Chapter 4
Alcohols and Alkyl Halides

Overview of Chapter

This chapter introduces chemical reactions and their mechanisms by focusing on two reactions that yield alkyl halides.

(1) alcohol + hydrogen halide

$$ROH + HX \varnothing RX + H_2O$$

(2) alkane + halogen

$$RH + X_2 \varnothing RX + HX$$

Both are substitution reactions

4.1
IUPAC Nomenclature of Alkyl Halides

IUPAC Nomenclature

There are several kinds of IUPAC nomenclature.

The two that are most widely used are:

- functional class nomenclature
- substitutive nomenclature

Both types can be applied to alcohols and alkyl halides.

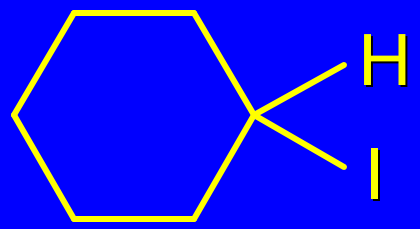
Functional Class Nomenclature of Alkyl Halides

Name the alkyl group and the halogen as separate words (*alkyl* + *halide*)

CH_3F

$CH_3CH_2CH_2CH_2CH_2Cl$

$CH_3CH_2\underset{\displaystyle Br}{\underset{|}{C}}HCH_2CH_2CH_3$



Functional Class Nomenclature of Alkyl Halides

Name the alkyl group and the halogen as separate words (*alkyl* + *halide*)

CH_3F

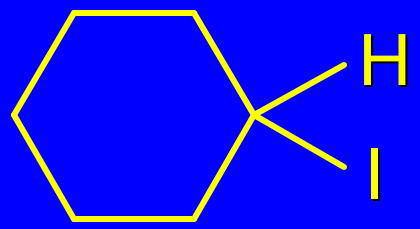
Methyl fluoride

$CH_3CH_2CH_2CH_2CH_2Cl$

Pentyl chloride

$CH_3CH_2\underset{\displaystyle Br}{\underset{|}{C}}HCH_2CH_2CH_3$

1-Ethylhexyl bromide

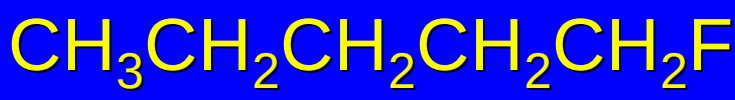


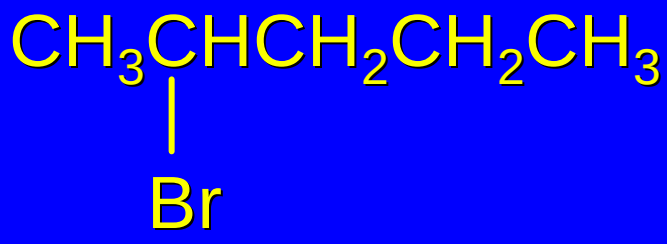
Cyclohexyl iodide

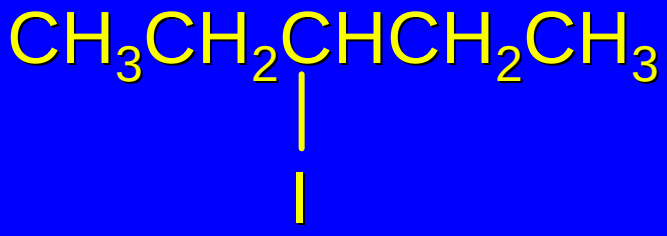
Substitutive Nomenclature of Alkyl Halides

Name as halo-substituted alkanes.

Number the longest chain containing the halogen in the direction that gives the lowest number to the substituted carbon.







