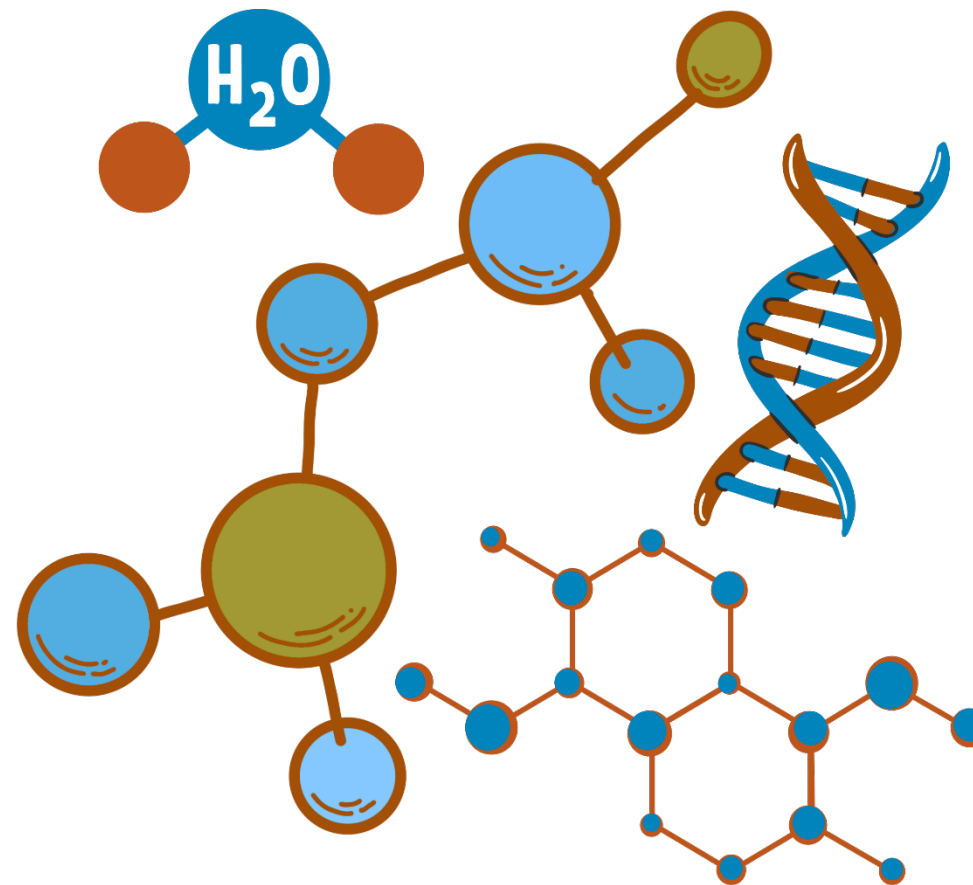


Chapter 3:
Nomenclature of
Organic Compounds



- The older unsystematic names, (*Common names*).
- Systematic nomenclature developed and updated by the International Union of Pure and Applied Chemistry (IUPAC).

1. Nomenclature of Alkanes and Cycloalkanes

- The names for some unbranched alkanes are listed in Table 3.1.
- The ending for all of the names of alkanes is *-ane*.
- The stems of the names of most of the alkanes (above C₄) are of Greek and Latin origin. Thus, *one*, *two*, *three*, *four*, and *five* become *meth-*, *eth-*, *prop-*, *but-*, and *pent-*.

Table 3-1 The Unbranched alkanes					
Name	Number of Carbon Atoms	Structure	Name	Number of Carbon Atoms	Structure
Methane	1	CH ₄	Hexane	6	CH ₃ (CH ₂) ₄ CH ₃
Ethane	2	CH ₃ CH ₃	Heptane	7	CH ₃ (CH ₂) ₅ CH ₃
Propane	3	CH ₃ CH ₂ CH ₃	Octane	8	CH ₃ (CH ₂) ₆ CH ₃
Butane	4	CH ₃ (CH ₂) ₂ CH ₃	Nonane	9	CH ₃ (CH ₂) ₇ CH ₃
Pentane	5	CH ₃ (CH ₂) ₃ CH ₃	Decane	10	CH ₃ (CH ₂) ₈ CH ₃



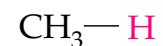
1. Nomenclature of Alkanes and Cycloalkanes

1.1. How to Name Alkyl Groups

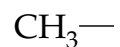
- If we remove **one terminal hydrogen** atom from an alkane, we obtain what is called an **alkyl** group.
- These alkyl groups have names that end in **-yl**.

Alkane $\longrightarrow$ Alkyl

- **Example;**



Methane

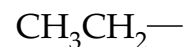


Methyl

Me-



Ethane



Ethyl

Et-



Chapter 3: Nomenclature of Organic Compounds

1. Nomenclature of Alkanes and Cycloalkanes

1.1. How to Name Alkyl Groups

- For **alkanes** with **more than two carbon atoms**, more than one derived group is possible.

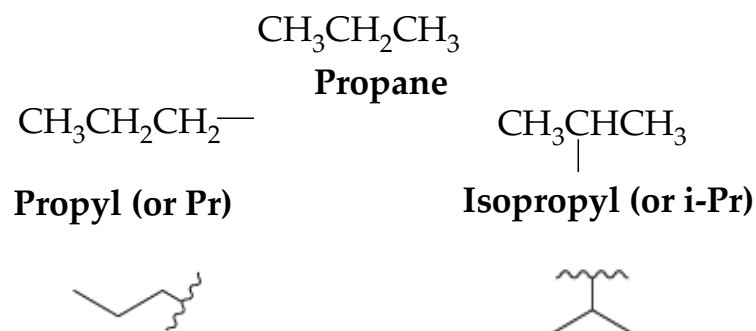
- For example;

Two groups can be derived from propane,

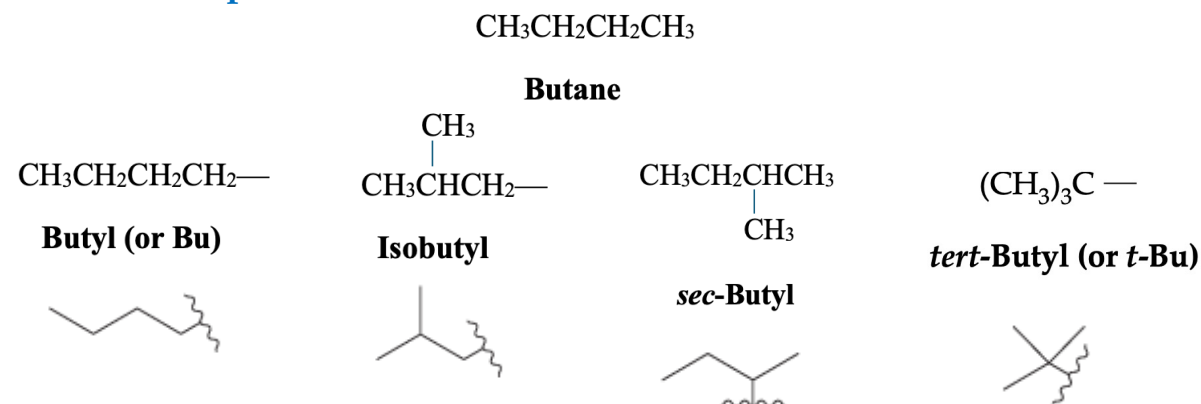
the **propyl group** is derived by removal of a terminal hydrogen, and

the **isopropyl** (common name) is derived by removal of a hydrogen from the central carbon.

Three-Carbon Groups



Four-Carbon Groups



- The **common names isopropyl, isobutyl, sec-butyl, and tert-butyl** are approved by IUPAC for the unsubstituted groups, and they are still very frequently used.

