Functional Groups

Most organic chemistry involves substituents attached to hydrocarbon chains.

The substituents of organic molecules often contain oxygen, nitrogen, sulfur, and/or phosphorus.

They are called functional groups because they are the chemically functional parts of the molecules.

A **functional group** is a specific arrangement of atoms in an organic compound that is capable of characteristic chemical reactions.

Organic compounds can be classified according to their functional groups.

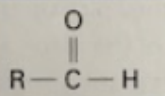
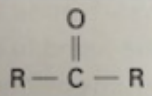
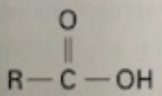
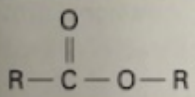
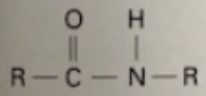
Look at Table 23.1 on page 726

The symbol "R" represents any carbon chain or rings attached to the functional group.

Functional Groups

Table 23.1

Organic Compounds Classified by Functional Group

Compound type	Compound structure	Functional group
Halocarbon	R—X (X = F, Cl, Br, or I)	Halogen
Alcohol	R—OH	Hydroxyl
Ether	R—O—R	Ether
Aldehyde		Carbonyl
Ketone		Carbonyl
Carboxylic acid		Carboxyl
Ester		Ester
Amine	$R—NH_2$	Amino
Amide		Amide

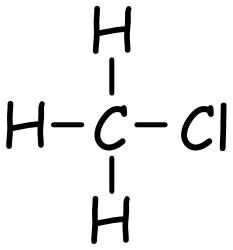
Halogen Substituents

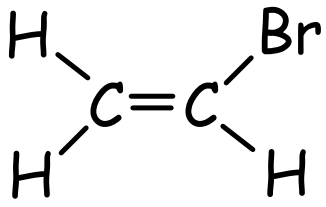
A halocarbon is a carbon containing compound with a halogen substituent.

Halocarbons contain covalent bonds of F, Cl, Br, or I.

The IUPAC rules for naming halocarbons are based on the parent hydrocarbon. The halogens group is a substituent.

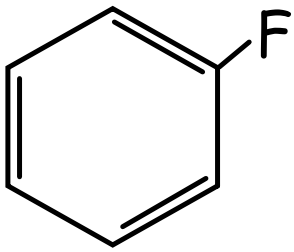
Example:





Practice

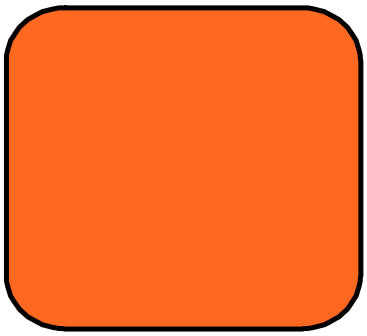
What would be the IUPAC name for the following compound?



Practice

What would be the structural compound of

2-bromo-2-chloro-1,1,1-trifluoroethane?



*It's common name is halothane, which is used as an anesthetic.

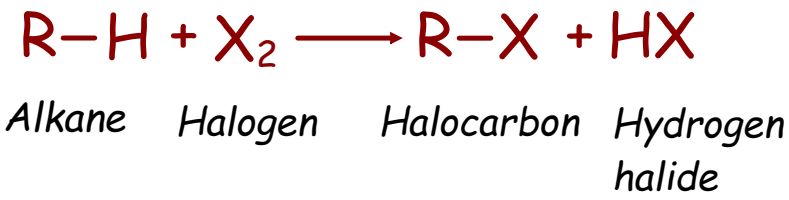
Substitution Reactions

Organic reactions often proceed more slowly than inorganic reactions.

This is because organic reactions commonly involve the breaking of relatively strong covalent bonds. Catalysts are often needed.

A common type of organic reaction is a **substitution reaction**, where an atom, or a group of atoms, replaces another atom or group of atoms.

A halogen can replace a hydrogen atom on an alkane to produce a halocarbon.

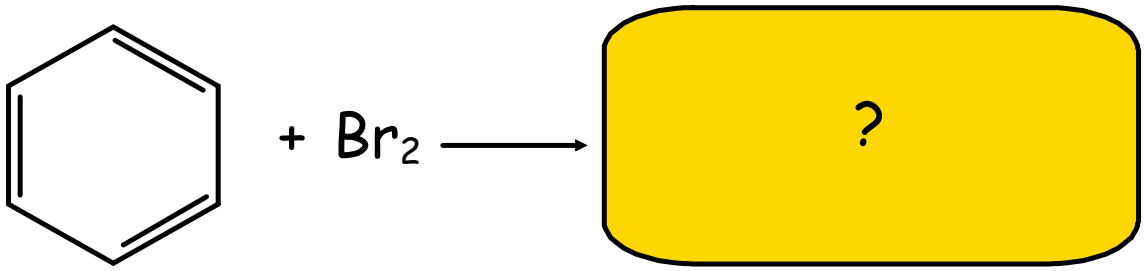


Where X stands for a halogen

As an example, sunlight or another source of UV radiation usually serves as a catalyst.