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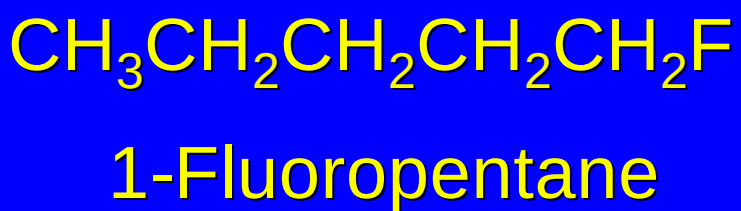
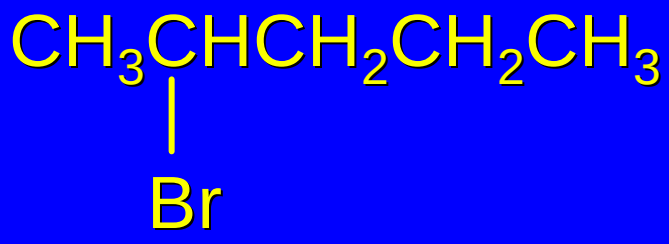
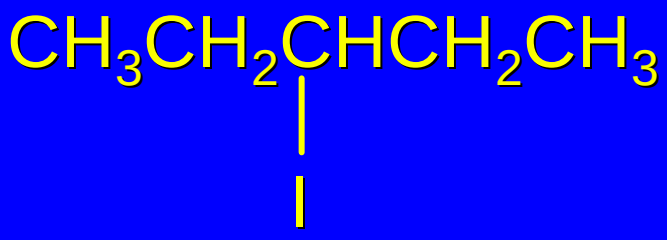