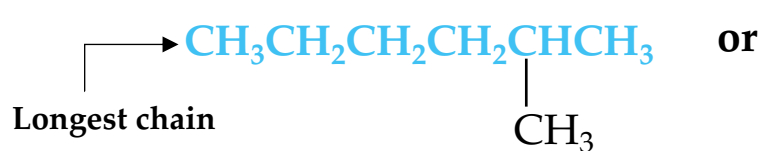
1. Nomenclature of Alkanes and Cycloalkanes

1.2. How to Name Alkanes

- Branched-chain alkanes are named according to the following rules:

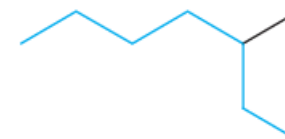
1. Locate the **longest continuous chain of carbon atoms**; this chain determines the parent's name for the alkane.

The longest continuous chain may not always be obvious from the way the formula is written.



Hexane

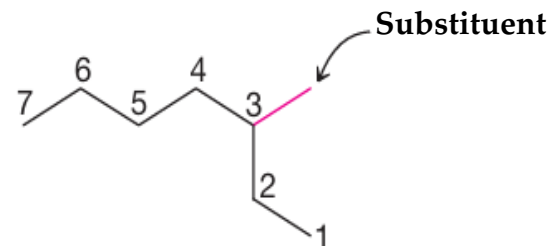
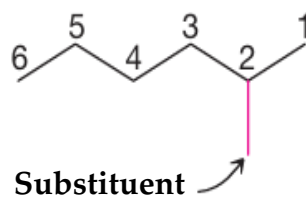
Because the longest continuous chain contains six carbon atoms



Heptane

Because the longest chain contains seven carbon atoms

2. Number the longest chain beginning with the end of the chain nearer the substituent.

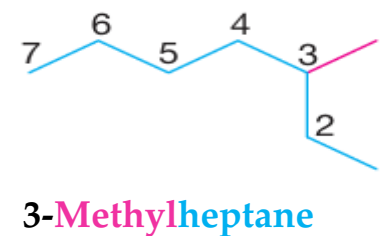
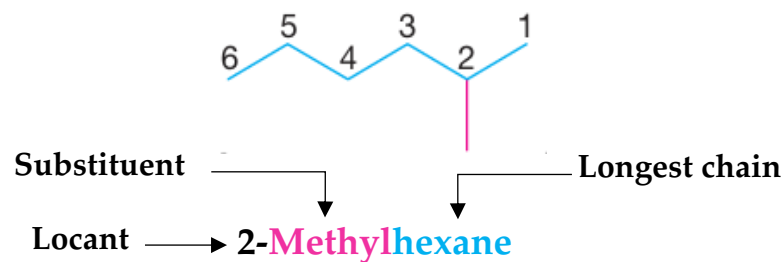


1. Nomenclature of Alkanes and Cycloalkanes

1.2. How to Name Alkanes

3. Use the numbers obtained by application of rule 2 to designate the location of the substituent group.

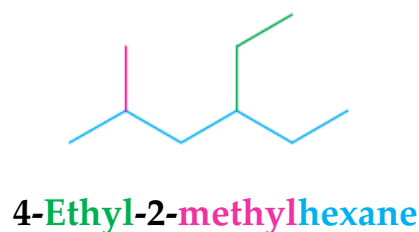
The parent's name is placed last, and the substituent group, preceded by the number designating its location on the chain, is placed first. Numbers are separated from words by a hyphen (-).



4. When two or more substituents are present, give each substituent a number corresponding to its location on the longest chain.

The substituent groups should be listed alphabetically (i.e., ethyl before methyl).

In deciding on alphabetical order, disregard multiplying prefixes such as “di” and “tri”.



Chapter 3: Nomenclature of Organic Compounds

1. Nomenclature of Alkanes and Cycloalkanes

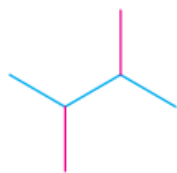
1.2. How to Name Alkanes

5. When two substituents are present on the same carbon atom, use that **number repeated twice**.

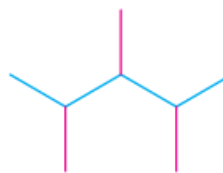


3-Ethyl-3-methylhexane

6. When two or more substituents are identical, indicate this by the use of the prefixes **di-**, **tri-**, **tetra-**, and so on. Then, make sure that each substituent is assigned a number. *Commas (,)* are used to separate numbers from each other.



2,3-Dimethylbutane



2,3,4-Trimethylpentane



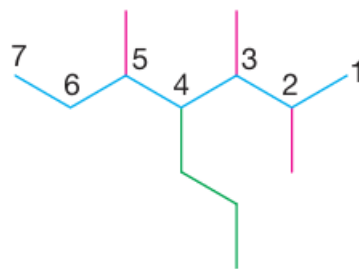
2,2,4,4-Tetramethylpentane

Chapter 3: Nomenclature of Organic Compounds

1. Nomenclature of Alkanes and Cycloalkanes

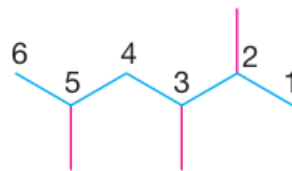
1.2. How to Name Alkanes

7. When two chains of equal length compete for selection as the parent chain, choose the chain with the greater number of substituents.



2,3,5-Trimethyl-4-propylheptane
(four substituent)

8. When branching first occurs at an equal distance from either end of the longest chain, choose the name that gives the lower number at the first point of difference.



2,3,5-Trimethylhexane
(not 2,4,5-Trimethylhexane)



1. Nomenclature of Alkanes and Cycloalkanes

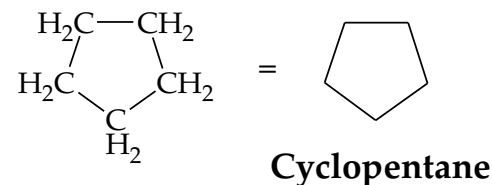
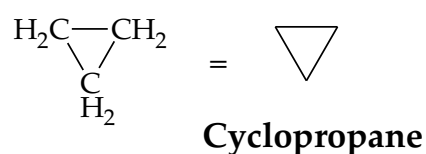
1.3. How to Name Monocyclic Cycloalkanes

- **Cycloalkanes** are named by adding “*cyclo*” before the parent's name.

1. Cycloalkanes with one ring and no substituents:

Count the number of carbon atoms in the ring, then add “*cyclo*” to the beginning of the name of the alkane with that number of carbons.

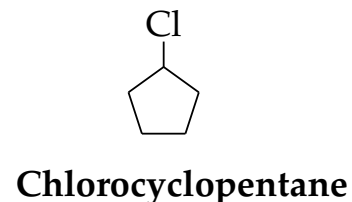
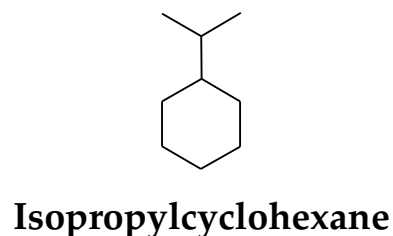
Example; **cyclopropane** has three carbons and **cyclopentane** has five carbons.



2. Cycloalkanes with one ring and one substituent:

Add the name of the substituent to the beginning of the parent's name.

For compounds with only one substituent, it is not necessary to specify a number (locant) for the carbon bearing the substituent.



