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Structure 3.2

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Structural formulas

Structural formulas

Molecular formula: actual number of atoms in the compound.

Empirical formula: lowest whole number ratio of atoms in the compound.

Full structural formula: shows all atoms and bonds between the atoms.

Condensed structural formula: shows only the atoms and omits the bonds.

Skeletal formula: C atoms and H atoms bonded to C atoms are omitted leaving only the carbon skeleton.

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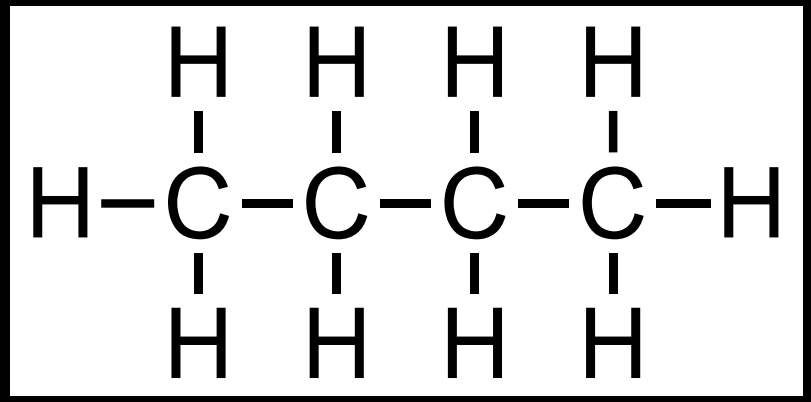
Structural formulas

Butane

molecular formula

C_4H_{10}

full structural formula



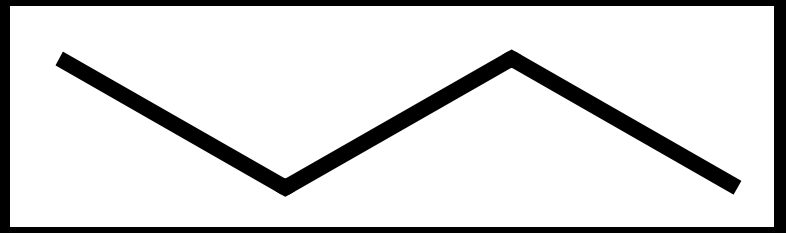
empirical formula

C_2H_5

condensed structural formula

$CH_3CH_2CH_2CH_3$

skeletal formula



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Structural formula

But-1-ene

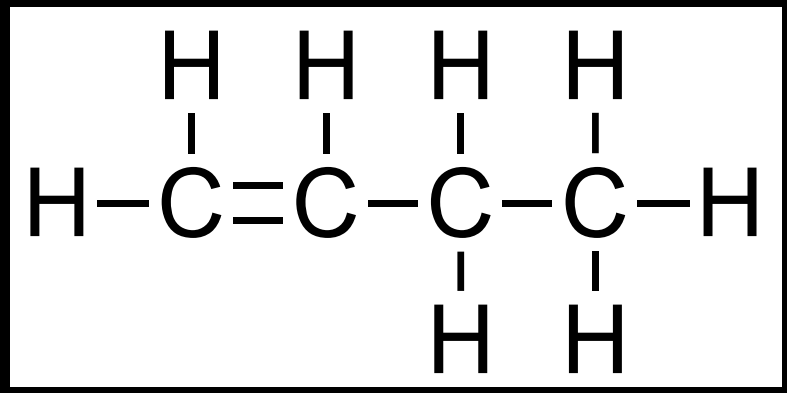
molecular formula

C_2H_8

empirical formula

CH_4

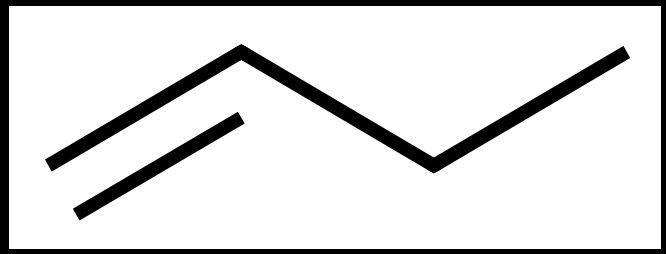
full structural formula



condensed structural formula

$CH_2CHCH_2CH_3$

skeletal formula



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Structural formula

Propanoic acid

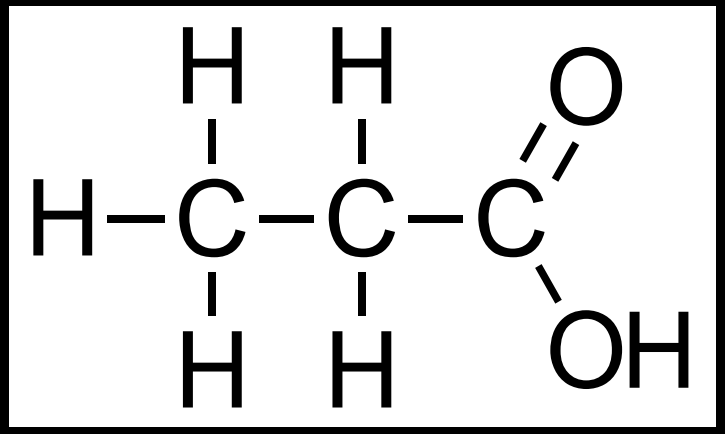
molecular formula

$C_3H_6O_2$

empirical formula

$C_3H_6O_2$

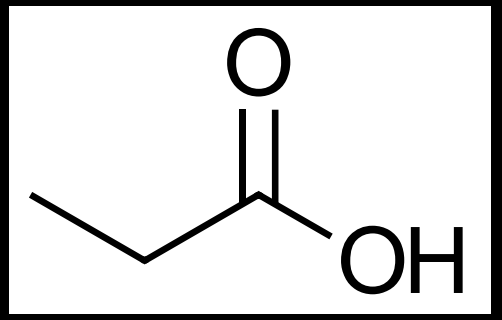
full structural formula



condensed structural formula

CH_3CH_2COOH

$CH_3CH_2CO_2H$



skeletal formula

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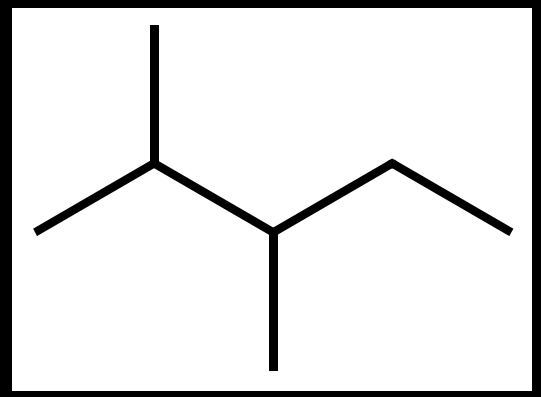
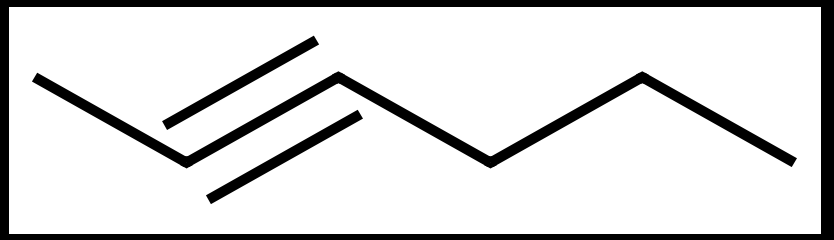
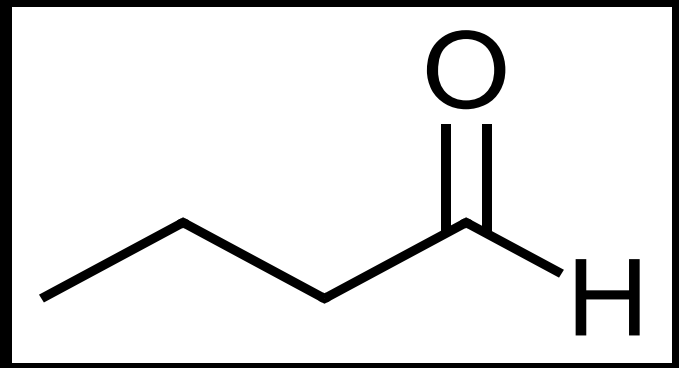
Skeletal formulas



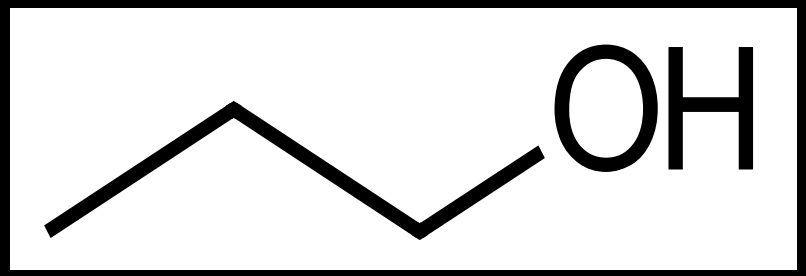
2,3-dimethylpentane



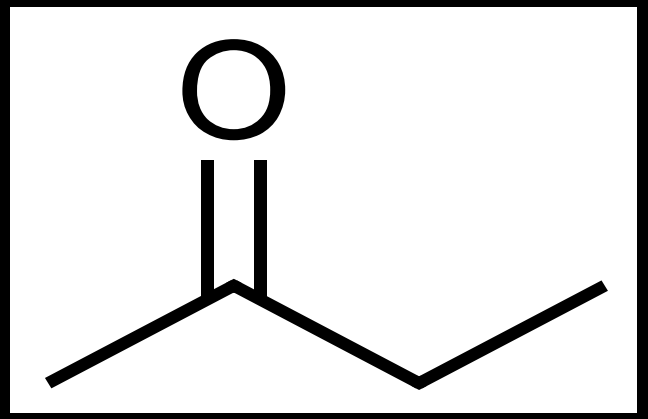
hex-2-yne



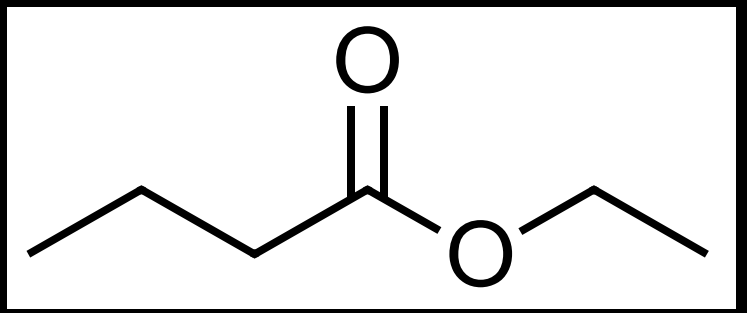
butanal



propan-1-ol



butanone



ethyl butanoate

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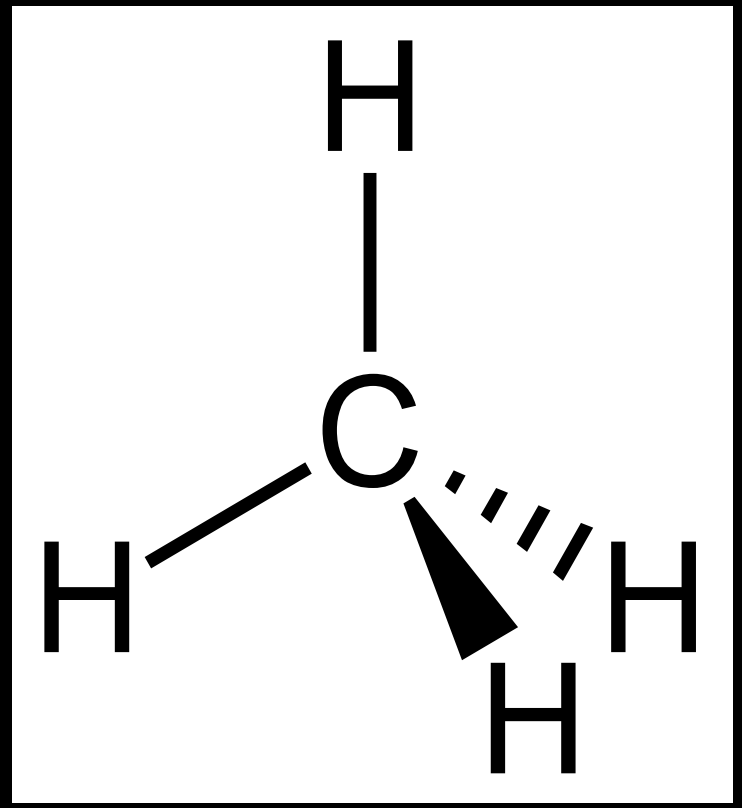
Stereochemical formula

The two solid lines are in the plane of the paper.