1-Fluoropentane

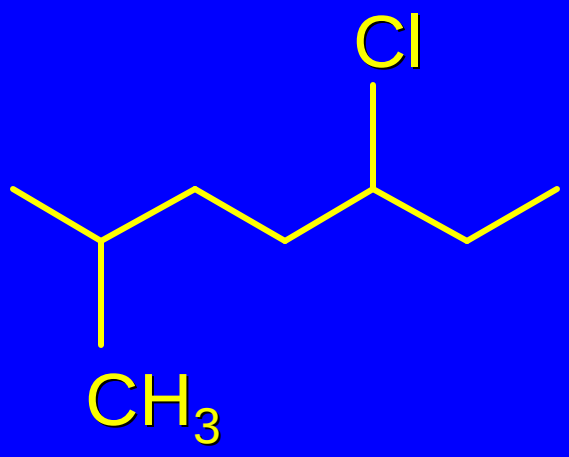


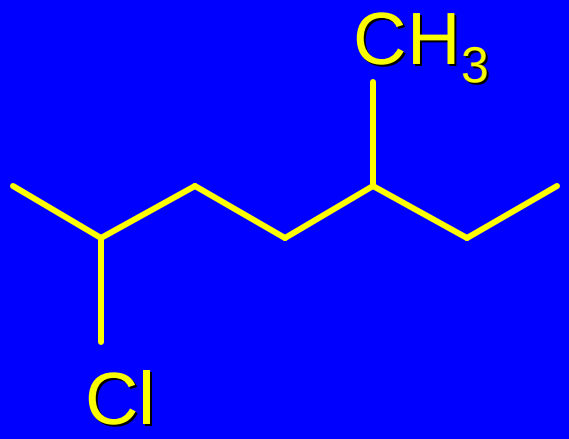
2-Bromopentane



3-Iodopentane

Substitutive Nomenclature of Alkyl Halides

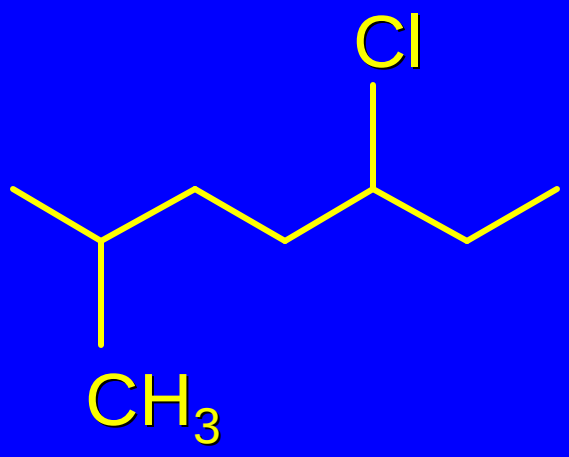




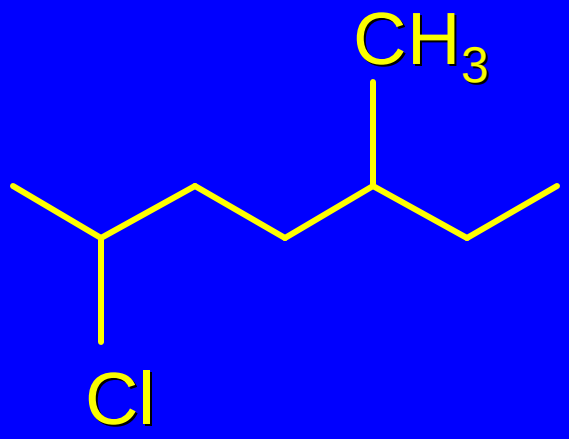
Halogen and alkyl groups are of equal rank when it comes to numbering the chain.

Number the chain in the direction that gives the lowest number to the group (halogen or alkyl) that appears first.

Substitutive Nomenclature of Alkyl Halides



5-Chloro-2-methylheptane

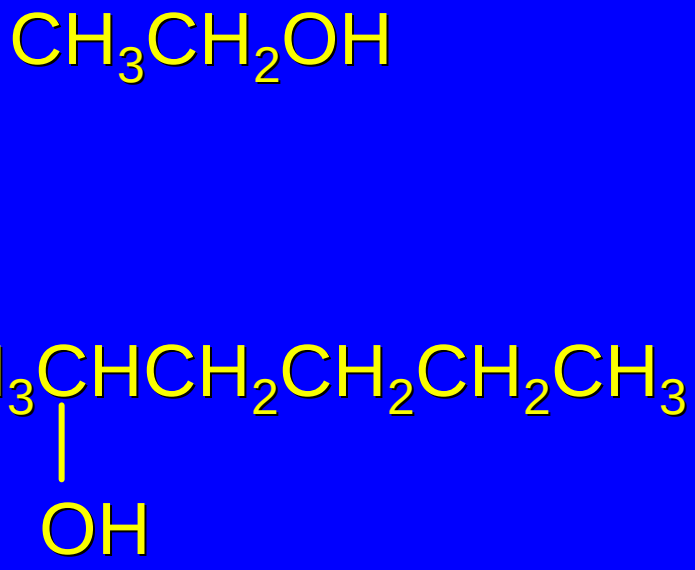


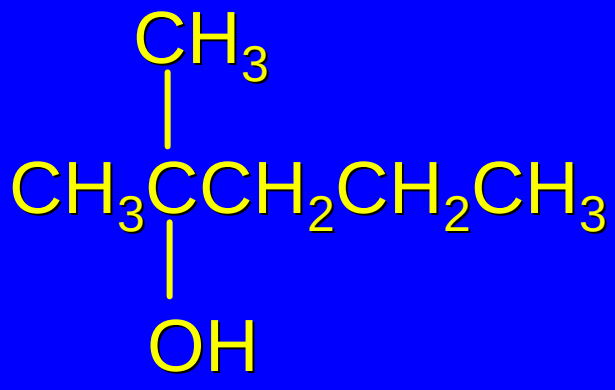
2-Chloro-5-methylheptane

4.2
IUPAC Nomenclature of Alcohols

Functional Class Nomenclature of Alcohols

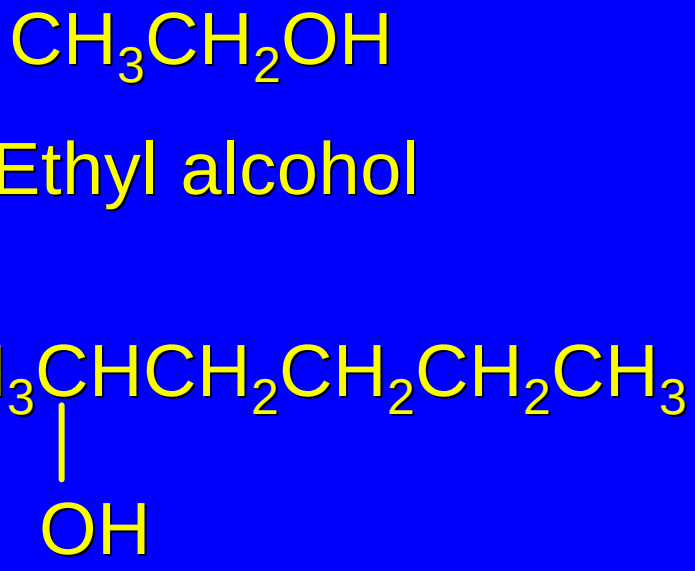
Name the alkyl group and add "alcohol" as a separate word.