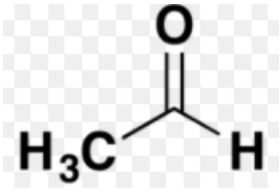
$$CH_4 + Cl_2 \xrightarrow[\text{light}]{\text{UV}} CH_3Cl + HCl$$

What do you suppose will happen if we have benzene reacting with bromine gas?

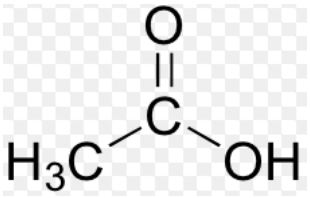


Practice

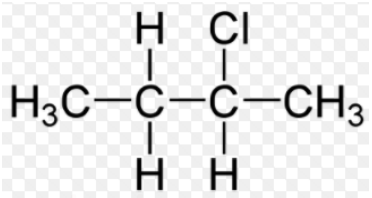
Using the chart, try to identify the functional group in each situation.

a) 

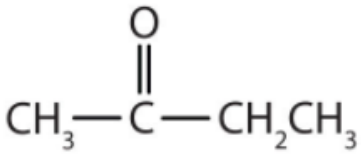
carbonyl (aldehyde)

b) 

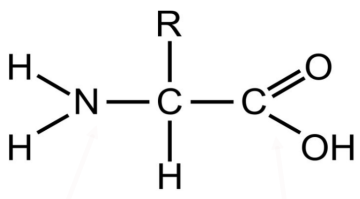
carboxyl

c) 

halogen

d) 

carbonyl (keytone)

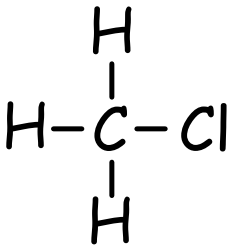
e) 

amino carboxyl

Try questions on Pg. 729
#1-4, 5b, 6

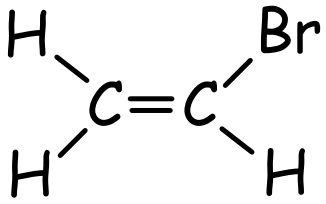
The common names for each of them have rules as well. The first part names the hydrocarbon portion of the molecule as an alkyl group.

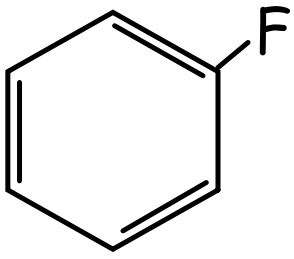
The second part gives the halogen with an *-ide* ending.



Chloromethane

Bromoethene





Fluorobenzene

When we use the common names, halocarbons in which a halogen is attached to a carbon of an aliphatic* chain are called **alkyl halides**.

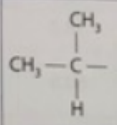
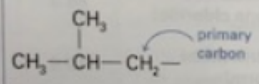
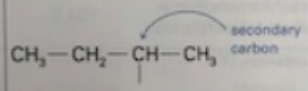
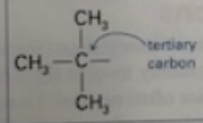
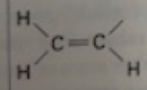
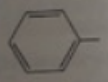
*Aliphatic chains are non-aromatic. They have straight-chain or branch chained carbons.

The number of carbon atoms attached to the carbon that is bonded to the halogen determines whether it is primary, secondary, or tertiery.

Table 23.2 lists some common alkyl groups

Table 23.2

Names of Some Common Alkyl Groups

Name	Alkyl group	Remarks
Isopropyl		The prefix *iso-* is used when there is a methyl group on the carbon second from the unsubstituted end of the longest chain.
Isobutyl		The carbon joining this alkyl group to another group is bonded to one other carbon; it is a primary carbon.
Secondary butyl (*sec*-butyl)		The carbon joining this alkyl group to another group is bonded to two other carbons; it is a secondary carbon.
Tertiary butyl (*tert*-butyl)		The carbon joining this alkyl group to another group is bonded to three carbons; it is a tertiary carbon.
Vinyl		When used as an alkyl group in giving compounds common names, this group is called vinyl.
Phenyl		Phenyl is derived from benzene.