The solid wedge is coming out from the paper.

The dashed wedge is going into the paper.

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Functional groups

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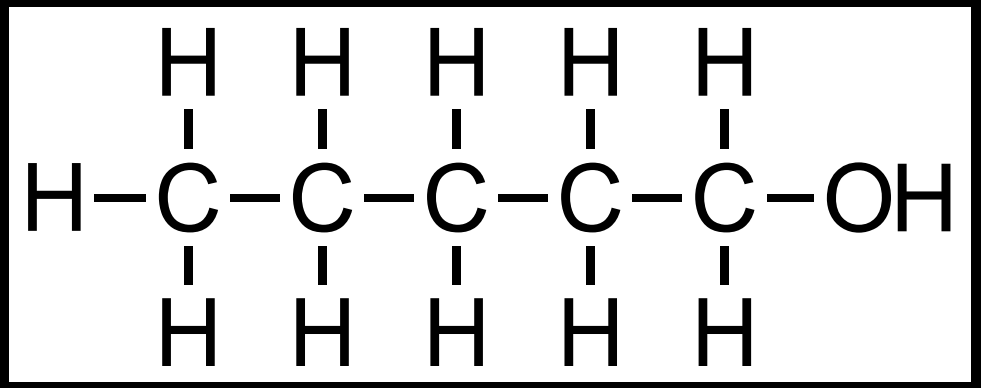
Functional groups

A functional group is a group of atoms within a molecule that are responsible for the characteristic chemical reactions of the molecule.



pentan-1-ol

Class: alcohol
Functional group: OH
hydroxyl group

Compounds with the same functional group belong to the same class.

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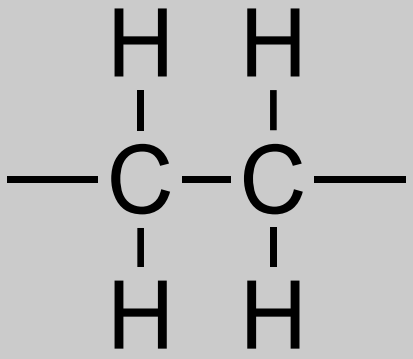
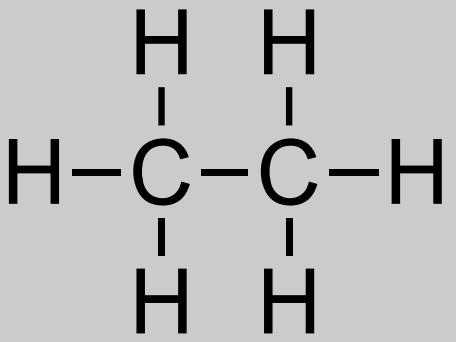
Functional groups

Class	Functional group	Name	Example
Alkane			 **Ethane CH_3CH_3**

General formula	Type of reactions
C_nH_{2n+2}	**Combustion** **Free-radical substitution**

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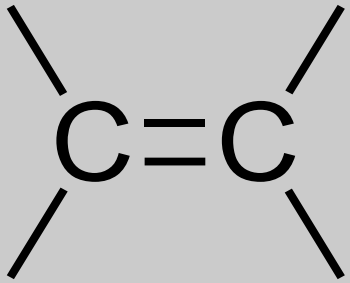
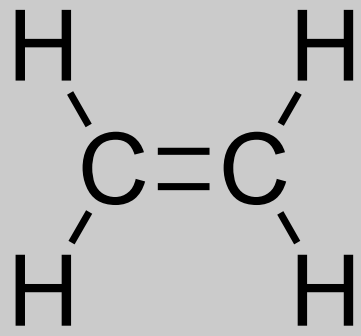
Functional groups

Class	Functional group	Name	Example
Alkene		Alkenyl	 Ethene CH_2CH_2

General formula	Type of reactions
C_nH_{2n}	Combustion Electrophilic addition

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Functional groups

Class	Functional group	Name	Example
Alkyne	—C≡C—	Alkynyl	H–C≡C–H Ethyne CHCH

General formula	Type of reactions
C_nH_{2n-2}	Combustion Electrophilic addition

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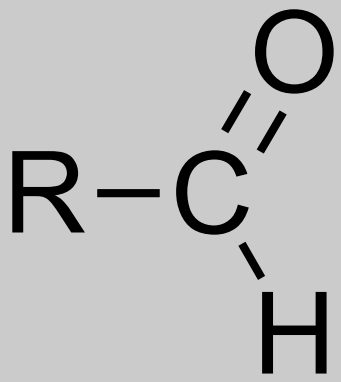
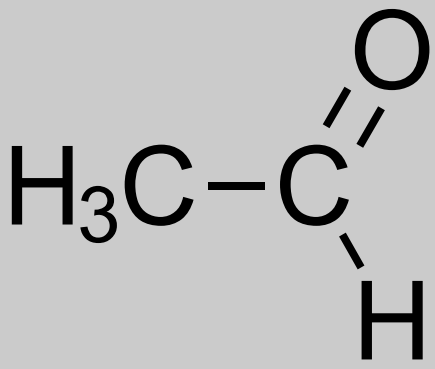
Functional groups

Class	Functional group	Name	Example
Aldehyde	 R-CHO	**Carbonyl**	 **Ethanal** CH_3CHO

General formula	Type of reactions
$C_nH_{2n}O$	**Oxidation** **Reduction (HL)**

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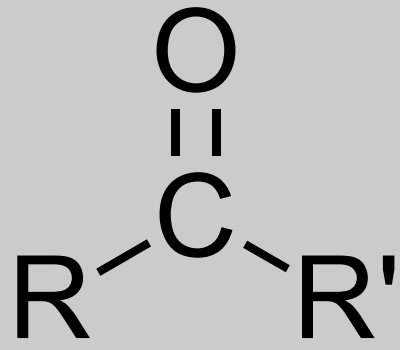
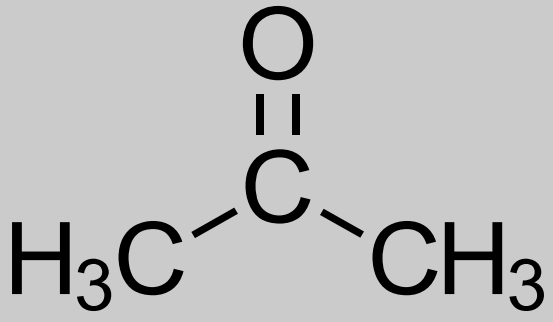
Functional groups

Class	Functional group	Name	Example
Ketone	 R-CO-R'	Carbonyl	 Propanone CH_3COCH_3

General formula	Type of reactions
$C_nH_{2n}O$	Oxidation Reduction (HL)

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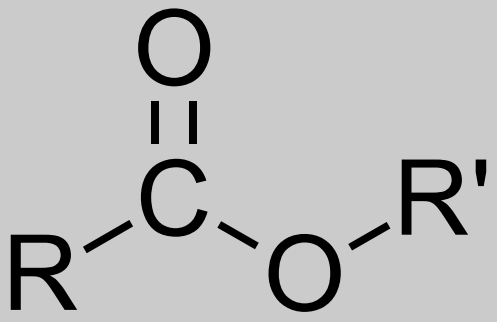
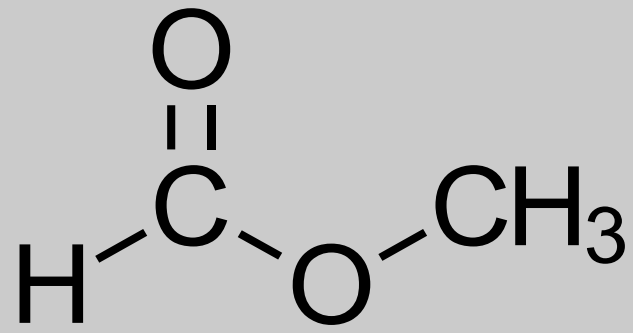
Functional groups

Class	Functional group	Name	Example
Ester	 R-COO-R' $R\text{-}CO_2\text{-}R'$	**Ester**	 **Methyl methanoate** **$HCOOCH_3$ or HCO_2CH_3**

General formula	Type of reactions
$C_nH_{2n}O_2$	

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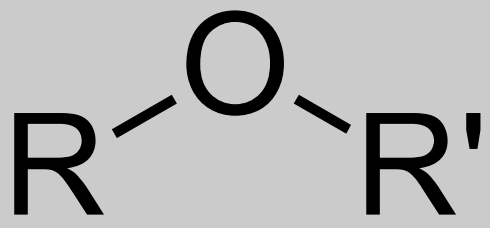
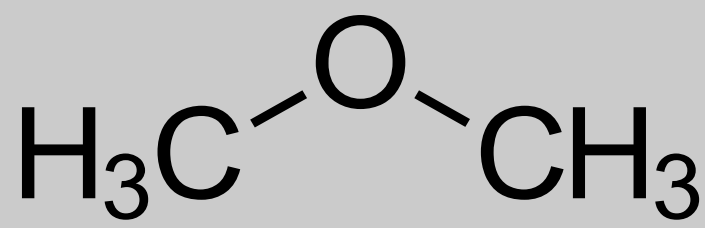
Functional groups

Class	Functional group	Name	Example
Ether	 R-O-R'	Alkoxy	 Methoxymethane CH_3OCH_3

General formula	Type of reactions
$C_nH_{2n+2}O$	Not covered in IB chemistry

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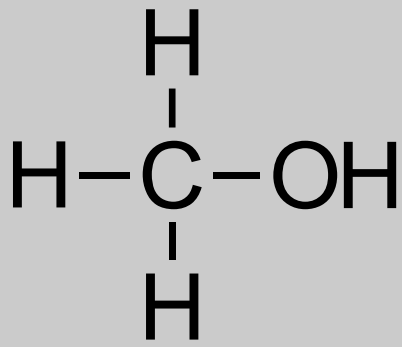
Functional groups

Class	Functional group	Name	Example
Alcohol	R–OH	**Hydroxyl**	 **Methanol** **CH_3OH**

General formula	Type of reactions
$C_nH_{2n+2}O$	**Combustion** **Oxidation**

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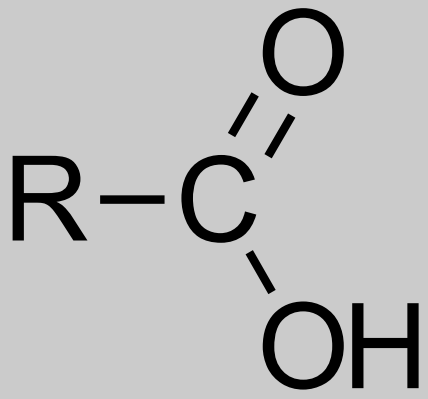
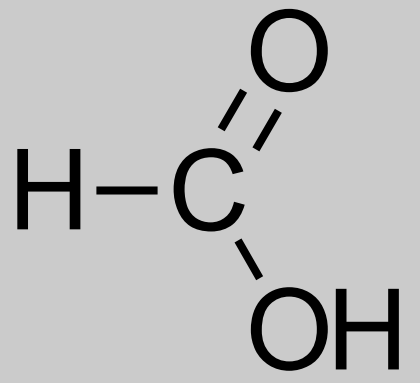
Functional groups