1. Nomenclature of Alkanes and Cycloalkanes

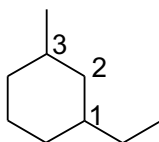
1.3. How to Name Monocyclic Cycloalkanes

3. Cycloalkanes with one ring and two or more substituents:

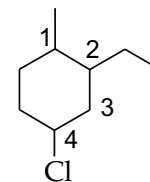
For a ring with two substituents, begin by numbering the carbons in the ring, starting at the carbon with the substituent that is first in the alphabet and number in the direction that gives the next substituent the lower number possible.

When there are three or more substituents, begin at the substituent that leads to the lowest set of numbers (locants).

The substituents are listed in alphabetical order, not according to the number of their carbon atom.

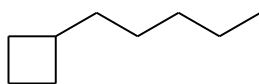


1-Ethyl-3-methylcyclohexane
(*not* 1-ethyl-5-methylcyclohexane)

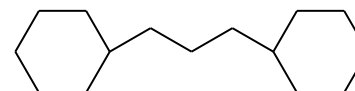


4-Chloro-2-ethyl-1-methylcyclohexane
(*not* 1-Chloro-3-ethyl-4-methylcyclohexane)

4. When a single ring system is attached to a single chain with a greater number of carbon atoms, or when more than one ring system is attached to a single chain, then it is appropriate to name the compounds as **cycloalkylalkanes**.



1-Cyclobutylpentane



1,3-Dicyclohexylpropane

2. Nomenclature of Alkenes and Cycloalkenes

2.1. How to Name Alkenes

- The IUPAC rules for naming alkenes are similar in many respects to those for naming alkanes:

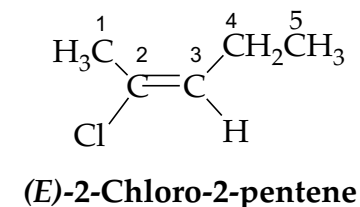
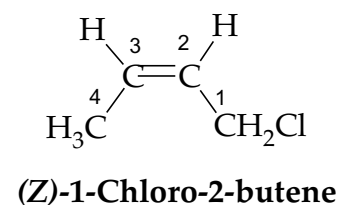
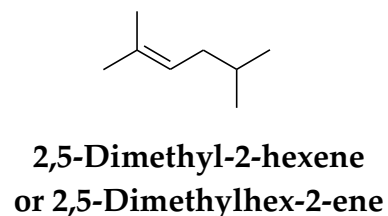
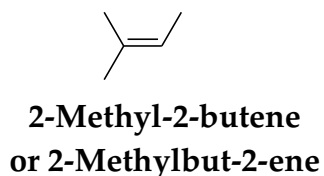
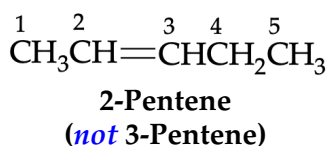
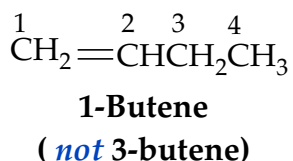
- Determine the parent's name by selecting the longest chain that **contains the double bond** and change the ending of the name of the alkane of identical length from **-ane** to **-ene**.

			
IUPAC name	Ethene	Propene	2-Methylpropene
Common name	Ethylene	Propylene	Isobutylene

- Number the chain from the end nearest the double bond, **ensuring that both double-bonded carbon atoms are included in the parent chain**.

Designate the location of the double bond by using the number of the first atom of the double bond as a **prefix**. The locant for the alkene **suffix** may precede the parent's name or be placed immediately before the suffix.

- Indicate the locations of the substituent groups by the numbers of the carbon atoms to which they are attached.



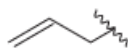
2. Nomenclature of Alkenes and Cycloalkenes

2.1. How to Name Alkenes

4. Two frequently encountered alkenyl groups are the **vinyl group** and the **allyl group**.

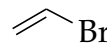


The vinyl group



The allyl group

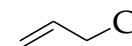
IUPAC name
Common name



Bromoethene
Vinyl bromide



Ethenylcyclopropane
Vinylcyclopropane

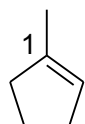


3-Chloropropene
Allyl chloride

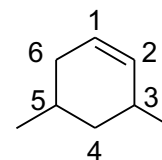
2.2. How to Name Cycloalkenes

Number substituted **cycloalkenes** in the way that gives the carbon atoms of the **double bond** the **1 and 2 positions** and that also gives the substituent groups the lower numbers at the first point of difference.

With substituted cycloalkenes it is not necessary to specify the position of the double bond since it will always begin with C1 and C2.



1-Methylcyclopentene
(*not* 2-methylcyclopentene)



3,5-Dimethylcyclohexene
(*not* 4,6-Dimethylcyclohexene)

3. Nomenclature of Alkyne

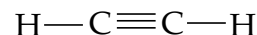
3.1. How to Name Alkyne

- Alkynes are named in much the same way as alkenes.
- Alkynes, are named by replacing the *-ane* of the name of the corresponding alkane with the ending *-yne*.

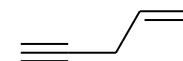
The chain is numbered to give the carbon atoms of the triple bond the lower possible numbers. The lower number of the two carbon atoms of the triple bond is used to designate the location of the triple bond.

- When double and triple bonds are present, the direction of numbering is chosen so as to give the lowest overall set of locants. In the face of equivalent options, then preference is given to assigning lowest numbers to the double bonds.
- The locations of substituent groups of branched alkynes and substituted alkynes are also indicated with numbers.

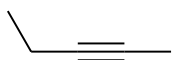
IUPAC name
Common name



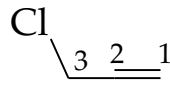
Ethyne
Acetylene



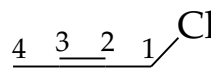
1-Penten-4-yne
or Pent-1-en-4-yne



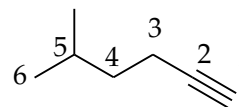
2-Pentyne



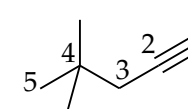
3-Chloropropyne



1-Chloro-2-but-yne
or 1-Chlorobut-2-yne



5-Methyl-1-hexyne
or 5-Methylhex-1-yne

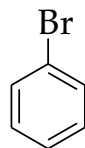


4,4-Dimethyl-1-pentyne
or 4,4-Dimethylpent-1-yne

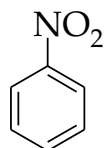
4. Nomenclature of Aromatic Compounds

4.1. How to Name Monosubstituted Benzene

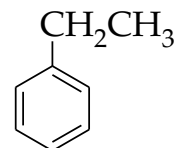
- **Benzene** is the simplest aromatic compound, and the simple monosubstituted ring is named as derivative of benzene.



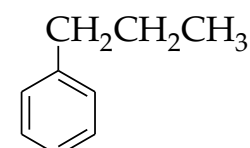
Bromobenzene



Nitrobenzene

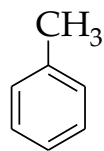


Ethylbenzene

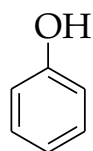


Propylbenzene

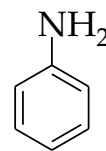
- Common names are accepted by IUPAC as parent compounds.