Functional Class Nomenclature of Alcohols

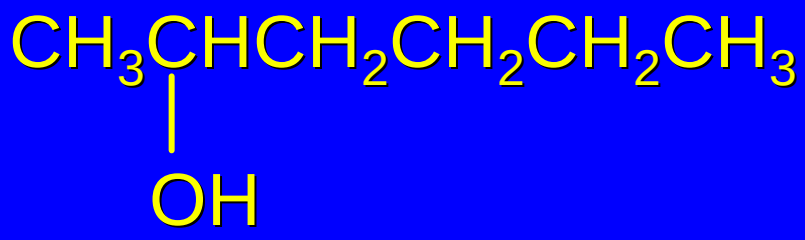
Name the alkyl group and add "alcohol" as a separate word.

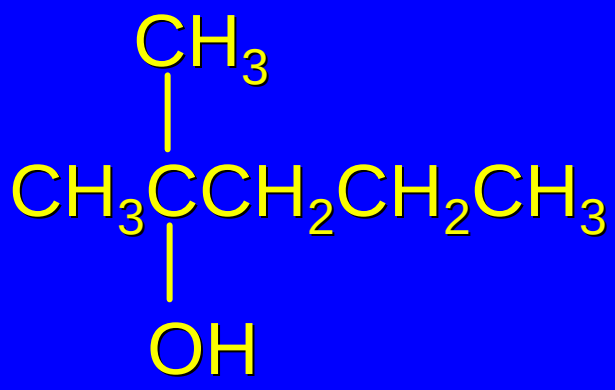


Substitutive Nomenclature of Alcohols

Name as "alkanols." Replace -e ending of alkane name by -ol.

Number chain in direction that gives lowest number to the carbon that bears the —OH group.





Substitutive Nomenclature of Alcohols

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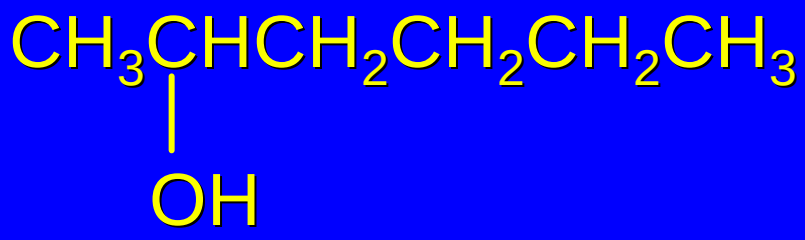
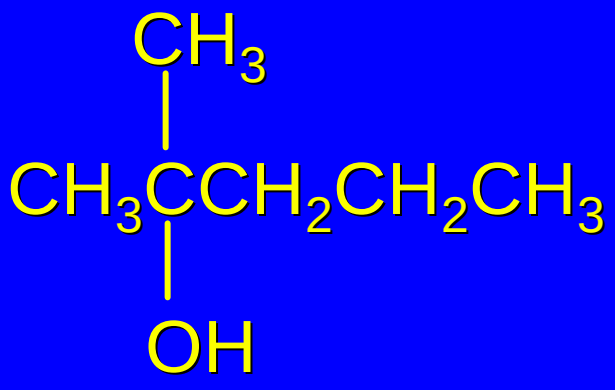
Ethanol