Class	Functional group	Name	Example
Carboxylic acid	 R-COOH $R\text{-}CO_2H$	**Carboxyl**	 **Methanoic acid** **HCOOH or HCO_2H**

General formula	Type of reactions
$C_nH_{2n}O_2$	**Nucleophilic substitution (with alcohols)** **Reduction (HL)**

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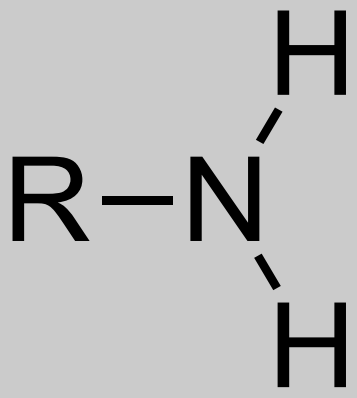
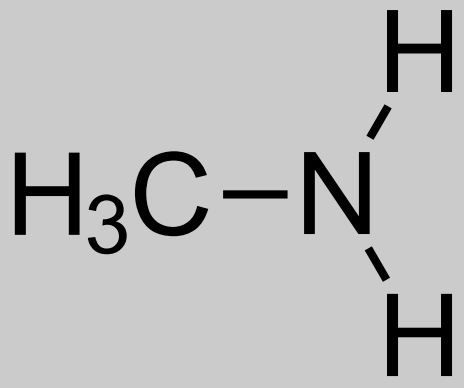
Functional groups

Class	Functional group	Name	Example
Amine	 R-NH_2	Amine Amino	 Methanamine CH_3NH_2

General formula	Type of reactions
$C_nH_{2n+3}N$	Can act as Bronsted-Lowry bases and Lewis bases (HL)

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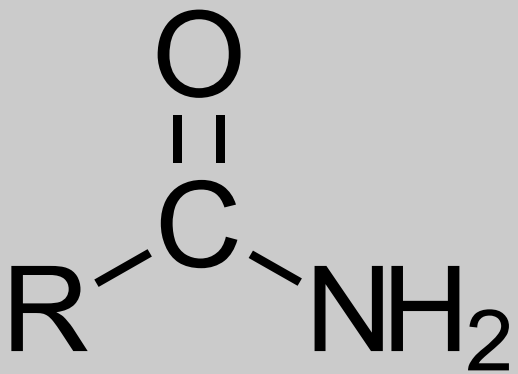
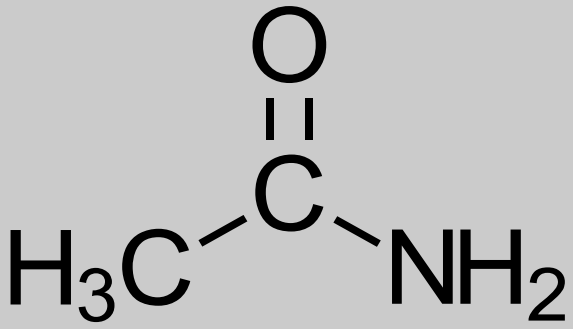
Functional groups

Class	Functional group	Name	Example
Amide	 **R-CONH$_2$**	**Carboxamide** **Amido**	 **Methanamide** **CH_3CONH_2**

General formula	Type of reactions
$C_nH_{2n+1}NO$	**Not covered in IB chemistry**

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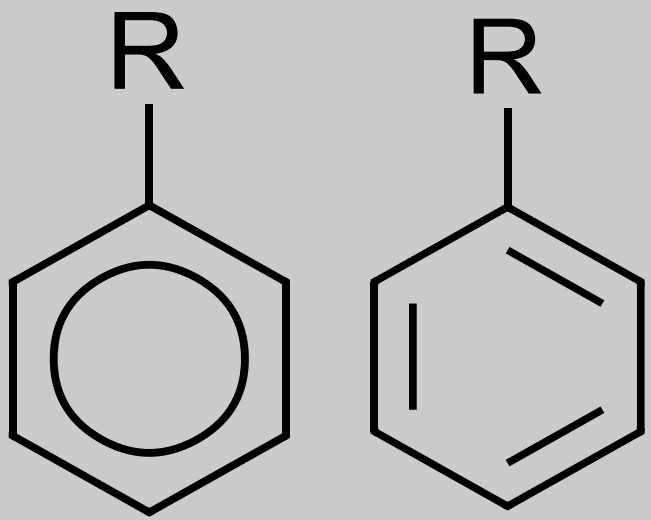
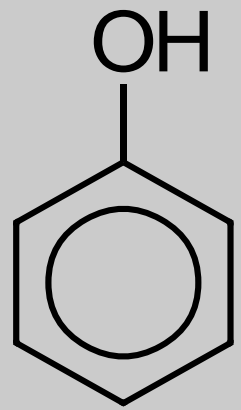
Functional groups

Class	Functional group	Name	Example
Arene	 C_6H_5-	Phenyl	 Phenol C_6H_5OH

General formula	Type of reactions
N/A	Reactions involving compounds with phenyl groups are covered in HL only

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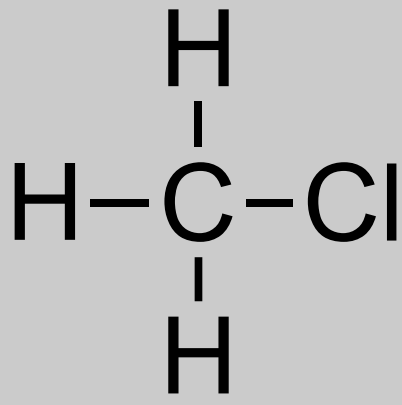
Functional groups

Class	Functional group	Name	Example
Halogeno-alkane	R-X where X is a F, Cl, Br or I atom	Fluoro- Chloro- Bromo- Iodo-	 Chloromethane CH_3Cl

General formula	Type of reactions
$C_nH_{2n+1}X$	Nucleophilic substitution

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Tutorials for IB Chemistry

Identifying functional groups

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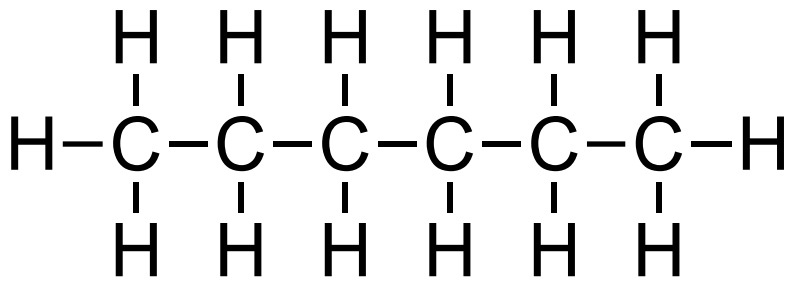
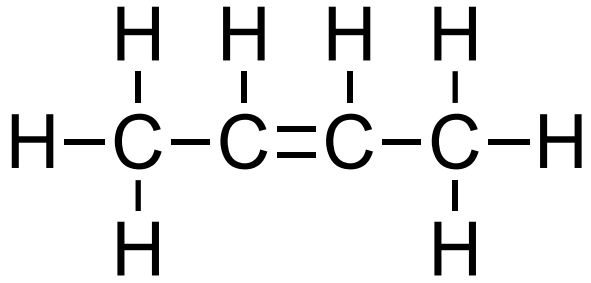
Tutorials for IB Chemistry

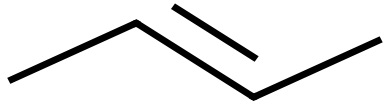
Identifying functional groups

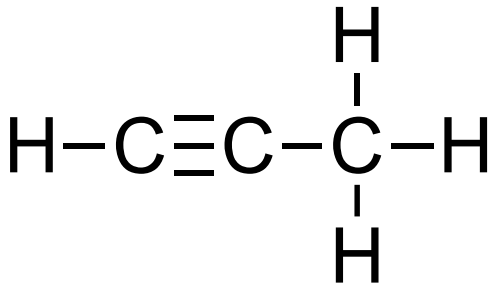


$CH_3CH_2CH_2CH_2CH_2CH_3$

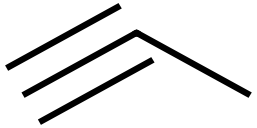


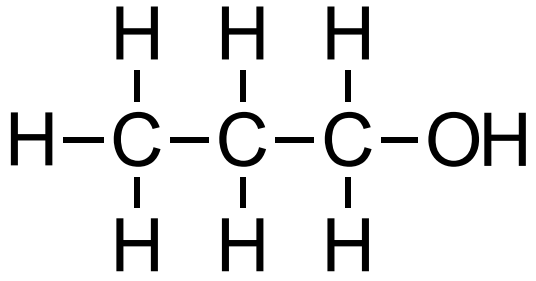
$CH_3CHCHCH_3$



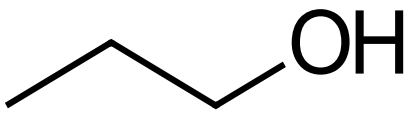


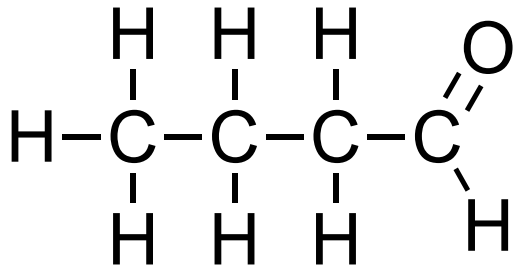
$CHCCH_3$



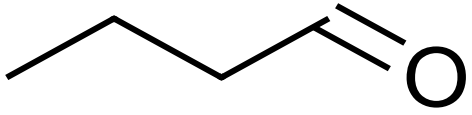


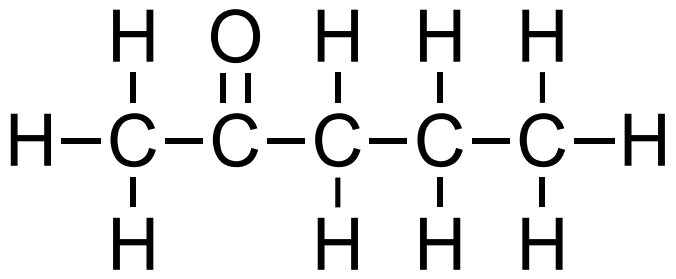
$CH_3CH_2CH_2OH$



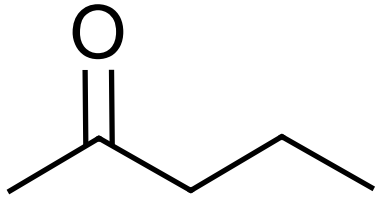


$CH_3CH_2CH_2CHO$





$CH_3COCH_2CH_2CH_3$



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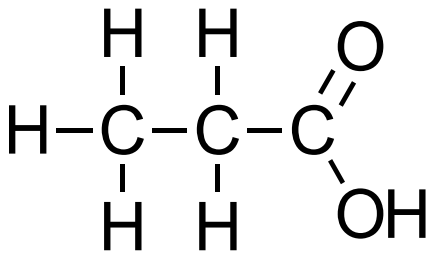
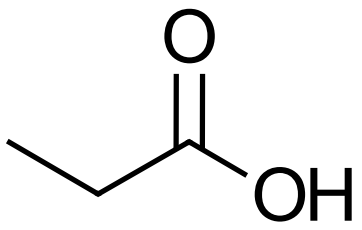
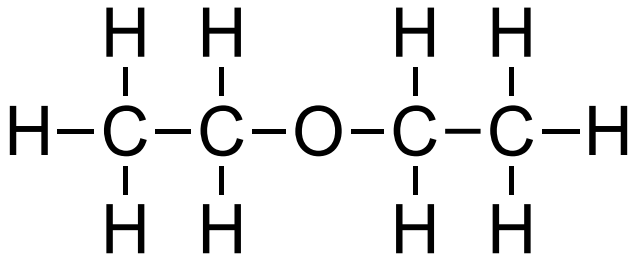
Identifying functional groups