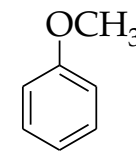
Toluene



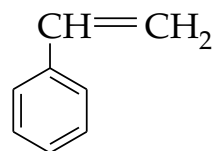
Phenol



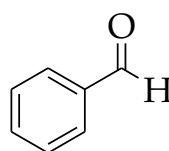
Aniline



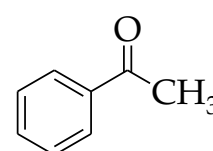
Anisole



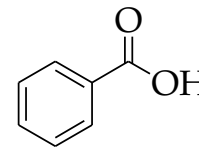
Styrene



Benzaldehyde



Acetophenone

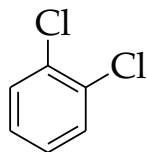
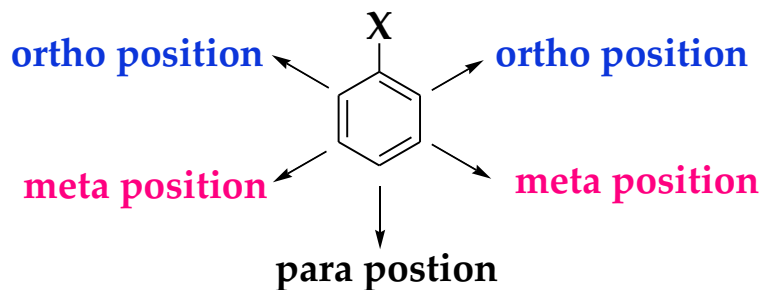


Benzoic acid

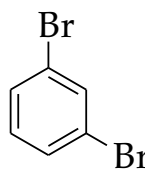
4. Nomenclature of Aromatic Compounds

4.2. How to Name Disubstituted Benzene

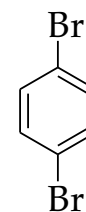
- When two substituents are present, their relative positions are indicated by the prefixes *ortho-*, *meta-*, and *para-* (abbreviated *o-*, *m-*, and *p-*) or using numbers.
- If substituent **X** is attached to carbon **1**;
 - o-* groups are on carbons **2** and **6**;
 - m-* groups are on carbons **3** and **5**, and
 - p-* groups are on carbon **4**.



1,2-Dichlorobenzene
(*o*-Dichlorobenzene)



1,3-Dibromobenzene
(*m*-Dibromobenzene)

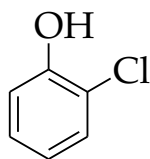


1,4-Dibromobenzene
(*p*-Dibromobenzene)

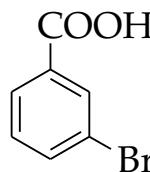
4. Nomenclature of Aromatic Compounds

4.2. How to Name Disubstituted Benzene

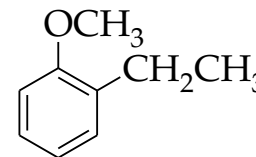
- If a substituent have a special name, it could be used as the parent's name with the possible lowest number .
- Some disubstituted benzene derivatives have a common names.



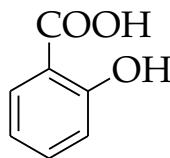
2-Chlorophenol
(*o*-Chlorophenol)



3-Bromobenzoic acid
(*m*-Bromobenzoic acid)

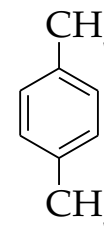


2-Ethylanisole
(*o*-Ethylanisole)



IUPAC name
Common name

2-Hydroxybenzoic acid
Salicylic acid

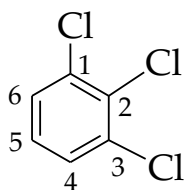


1,4-Dimethylbenzene

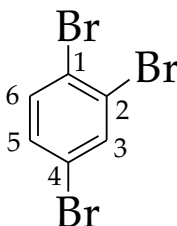
4. Nomenclature of Aromatic Compounds

4.3. How to Name Polysubstituted Benzene

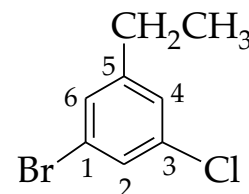
- If more than two groups are present on the benzene ring, their positions must be indicated using **numbers only**.
- The benzene ring is numbered so as to give the lowest possible numbers to the substituents.



1,2,3-Trichlorobenzene

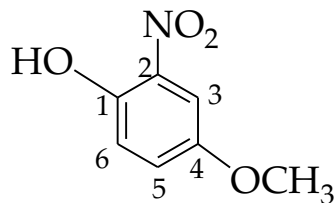


1,2,4-Tribromobenzene

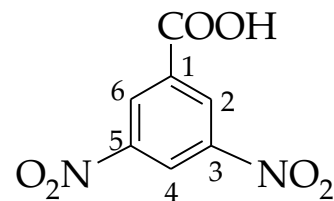


1-Bromo-3-chloro-5 ethylbenzene

- When a substituent is one that together with the benzene ring gives a new base name, that substituent is assumed to be in position 1 and the new parent's name is used.



4-Methoxy-2-nitro-phenol

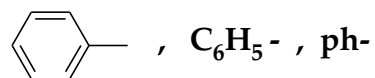


3,5-Dinitrobenzoic acid

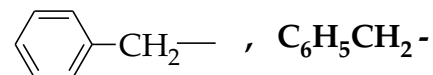
4. Nomenclature of Aromatic Compounds

4.4. How to Name Aryl Groups

- When the C_6H_5- group is named as a substituent, it is called a **phenyl group (Ph-)**.
- Benzyl group ($\text{C}_6\text{H}_5\text{CH}_2-$)** is an alternative name for the **phenylmethyl group**.

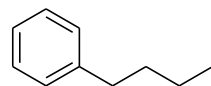


Phenyl group

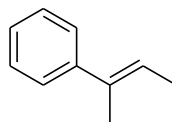


Benzyl group

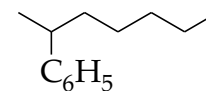
- A hydrocarbon composed of **one saturated chain** and **one benzene** ring is usually named as a derivative of the **larger structural unit**.



Butylbenzene

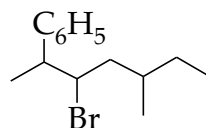


(E)-2-Phenyl-2-butene

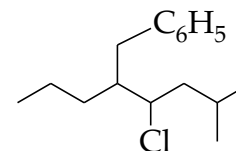


2-Phenylheptane

- If the chain is **unsaturated**, the compound may be named as a derivative of that chain, regardless of ring size.



3-Bromo-5-methyl-2-phenylheptane



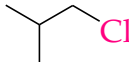
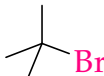
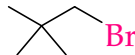
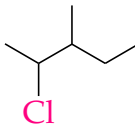
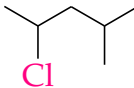
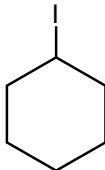
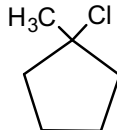
5-Benzyl-4-chloro-2-methyloctane

Chapter 3: Nomenclature of Organic Compounds

5. Nomenclature of Halogen Compounds

5.1. How to Name Alkyl and Cycloalkyl Halides

- Alkanes bearing halogen substituents are named in the IUPAC substitutive system as haloalkanes.
- Common nomenclature system, called functional class nomenclature, haloalkanes are named as alkyl halides.
- When the parent chain has both a halo and an alkyl substituent attached to it, number the chain from the end nearer the first substituent, regardless of whether it is halo or alkyl.
- If two substituents are at equal distance from the end of the chain, then number the chain from the end nearer the substituent that has alphabetical precedence.
- Cycloalkyl halides are organic halides in which a halogen atom is attached directly to a carbon atom of a cycloalkane ring.