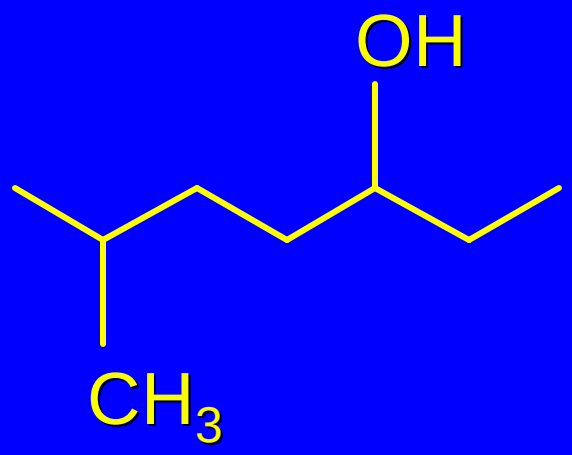


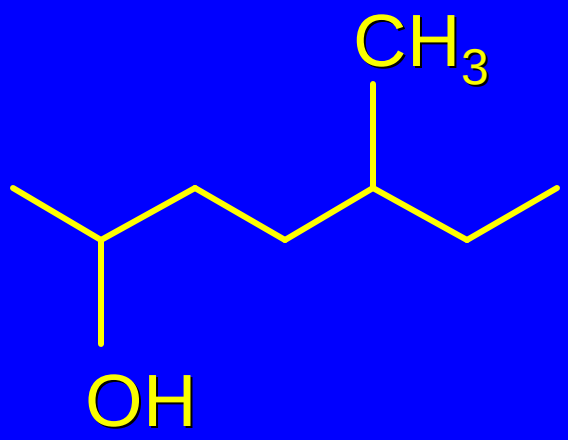
2-Hexanol



2-Methyl-2-pentanol

Substitutive Nomenclature of Alcohols

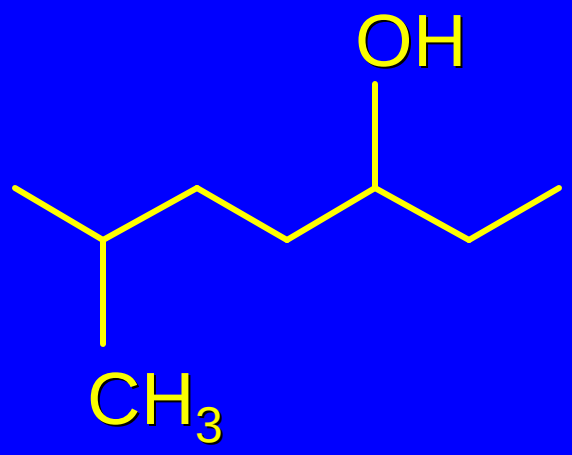




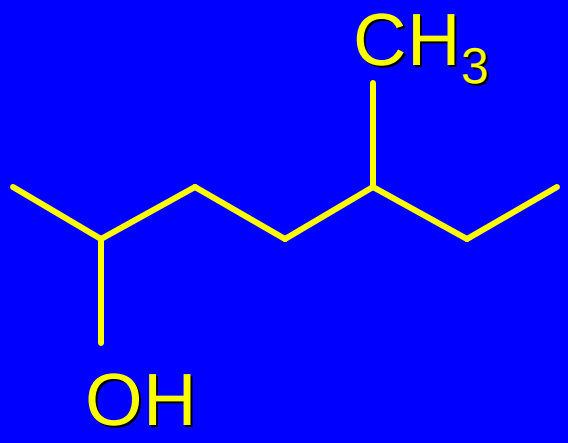
Hydroxyl groups outrank alkyl groups when it comes to numbering the chain.

Number the chain in the direction that gives the lowest number to the carbon that bears the OH group

Substitutive Nomenclature of Alcohols



6-Methyl-3-heptanol



5-Methyl-2-heptanol

4.3
Classes of Alcohols and Alkyl Halides

Classification

Alcohols and alkyl halides are classified as

- primary
- secondary
- tertiary

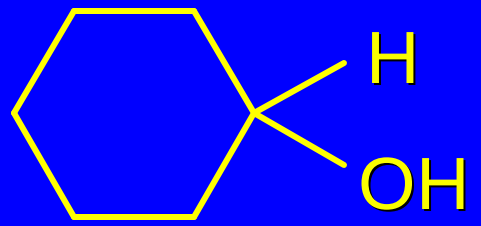
according to their "degree of substitution."

Degree of substitution is determined by counting the number of carbon atoms directly attached to the carbon that bears the halogen or hydroxyl group.

Classification

$CH_3CH_2CH_2CH_2CH_2F$

primary alkyl halide



secondary alcohol

$CH_3CHCH_2CH_2CH_3$
|
Br

secondary alkyl halide

CH_3
|
$CH_3CCH_2CH_2CH_3$
|
OH

tertiary alcohol