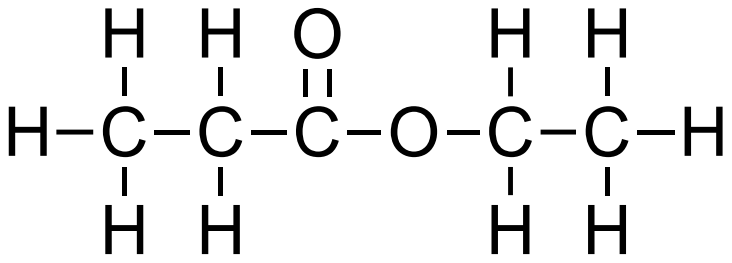


CH_3CH_2COOH

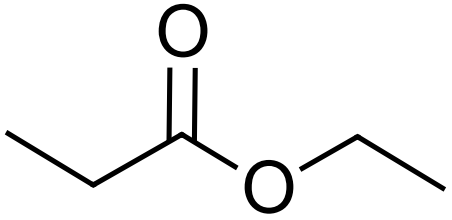


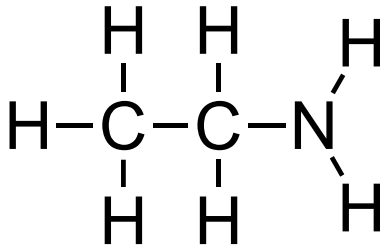


$CH_3CH_2OCH_2CH_3$

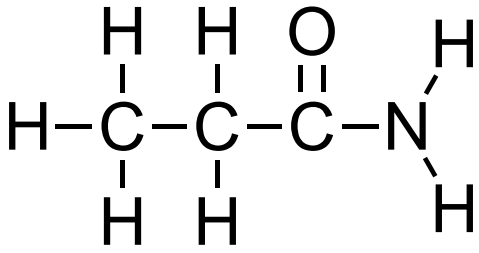


$CH_3CH_2COOCH_2CH_3$

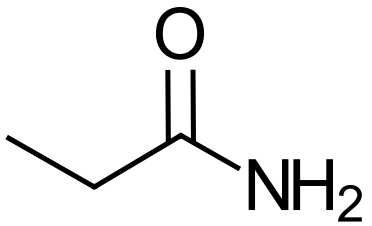


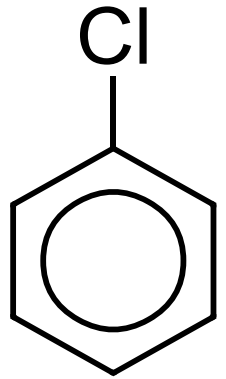


$CH_3CH_2NH_2$



$CH_3CH_2CONH_2$





C_6H_5Cl

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Homologous series

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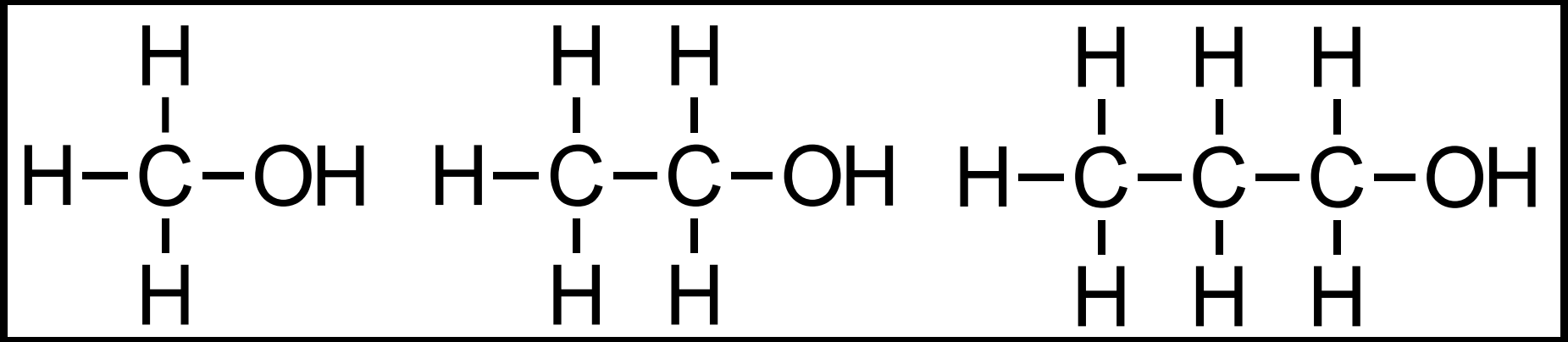
Homologous series

A homologous series is a series of organic compounds of the same family which differ by a common structural unit.



Functional group: hydroxyl (OH) – each member differs by CH_2

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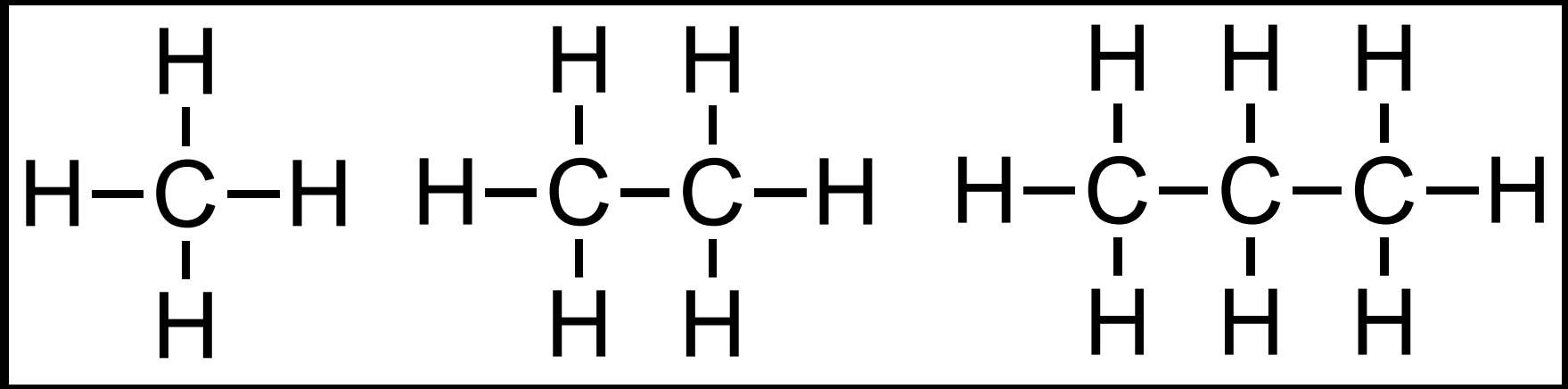
Homologous series

Members of a homologous series have similar chemical properties.



They also show a gradation in physical properties (such as the increasing boiling point of the alkanes).

Homologous series

Members of a homologous series:

- differ by a CH_2
- have the same general formula
- have similar chemical properties
- show a gradation (gradual increase) in physical properties such as boiling point

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Factors that affect the boiling points of organic compounds

Boiling points of organic compounds

Factors that affect the boiling points of organic compounds are:

- Molar mass of the compound
- Structure of the molecule (straight-chain vs branched-chain isomers)
- Type of functional group (hydrogen bonding, dipole-dipole, London dispersion)

Boiling points of the alkanes

alkane	molar mass ($gmol^{-1}$)	boiling point (°C)
methane	16	-164
ethane	30	-89
propane	44	-42
butane	58	-0.5
pentane	72	36
hexane	86	69
heptane	100	98
octane	114	125
nonane	128	151
decane	142	174

As the molar mass of the compound increases, the boiling point also increases.

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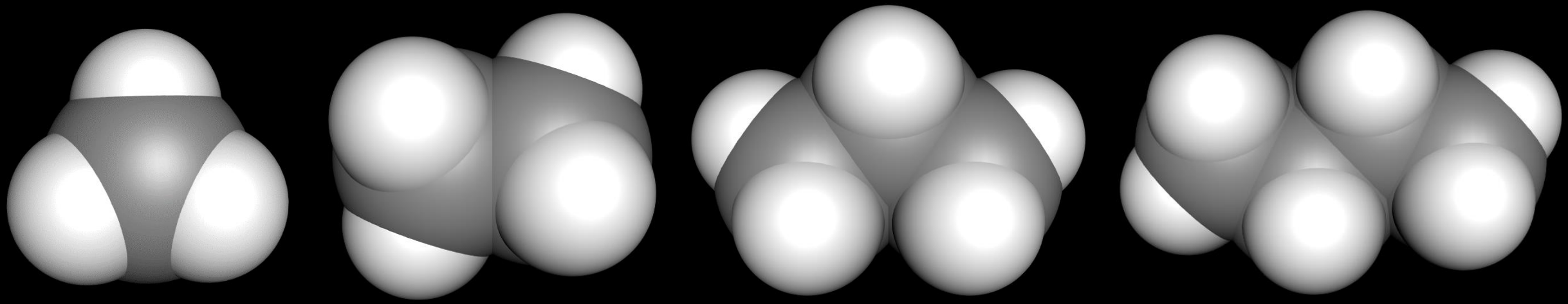
Boiling points of the alkanes



As the molar mass increases, the number of electrons within the molecule also increases.

Larger molecules are more polarisable and therefore have stronger London dispersion forces.

Larger molecules have an increased surface area over which the London dispersion forces can act.

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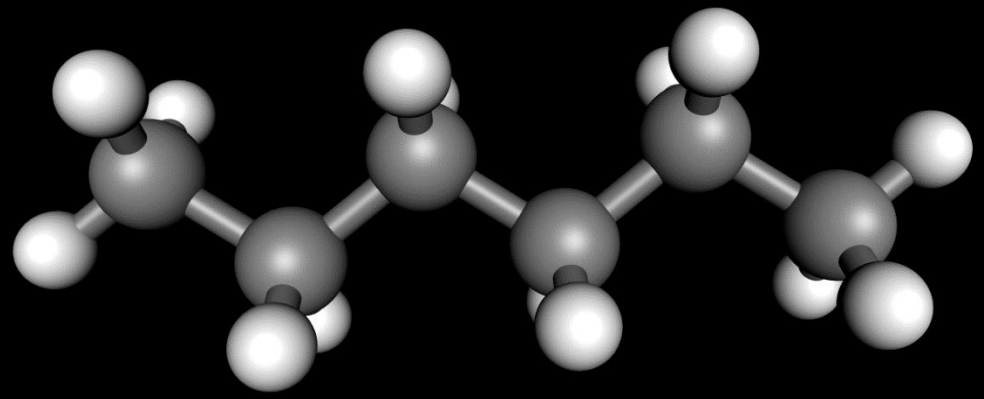
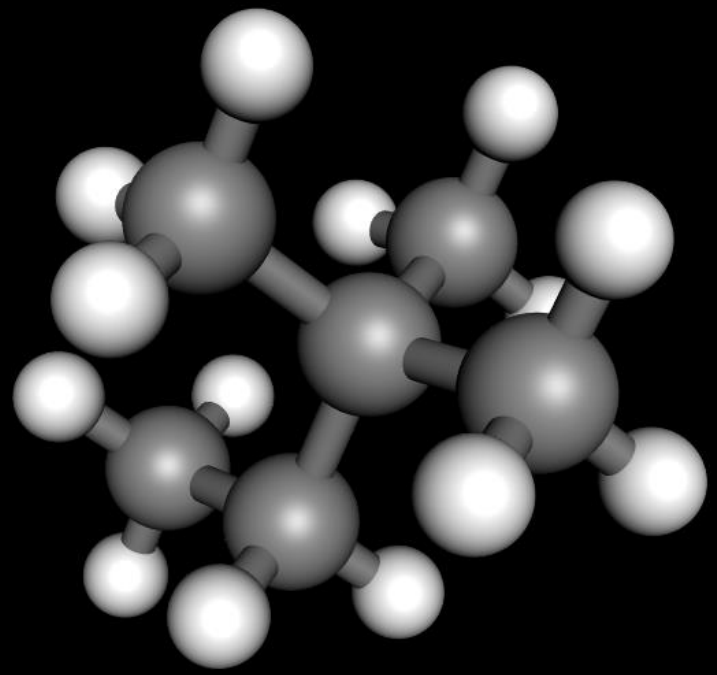
Branched vs straight-chain





Branched-chain isomers have lower boiling points than straight-chain isomers.