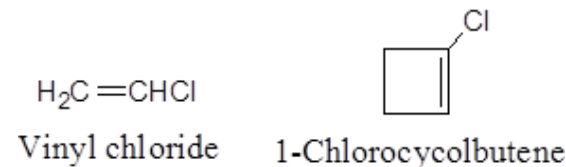
	$\text{CH}_3\text{CH}_2\text{Cl}$	$\text{CH}_3\text{CH}_2\text{CH}_2\text{F}$	$\text{CH}_3\text{CHBrCH}_3$
IUPAC name	Chloroethane	1-Fluoropropane	2-Bromopropane
Common name	Ethyl chloride	Propyl fluoride	Isopropyl bromide
			
IUPAC name	1-Chloro-2-methylpropane	2-Bromo-2-methylpropane	
Common name	Isobutyl chloride	<i>tert</i> -Butyl bromide	
			
IUPAC name	1-Bromo-2,2-dimethylpropane		
Common name	Neopentyl bromide		
			
IUPAC name	2-Chloro-3-methylpentane	2-Chloro-4-methylpentane	
			
IUPAC name	Cyclohexyl iodide	Methylcyclopentyl chloride	
Common name	Iodocyclohexane	1-Chloro-1-methylcyclopentane	

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5. Nomenclature of Halogen Compounds

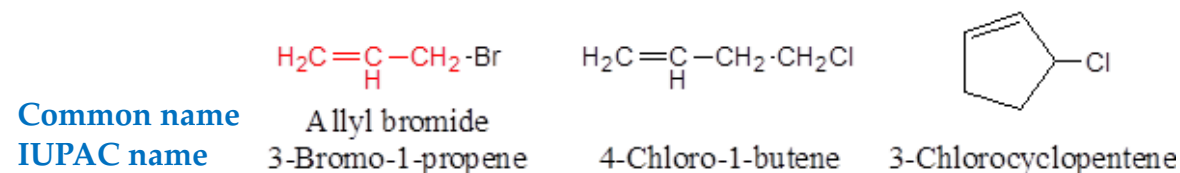
5.2. How to Name Vinylic halides

- Vinylic halides are organic halides in which a halogen atom is attached directly to a carbon atom of a C=C double bond.



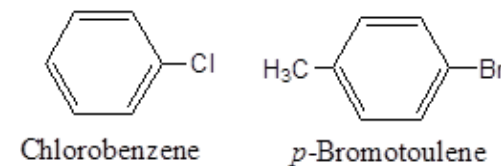
5.3. How to Name Allylic halides

- Allylic halides are organic halides in which a halogen atom is attached to a carbon atom adjacent to a C=C double bond.



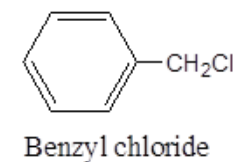
5.4. How to Name Aryl halides

- Aryl halides (Ar-X) are organic halides in which a halogen atom is attached directly to a carbon atom of an aromatic ring.



5.5. How to Name Benzylic halides

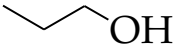
- Benzylic halides (Ar-C-X) are organic halides in which a halogen atom is attached to a carbon atom adjacent to an aromatic ring.



6. Nomenclature of Alcohols, Phenols and Thiols

6.1. How to Name Alcohols

- The **common names** for the simplest alcohols consist of **alkyl group** attached to the hydroxyl function followed by the word **alcohol**: **Alkyl alcohol**.
- In the **IUPAC system**, the following procedure should be followed:
 1. Select the longest continuous carbon chain to which the hydroxyl is directly attached. Change the name of the alkane corresponding to this chain by dropping the final **-e** and adding the suffix **-ol**: **Alkanol**.

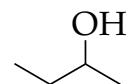
	CH_3OH	$\text{CH}_3\text{CH}_2\text{OH}$	
IUPAC name	Methanol	Ethanol	1-propanol
Common name	Methyl alcohol	Ethyl alcohol	Propyl alcohol

6. Nomenclature of Alcohols, Phenols and Thiols

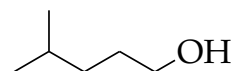
6.1. How to Name Alcohols

2. Number the longest continuous carbon chain so as to give the carbon atom bearing the hydroxyl group the lower number.

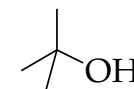
IUPAC name
Common name



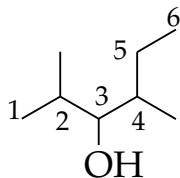
2-Butanol
sec-Butyl alcohol



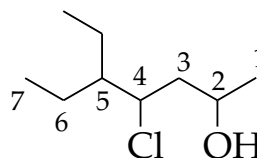
4-Methyl-1-pentanol
Isohexyl alcohol



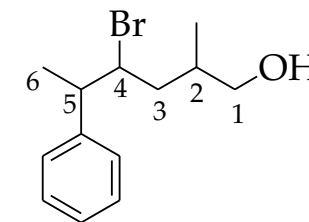
2-Methyl-2-propanol
tert-Butyl alcohol



2,4-Dimethyl-3-hexanol
or 2,4-Dimethylhexan-3-ol



4-Chloro-5-ethyl-2-heptanol
or 4-Chloro-5-ethylheptan-2-ol



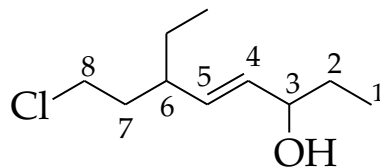
4-Bromo-2-methyl-5-phenyl-1-hexanol
or 4-Bromo-2-methyl-5-phenylhexan-1-ol

Chapter 3: Nomenclature of Organic Compounds

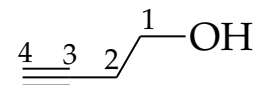
6. Nomenclature of Alcohols, Phenols and Thiols

6.1. How to Name Alcohols

3. The **hydroxyl group** has precedence over **double bonds** and **triple bonds** in deciding which functional group to name as the suffix.

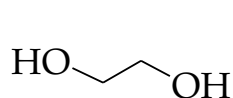


8-Chloro-6-ethyl-4-octen-3-ol
or 8-Chloro-6-ethyloct-4-en-3-ol



3-Butyn-1-ol
or But-3-yn-1-ol

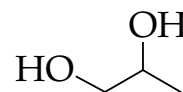
4. If more than one hydroxyl group is present, use the prefix **diol** (commonly called **glycol**) , **triol** (commonly called **glycerol**) , etc.



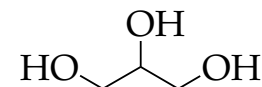
IUPAC name

1,2-Ethanediol
or Ethane-1,2-diol
Ethylene glycol

Common name



1,2-Propanediol
or Propane-1,2-diol
Propylene glycol

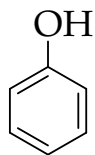


1,2,3-Propanetriol
or Propane-1,2,3-triol
glycerol

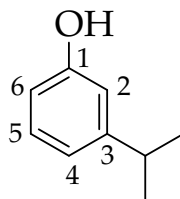
6. Nomenclature of Alcohols, Phenols and Thiols

6.2. How to Name Phenols

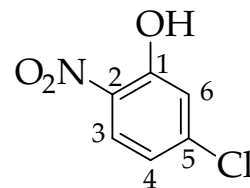
- Phenols are usually named as derivatives of the parent compounds; phenol itself could be named as **hydroxybenzene**.



Phenol

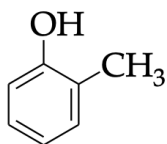


3-Isopropylphenol

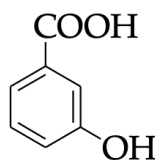


5-Chloro-2-nitrophenol

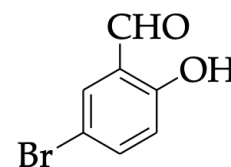
- The **hydroxyl group** is named as a substituent when it occurs in the same molecule **with carboxylic acid, aldehyde, or ketone** functionalities, which have **priority in naming**.



