}}\text{R} \end{array}$	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{CH}_3-\text{C}-\ddot{\text{O}}\text{CH}_3 \end{array}$		-COOR
Amide	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{R}-\text{C}-\ddot{\text{N}} \begin{array}{l} \text{H (o R)} \\ \text{H (o R)} \end{array} \end{array}$	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{CH}_3-\text{C}-\ddot{\text{N}}\text{H}_2 \end{array}$		-CONH ₂ -CONHR -CONR ₂
Acid Chloride	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{R}-\text{C}-\ddot{\text{Cl}} \end{array}$	$\begin{array}{c} \text{:O:} \\ \parallel \\ \text{CH}_3-\text{C}-\ddot{\text{Cl}} \end{array}$		-COCl

Polyfunctional Molecules

aromatic

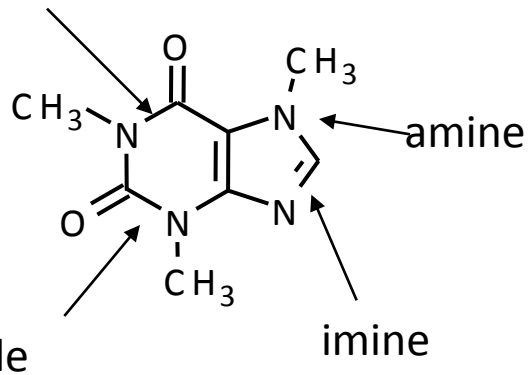


nicotine

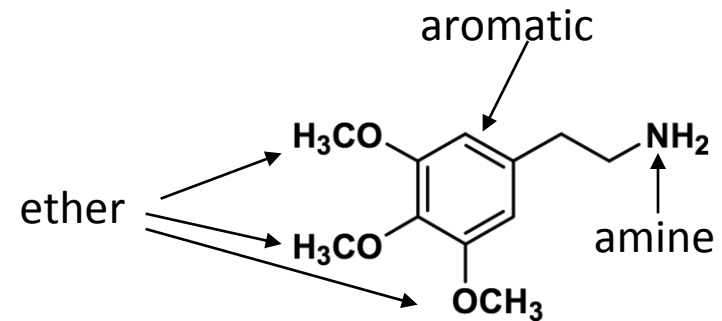


cholesterol

amide



caffeine



mescaline