The branches prevent the molecules getting close together (less surface area contact) which results in weaker London dispersion forces and a lower boiling point.

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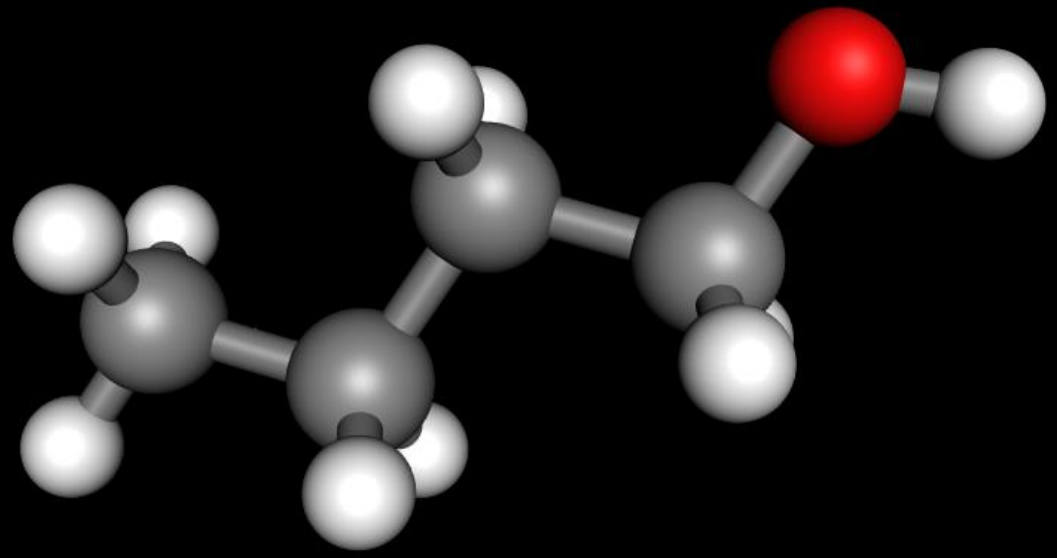
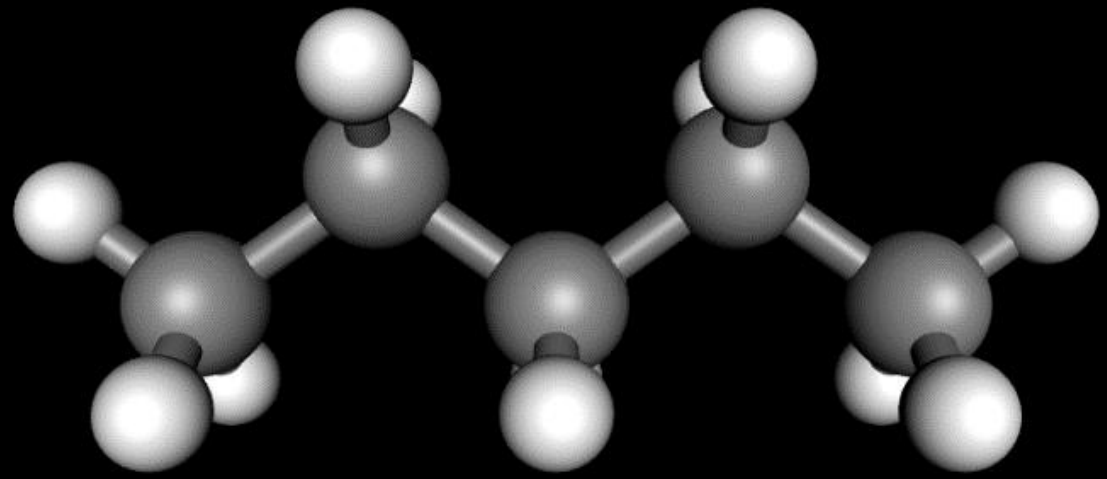
Effect of functional group





Butan-1-ol

M = 74.12 g mol^{-1}

B.P. = 118 °C

Pentane

M = 72.15 g mol^{-1}

B.P. = 36.1 °C

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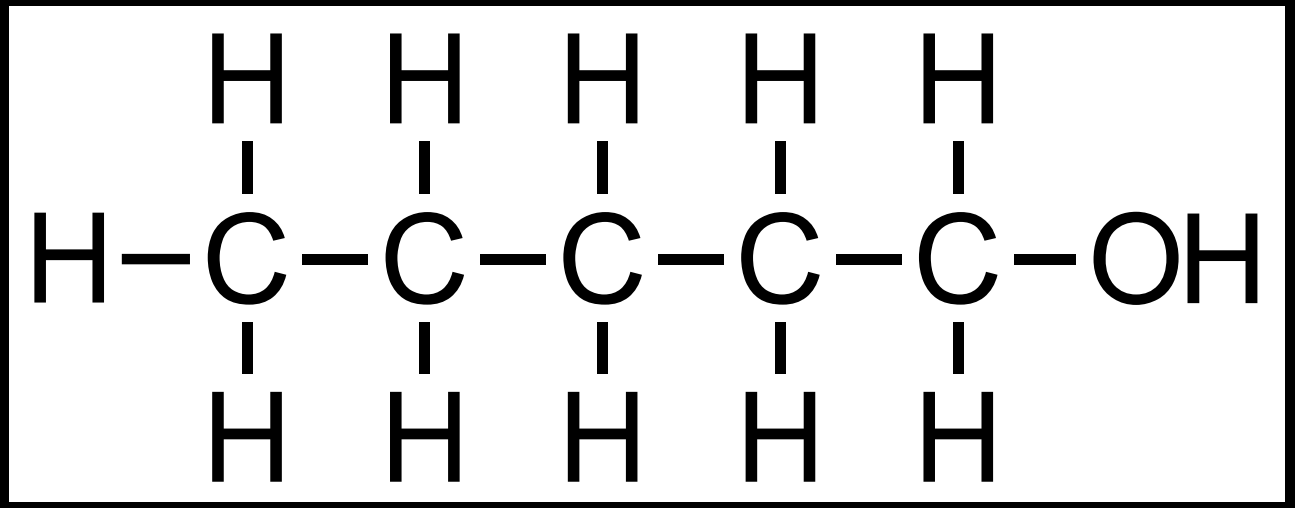
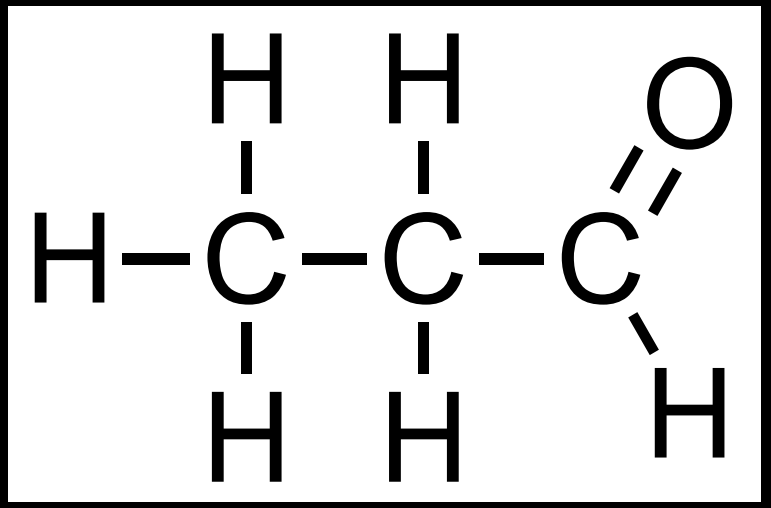
Effect of functional group



Functional group containing H bonded to O or N; hydrogen bonding between molecules



Functional group containing carbonyl group; dipole-dipole forces between molecules

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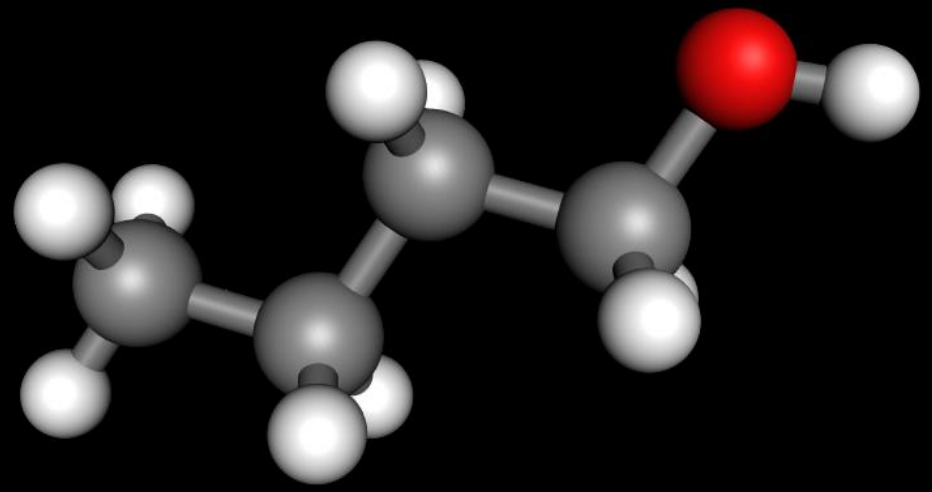
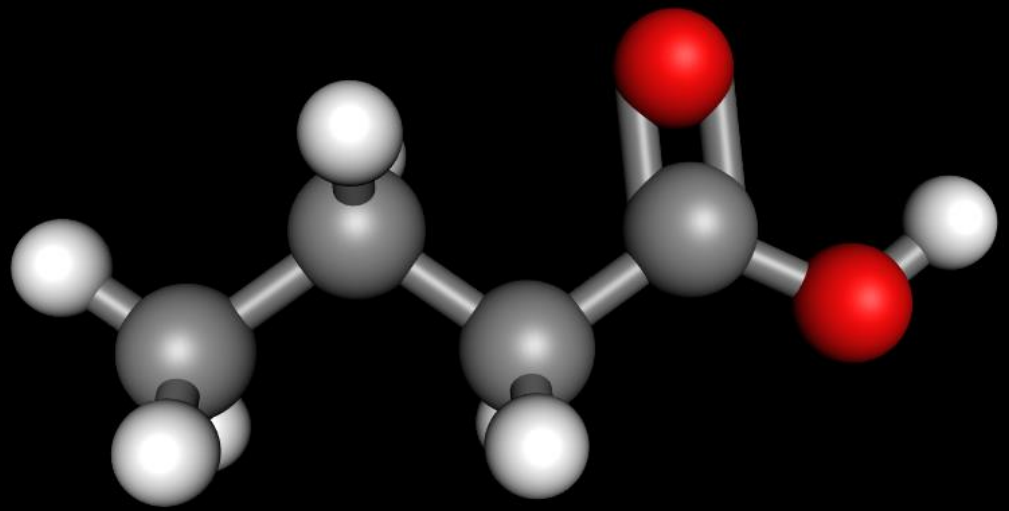
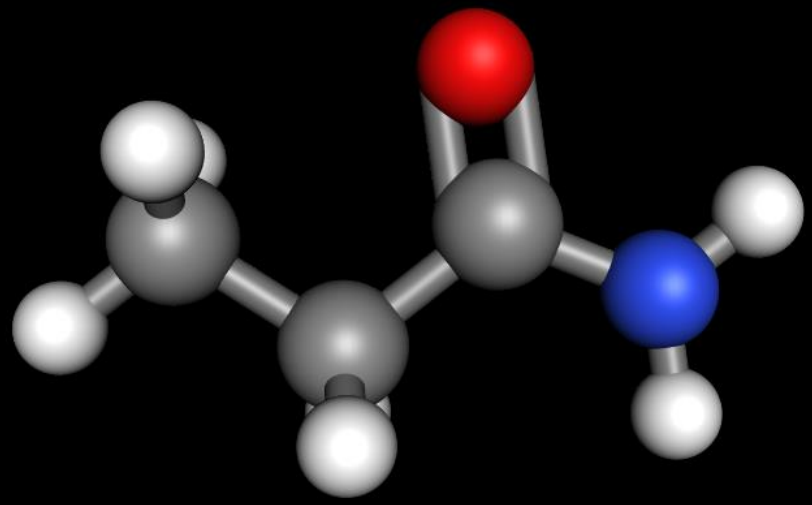
Effect of functional group





Alcohols, amides and carboxylic acids tend to have higher boiling points because they are able to form hydrogen bonds between their molecules.