2-Methylphenol



3-Hydroxybenzoic acid



5-Bromo-2-hydroxybenzaldehyde

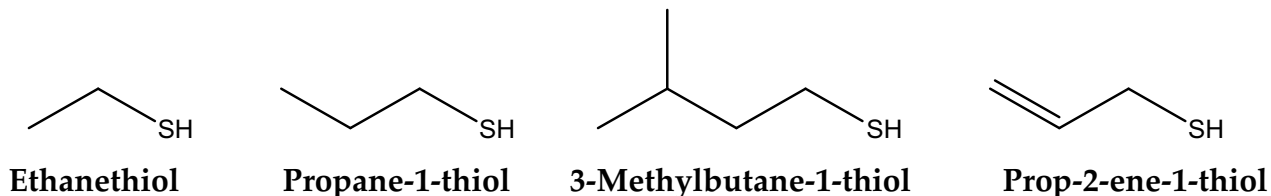
6. Nomenclature of Alcohols, Phenols and Thiols

6.3. How to Name Thiols

- The **sulfur** analog of an alcohol is called a **thiol**, in which the **hydroxyl group** ($-\text{OH}$) is replaced by a **sulfhydryl group** ($-\text{SH}$). Thiols are also commonly known as **mercaptans**.
- The **common names** for simple thiols consist of the **alkyl group** attached to the **sulfhydryl** group followed by the word mercaptan: Alkyl mercaptan.
- In the **IUPAC system**, thiols are named using the same general rules as alcohols, but the suffix **-thiol** is used instead of **-ol**.

The following procedure should be followed:

1. Select the longest continuous carbon chain containing the carbon atom bonded to the sulfhydryl group ($-\text{SH}$). Name the corresponding alkane and replace the ending with the suffix **-thiol**: Alkanethiol.
2. Number the longest continuous carbon chain to give the carbon atom bearing the sulfhydryl group the lower number.
3. When both a **sulfhydryl group** ($-\text{SH}$) and a **double bond** are present, the chain is numbered to give the **-SH** group the lowest possible number. The position of the double bond is then indicated in the name.



7. Nomenclature of Ethers and Epoxides

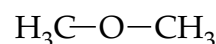
7.1. How to Name Ethers

- Common names, simple ethers are frequently given common functional class names.

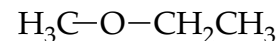
One simply lists (in alphabetical order) both groups that are attached to the oxygen atom and adds the word, *Ether*.

- In the IUPAC style, ethers are named as alkoxyalkanes. The $-OR$ group is an alkoxy group.

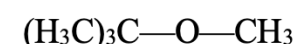
Choose the longest chain as the parent alkane and then name as usual.



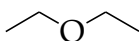
IUPAC name Methoxymethane
Common name Dimethyl ether



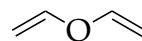
Methoxy-ethane
Ethyl methyl ether



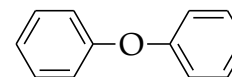
2-Methyl-2-methylpropane
tert-Butyl methyl ether



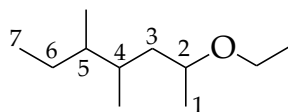
IUPAC name Ethoxyethane
Common name Diethyl ether



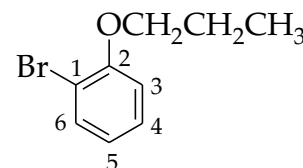
Vinyloxy-ethene
Divinyl ether



Phenoxybenzene
Diphenyl ether



2-Ethoxy-4,5-dimethylheptane

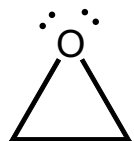


1-Bromo-2-propoxybenzene

7. Nomenclature of Ethers and Epoxides

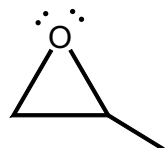
7.2. How to Name Epoxides

- Common names, epoxides are commonly named as **alkene oxides**, using the name of the corresponding **alkene** followed by the word **oxide**.
Common name = Alkene name + oxide
- In the **IUPAC system**, epoxides are named as **oxiranes**. The oxygen atom is assigned position 1, and the two carbon atoms are numbered 2 and 3.
IUPAC name = Oxirane system
- Substituents attached to the oxirane ring are named as prefixes and numbered to give the lowest possible numbers.
- For disubstituted oxiranes, *cis* and *trans* may be used to indicate the relative positions of the substituents.

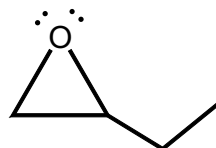


IUPAC name
Common name

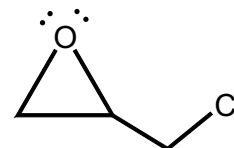
Oxirane
Ethylene oxide



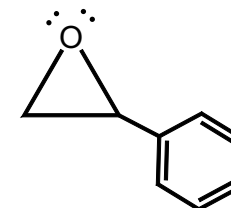
2-methyloxirane
Propylene oxide



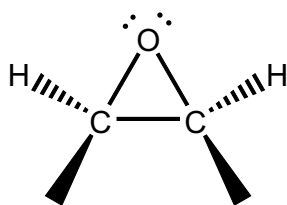
2-ethyloxirane
Butylene oxide



2-(chloromethyl)oxirane

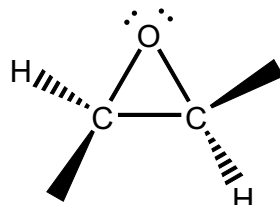


2-phenyloxirane



IUPAC name

cis-2,3-Dimethyloxirane



Trans-2,3-Dimethyloxirane

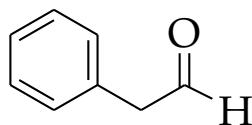
8. Nomenclature of Aldehydes and Ketones

8.1. How to Name Aldehydes

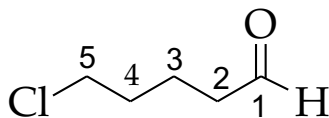
- The **common names** are derived from the common names for the corresponding carboxylic acids.
- In the **IUPAC System**, Aliphatic aldehydes are named substitutively by replacing the final **-e** of the name of the corresponding alkane with **-al**, **Alkanal**.
- Since the aldehyde group must be at the end of the carbon chain, there is no need to indicate its position.
- When other substituents are present, the **carbonyl group** carbon is assigned **position 1**.

Carbon atoms	Formula	Common name	IUPAC name
1	HCHO	Formaldehyde	Methanal
2	CH ₃ CHO	Acetaldehyde	Ethanal
3	CH ₃ CH ₂ CHO	Propionaldehyde	Propanal
4	CH ₃ (CH ₂) ₂ CHO	Butyraldehyde	Butanal
5	CH ₃ (CH ₂) ₃ CHO	Valeraldehyde	Pentanal

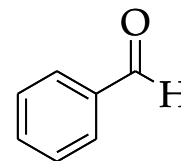
- **Aromatic aldehydes** are usually named as derivatives of the parent compound **benzaldehyde**.



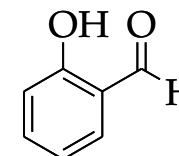
Phenylethanal



5-Chloropentanal



Benzaldehyde



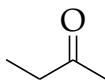
2-Hydroxybenzaldehyde

8. Nomenclature of Aldehydes and Ketones

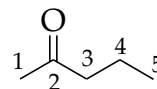
8.2. How to Name Ketones

- **Common** functional group names for ketones are obtained simply by separately naming the **two groups** attached to the carbonyl group and adding the word **ketone** as a separate word, **Alkyl ketone**.
- **In the IUPAC System**, Aliphatic ketones are named substitutively by replacing the final **-e** of the name of the corresponding alkane with **-one**, **Alkanone**.
- The chain is then numbered in the way that gives the carbonyl carbon atom the lower possible number, and this number is used to designate its position.