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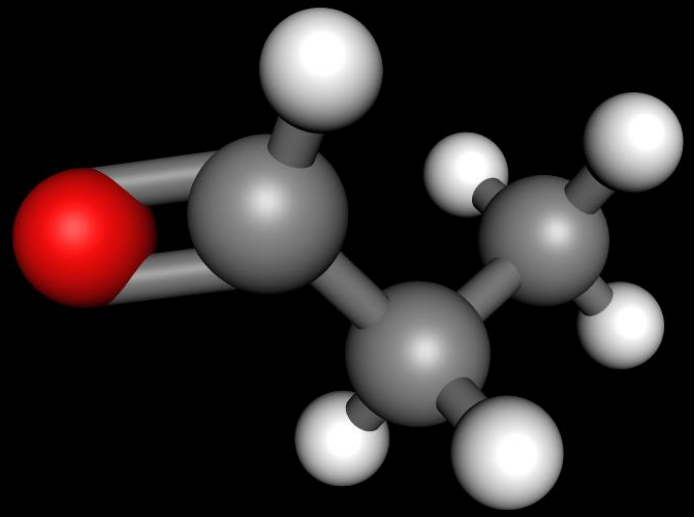
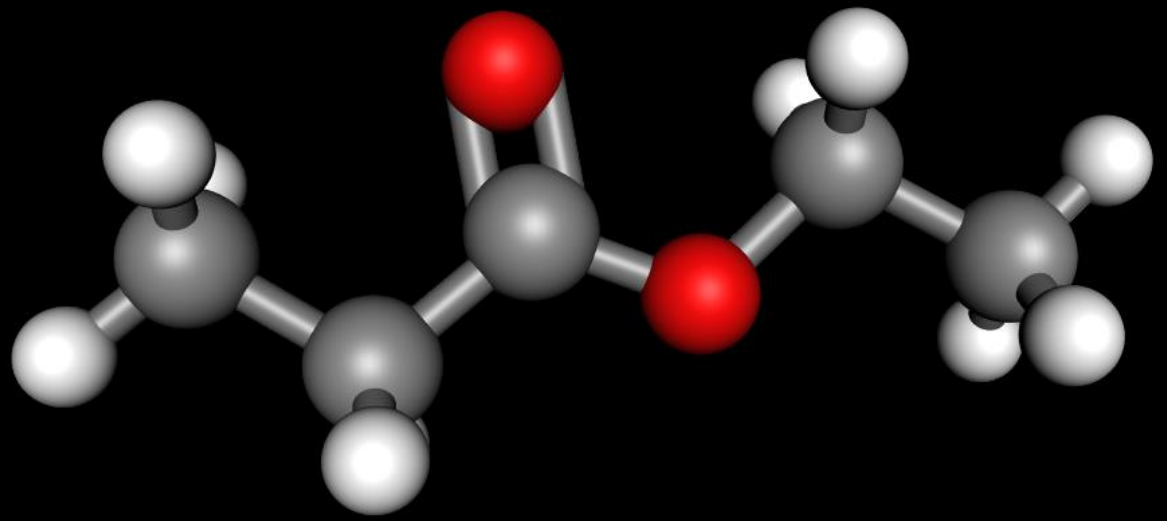
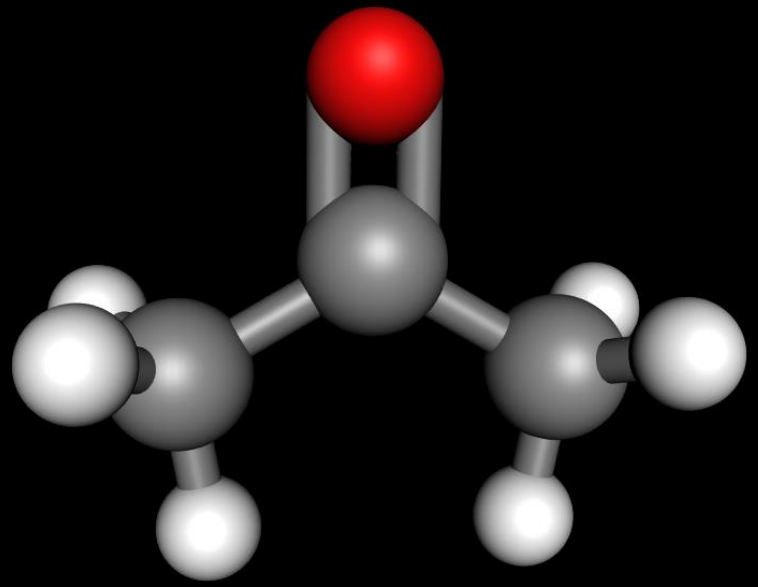
Effect of functional group







Aldehydes, ketones, and esters have dipole-dipole forces between their molecules.

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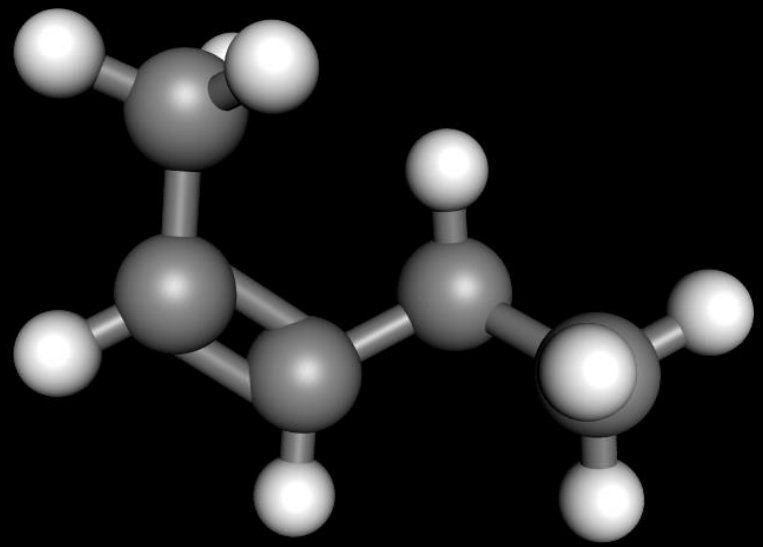
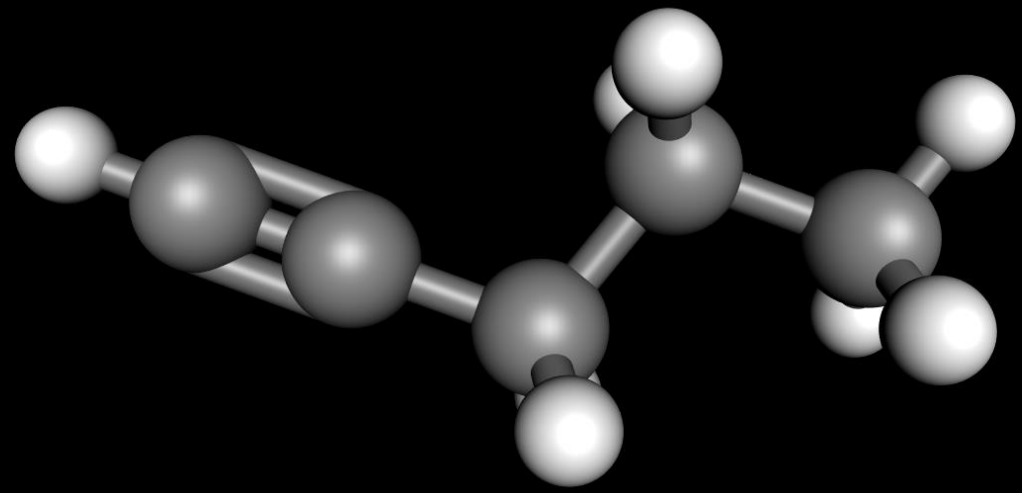
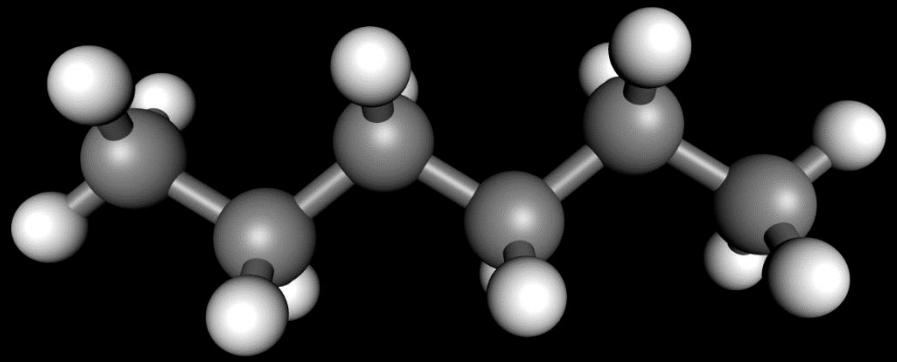
Effect of functional group







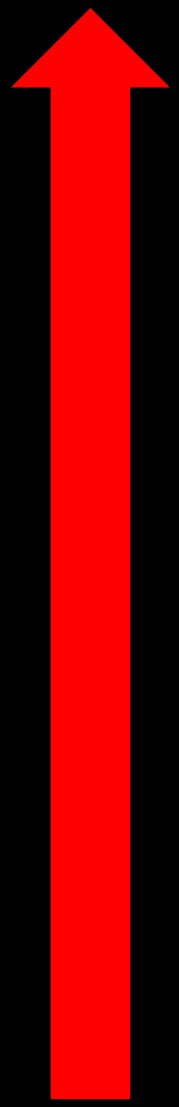
Alkanes, alkenes and alkynes have London dispersion forces between their molecules.

Effect of functional group

low volatility

Increasing boiling point

high volatility



Compounds that can form hydrogen bonds (alcohols, amides, amines, carboxylic acids)

Compounds that can form dipole-dipole forces (aldehydes, ketones, esters, ethers, nitriles)

Compounds that can form only London dispersion forces (alkanes, alkenes, alkynes)

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Naming alkanes

Naming alkanes

Alkanes are saturated hydrocarbons (C-C single bonds).

They have the general formula C_nH_{2n+2}

Alkanes have low reactivity for two reasons:

- the C-H bonds are non-polar (weakly polar).
- the C-C and C-H bonds are quite strong.

Alkanes undergo combustion and free-radical substitution reactions.