IUPAC name
Common name



Butanone
Ethyl methyl ketone

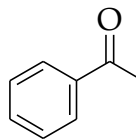


2-Pentanone
Methyl propyl ketone

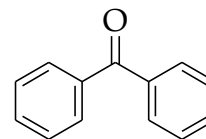


IUPAC name
Common name

Propanone
Acetone



1-Phenylethanone
Acetophenone

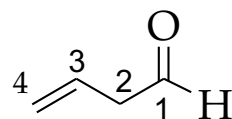


Diphenylmethanone
Diphenyl ketone

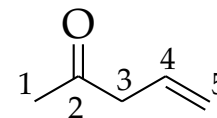
8. Nomenclature of Aldehydes and Ketones

8.3. How to Name Aldehydes and Ketones with Unsaturated Bonds and Aryl Groups

- The **carbonyl group** has precedence over **double bonds** and **triple bonds** in deciding which functional group to name as the suffix.

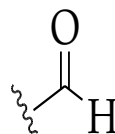


3-Butenal

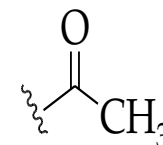


4-Penten-2-one
(not 1-penten-4-one)

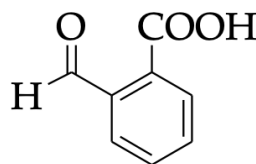
- When it is necessary to name (**-CHO** and **CH₃CO-**) as a prefix, it is called the **formyl group** and **acetyl group**, respectively.



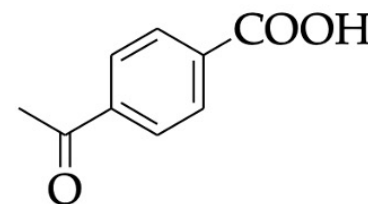
formyl group



acetyl group



2-Formylbenzoic acid



4-Acetylbenzoic acid

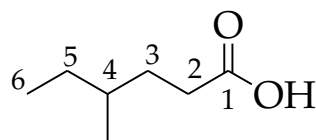
9. Nomenclature of Carboxylic acid and Their Derivatives

9.1. How to Name Carboxylic Acids

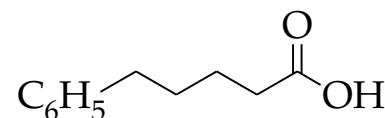
- Many carboxylic acids have **common names** that are derived from **Latin or Greek words** that indicate one of their natural sources.

Carbon atoms	Formula	Source	Common name	IUPAC name
1	HCOOH	formica, Latin: ant	Formic acid	Methanoic acid
2	CH ₃ COOH	acetum, Latin: vinegar	Acetic acid	Ethanoic acid
3	CH ₃ CH ₂ COOH	Milk, Greek: protos pion, first fat	Propionic acid	Propanoic acid
4	CH ₃ (CH ₂) ₂ COOH	butyrum, Latin: butter	Butyric acid	Butanoic acid
5	CH ₃ (CH ₂) ₃ COOH	valerian, a perennial herb	Valeric acid	Pentanoic acid

- In the **IUPAC System**, carboxylic acids are named by dropping the final **-e** of the name of the alkane corresponding to the longest chain in the acid and by adding **-oic acid, alkanolic acids**. The carboxyl carbon atom is assigned **number 1**.



4-Methylhexanoic acid



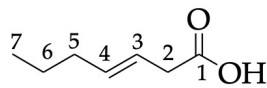
5-Phenylpentanoic acid

Chapter 3: Nomenclature of Organic Compounds

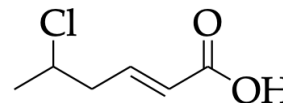
9. Nomenclature of Carboxylic acid and Their Derivatives

9.1. How to Name Carboxylic Acids

- The **carboxyl group** has precedence over **double bonds** and **triple bonds** in deciding which functional group to name as the suffix.



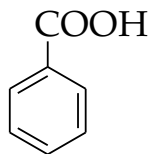
3-Heptenoic acid
or Hept-3-enoic acid



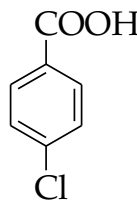
5-Chloro-2-hexenoic acid
or 5-Chlorohex-2-enoic acid

9.2. How to Name Aromatic Acids

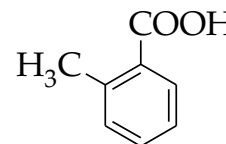
- Aromatic acids** are named by attaching the suffix **-oic acid** to an appropriate prefix derived from the aromatic hydrocarbon.



Benzoic acid



4-Chlorobenzoic acid



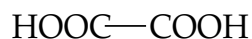
2-Methylbenzoic acid

Chapter 3: Nomenclature of Organic Compounds

9. Nomenclature of Carboxylic acid and Their Derivatives

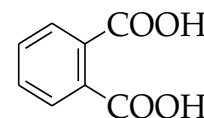
9.3. How to Name Dicarboxylic Acids

- **Dicarboxylic acids** are named as **alkanedioic acids** in the IUPAC systematic or substitutive system.
- Most simple dicarboxylic acids have common names.



IUPAC name
Common name

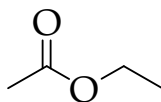
Ethanedioic acid
Oxalic acid



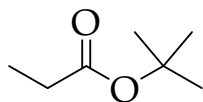
1,2-Benzenedicarboxylic acid
Phthalic acid

8.4. How to Name Esters

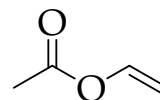
- The names of esters are derived from the names of the **alcohol** (with the ending **-yl**) and the **acid** (with the ending **-ate** or **-oate**).
- The portion of the name derived from the alcohol comes **first**.



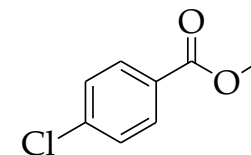
Ethyl ethanoate



tert-Butyl propanoate



Vinyl ethanoate



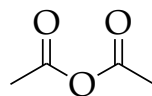
Methyl p-chlorobenzoate

9. Nomenclature of Carboxylic acid and Their Derivatives

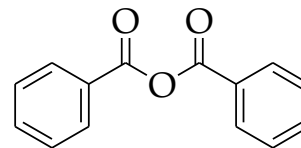
9.5. How to Name Carboxylic Anhydrides

- Most anhydrides are named by dropping the word **acid** from the name of the carboxylic acid and then adding the word **anhydride**.

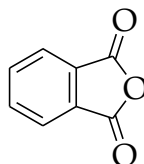
IUPAC name
Common name



Ethanoic anhydride
Acetic anhydride

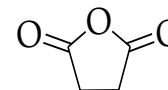


Benzoic anhydride



IUPAC name
Common name

1,2-Benzenedicarboxylic anhydride
Phthalic anhydride



Butanedioic anhydride

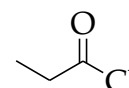
9. Nomenclature of Carboxylic acid and Their Derivatives

9.6. How to Name Acyl Chlorides

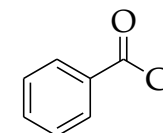
- Acyl chlorides are also called acid chlorides. They are named by dropping **-ic acid** from the name of the acid and then adding **-yl chloride**.



IUPAC name Ethanoyl chloride
Common name Acetyl chloride



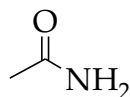
Propanoyl chloride



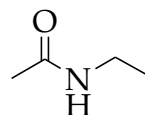
Benzoyl chloride

9.7. How to Name Amides

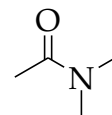
- Amides that have no substituent on nitrogen are named by dropping **-oic acid** from the name and then adding **-amide**.
- Alkyl groups on the nitrogen atom of amides are named as substituents, and the named substituent is prefaced by **N-** or **N,N-**.