Naming alkanes

Number of C atoms in the longest chain	Root/stem	Number of C atoms in the longest chain	Root/stem
1	meth-	6	hex-
2	eth-	7	hept-
3	prop-	8	oct-
4	but-	9	non-
5	pent-	10	dec-

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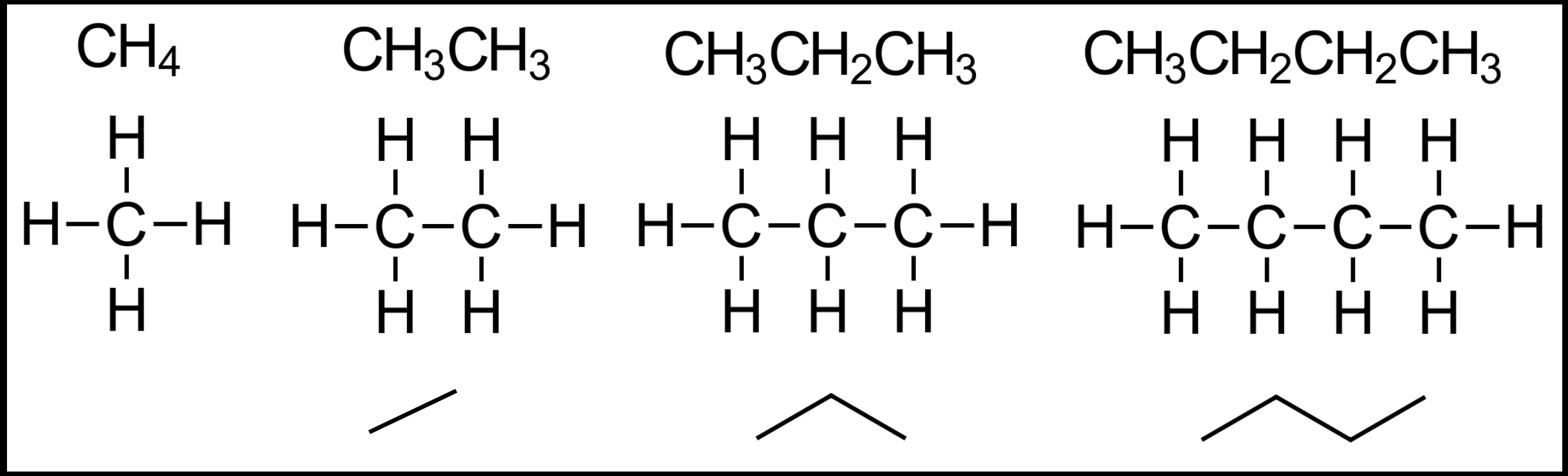
Naming alkanes



Methane CH_4

Ethane C_2H_6

Propane C_3H_8

Butane C_4H_{10}

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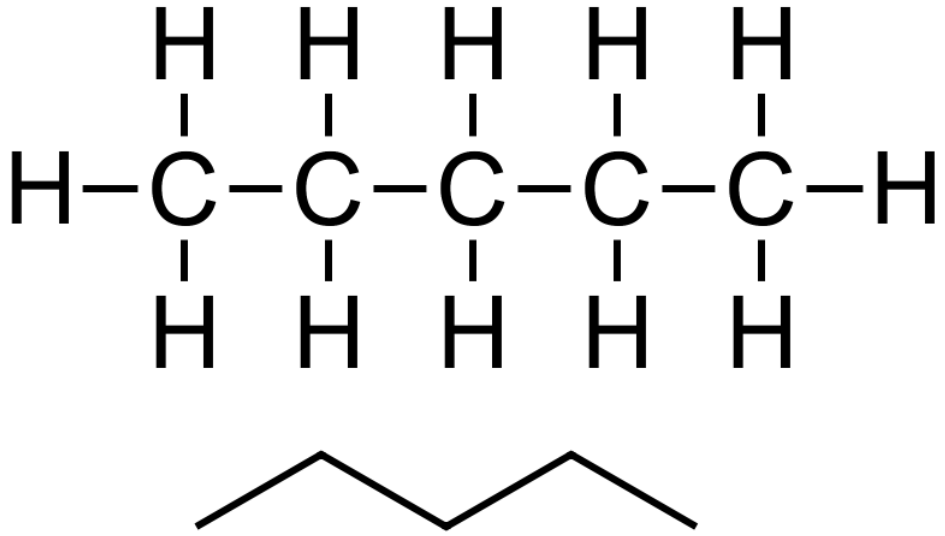
Naming alkanes

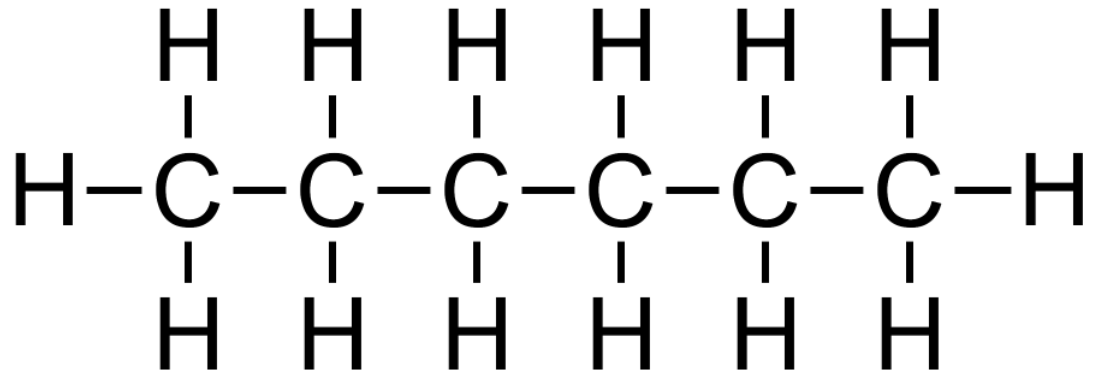
$CH_3CH_2CH_2CH_2CH_3$



Pentane

C_5H_{12}

$CH_3CH_2CH_2CH_2CH_2CH_3$



Hexane

C_6H_{14}

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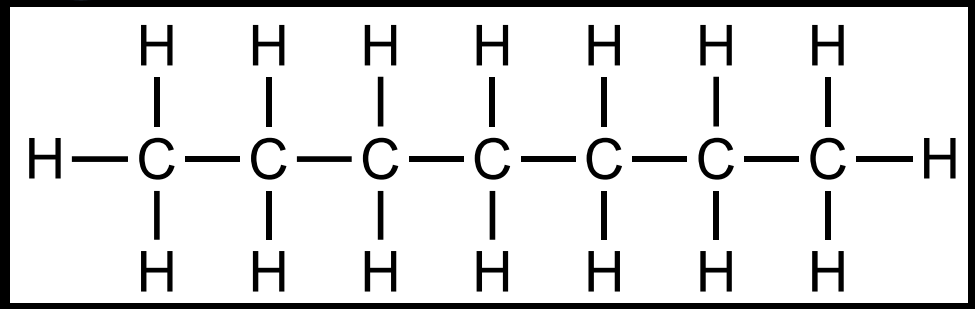
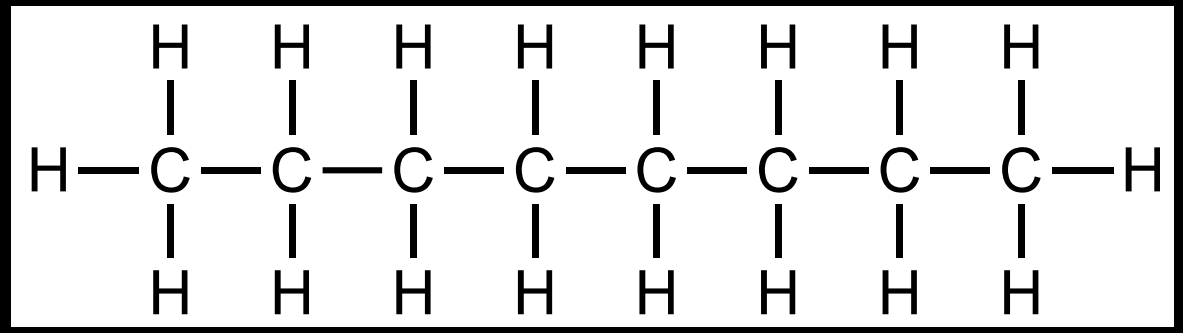
Naming alkanes

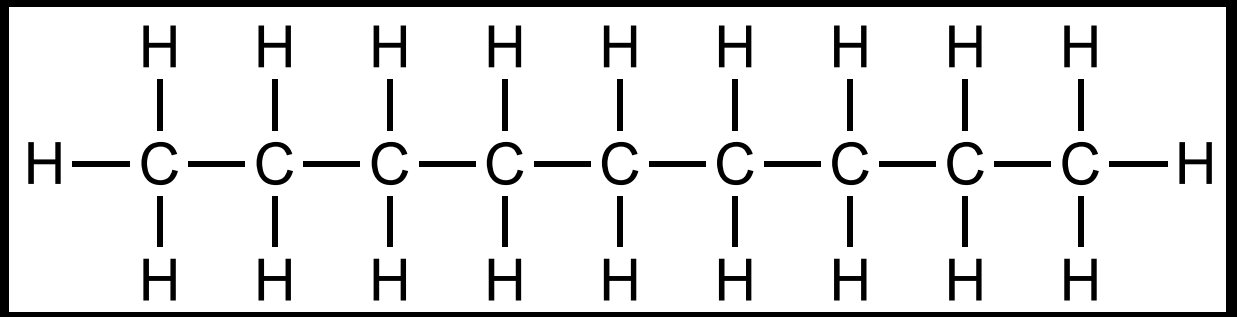
Heptane C_7H_{16}

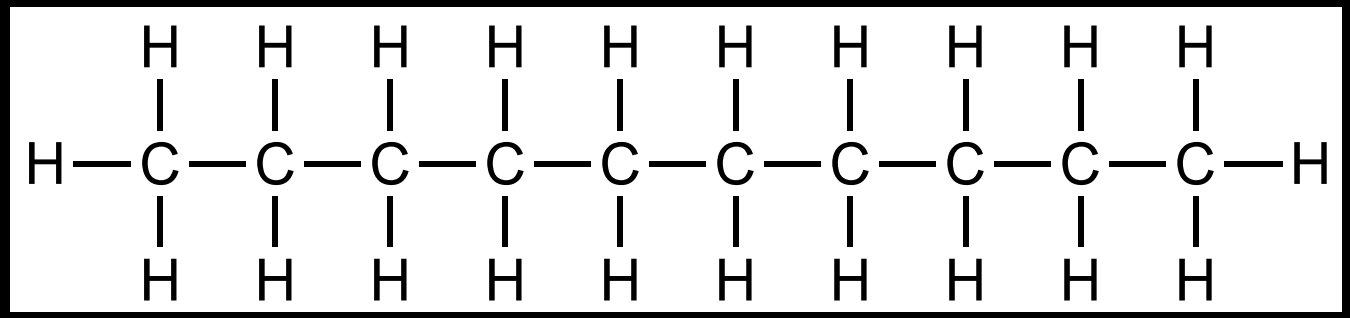




Octane C_8H_{18}

Nonane C_9H_{20}





Decane $C_{10}H_{22}$

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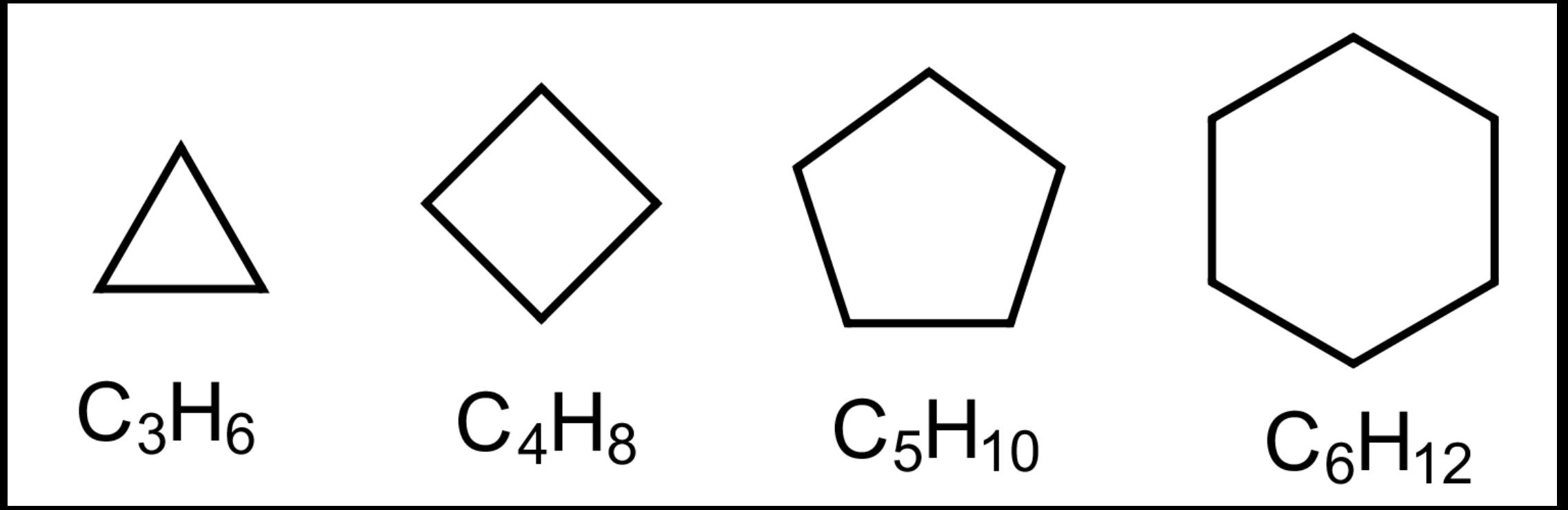
Naming alkanes

Cyclic alkanes feature a ring structure (C_nH_{2n}).