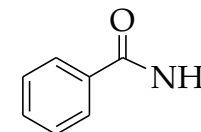
IUPAC name Ethanamide
Common name Acetamide



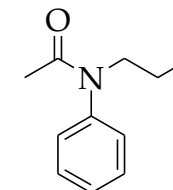
N-Ethylethanamide



N,N-Dimethylethanamide



Benzamide



N-Phenyl-N-propylethanamide

10. Nomenclature of Amines

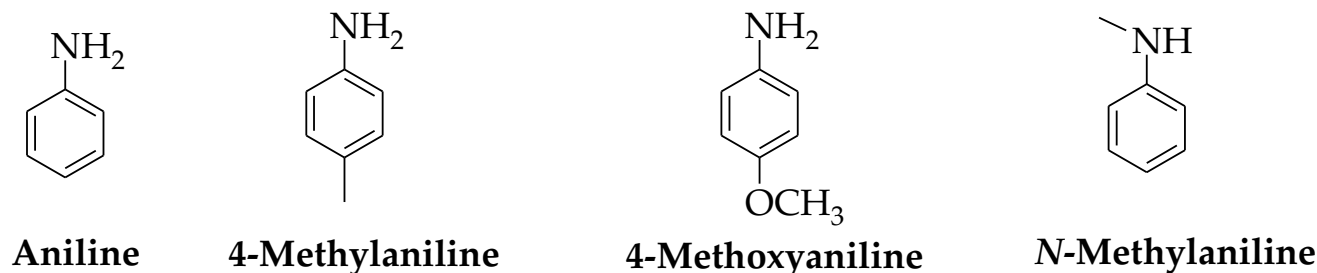
10.1. How to Name Amines

- In **common nomenclature**, most primary amines are named as **alkylamines**.
- In **systematic nomenclature**, they are named by adding the suffix **-amine** to the **name of the chain** or **ring** system to which the **NH₂** group is attached, with replacement of the final **-e**.

	$\text{H}_3\text{C}-\text{NH}_2$				
IUPAC name	Methanamine	Ethanamine	2-Methyl-1-propanamine		
Common name	Methylamine	Ethylamine	Isobutylamine		
IUPAC name	N-Methylethanamine	N-Ethylethanamine	N,N-Diethylethanamine	N-Ethyl-N-methyl-1-propanamine	
Common name	Ethylmethanamine	Diethylamine	Triethylamine	Ethylmethylpropylamine	

10.2. How to Aromatic Amines

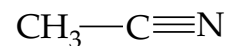
- Aromatic amines** are usually named as derivatives of the parent compound **aniline**.



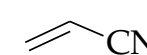
Chapter 3: Nomenclature of Organic Compounds

11. Nomenclature of Nitriles

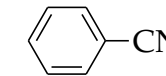
- In IUPAC substitutive nomenclature, acyclic nitriles are named by adding the suffix **-nitrile** to the name of the corresponding hydrocarbon, **Alkanenitrile**.
- The carbon atom of the **-C≡N** group is assigned **number 1**.



Ethanenitrile



Propenenitrile



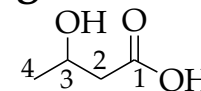
Benzonitrile

12. Priority of Functional Groups in IUPAC Nomenclature

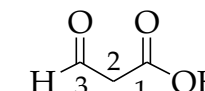
- The functional group priority order in nomenclature system is as following:

↑
Increasing
priority

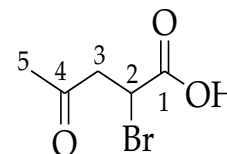
Class	Suffix name	Prefix name
Carboxylic acid	-oic acid	-
Ester	-oate	Alkoxycarbonyl
Amide	-amide	Amido
Aldehyde	-al	Oxo
Ketone	-one	Oxo
Alcohol	-ol	Hydroxy
Amine	-amine	Amino
Alkene	-ene	Alkenyl
Alkyne	-yne	Alkynyl
Alkane	-ane	Alkyl
Ether	-	Alkoxy



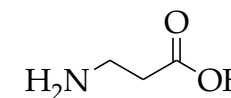
3-Hydroxybutanoic acid



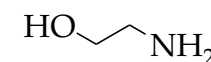
3-Oxopropanoic acid



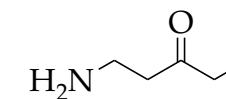
2-Bromo-4-oxopentanoic acid



3-Aminopropanoic acid



2-Aminoethanol

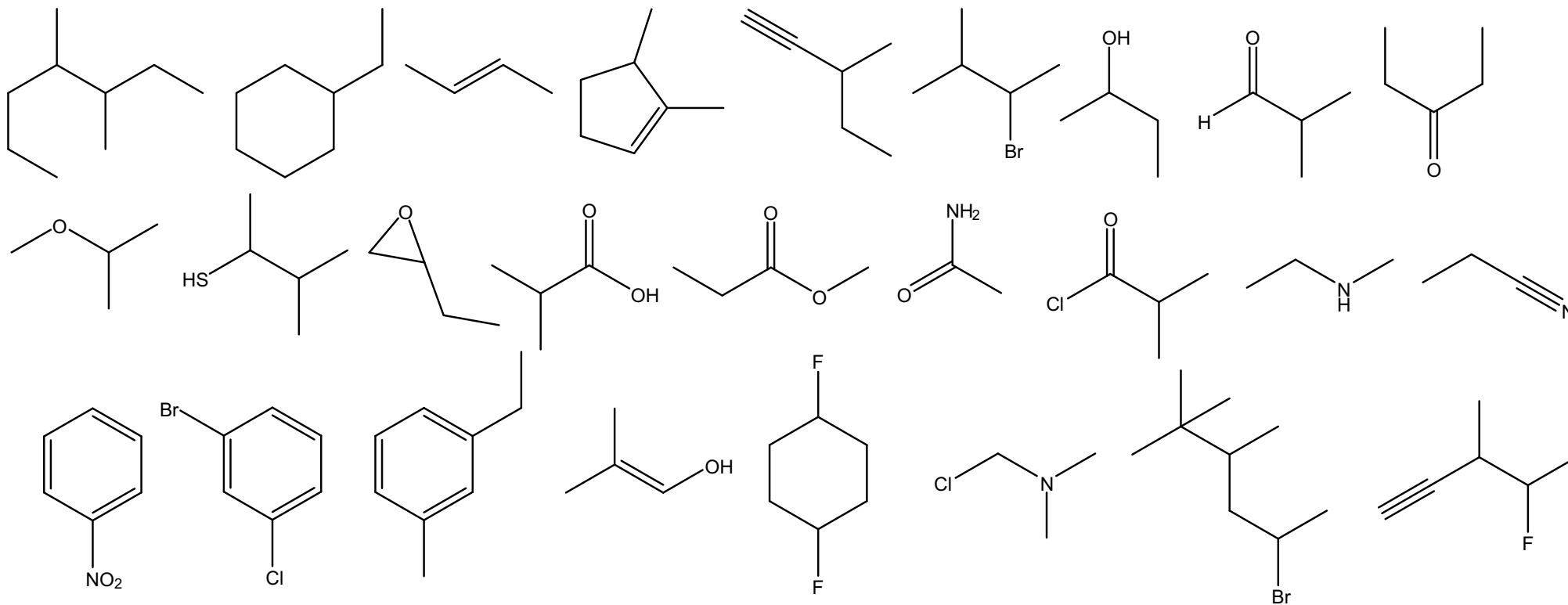


1-Amino-3-pentanone

Chapter 3: Nomenclature of Organic Compounds

11. Practice Problems

1) Give the IUPAC name of each of the following compounds



2) Give the common name of each of the following compounds