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Naming branched-chain alkanes

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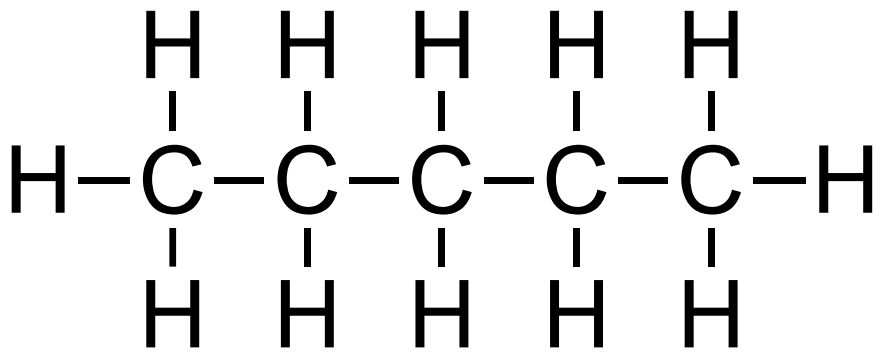
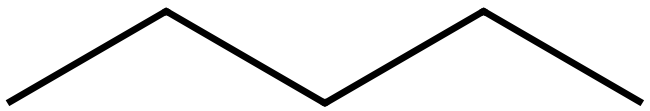
Branched-chain alkanes

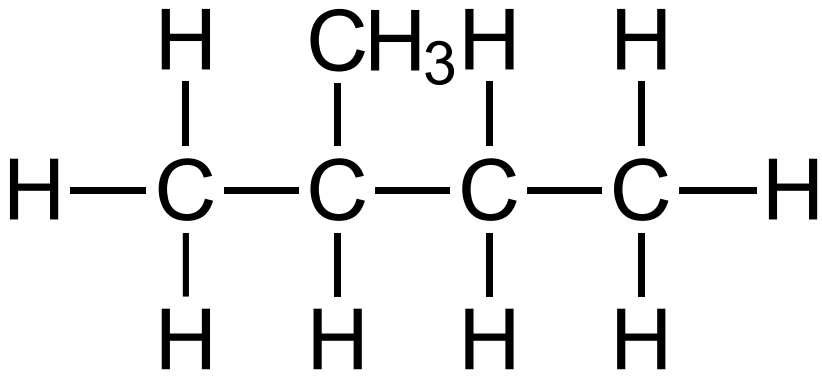
Branched-chain alkanes have branches which are alkyl substituents (-CH_3, -C_2H_5).

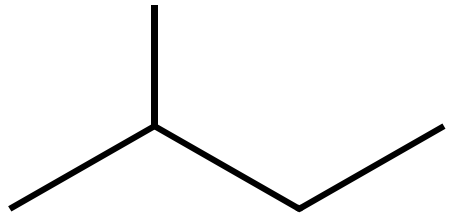
$CH_3CH_2CH_2CH_2CH_3$





$CH_3CH(CH_3)CH_2CH_3$





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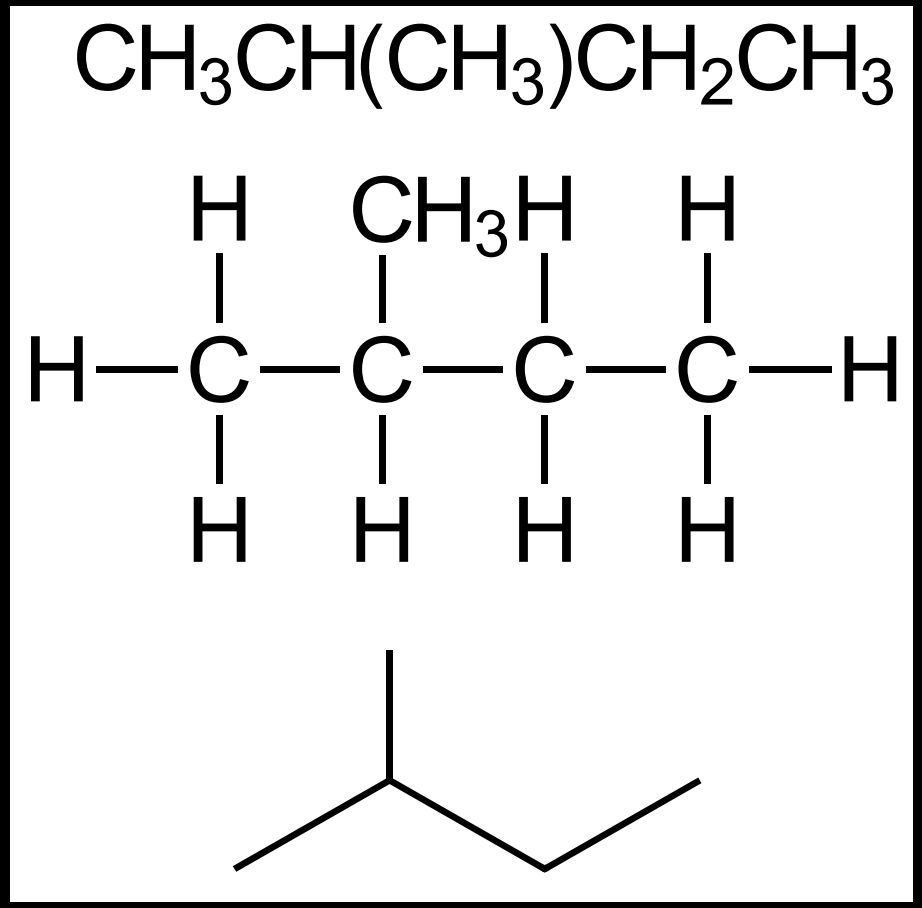
Branched-chain alkanes

1. Identify the longest continuous carbon chain.



2-methylbutane

2. Identify and number the position(s) of the branch(es), giving them the lowest number possible.

3. If more than one alkyl group is attached to the main chain, use the prefixes di-, tri-, etc.

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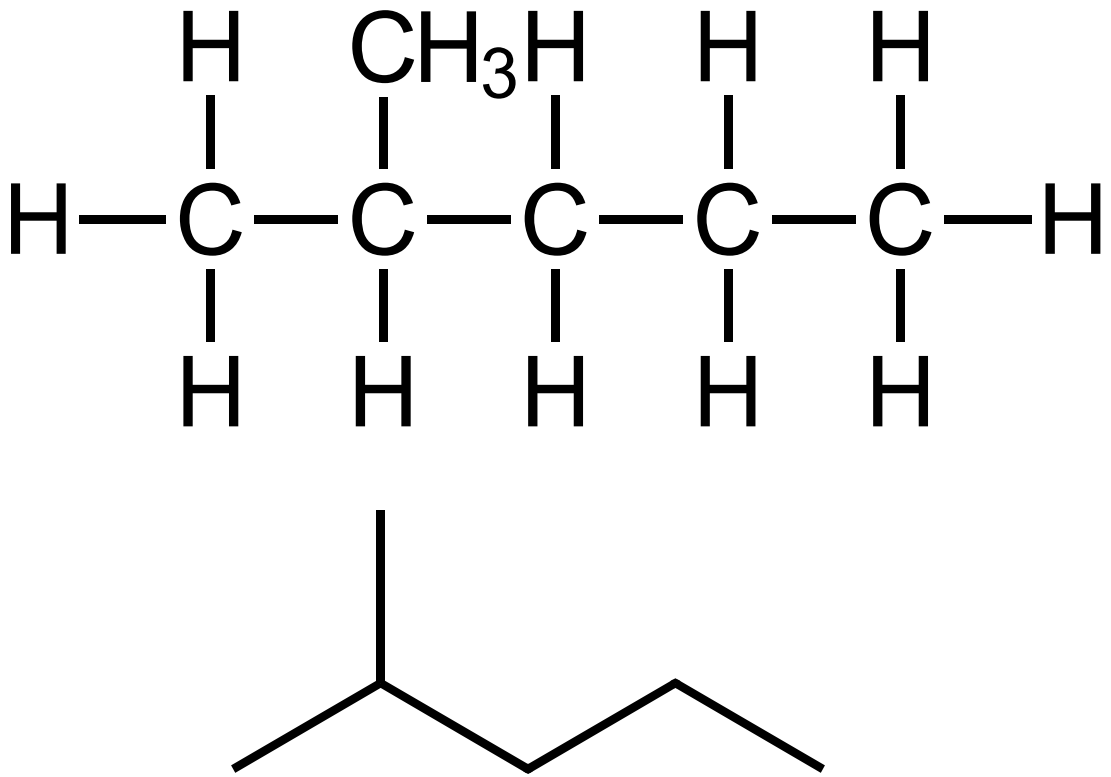
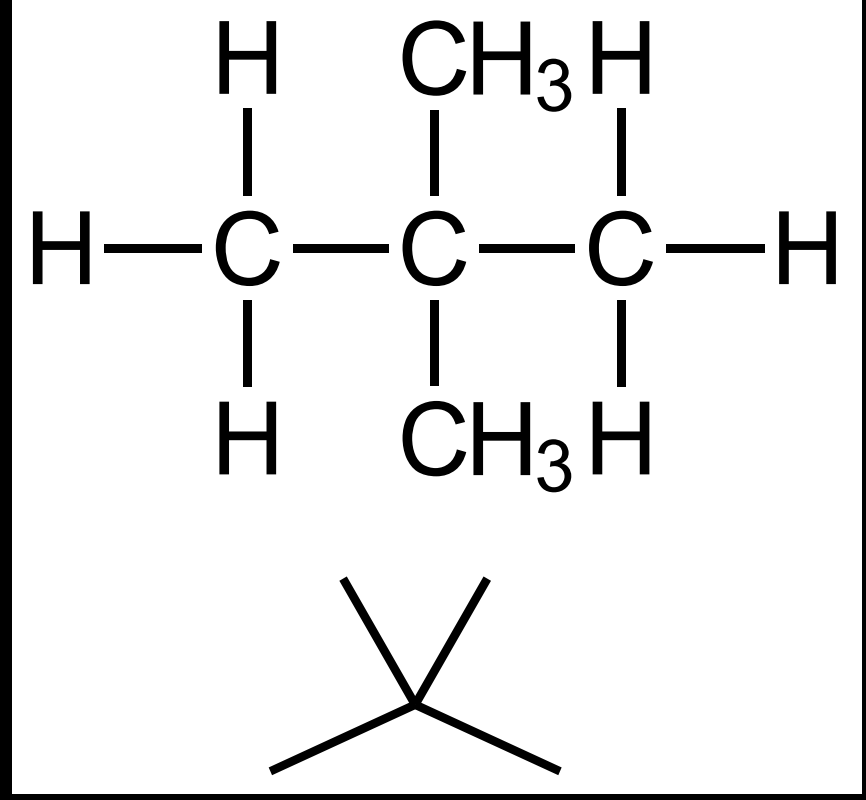
Branched-chain alkanes

$CH_3CH(CH_3)CH_2CH_2CH_3$



2-methylpentane

$CH_3C(CH_3)_2CH_3$



2,2-dimethylpropane

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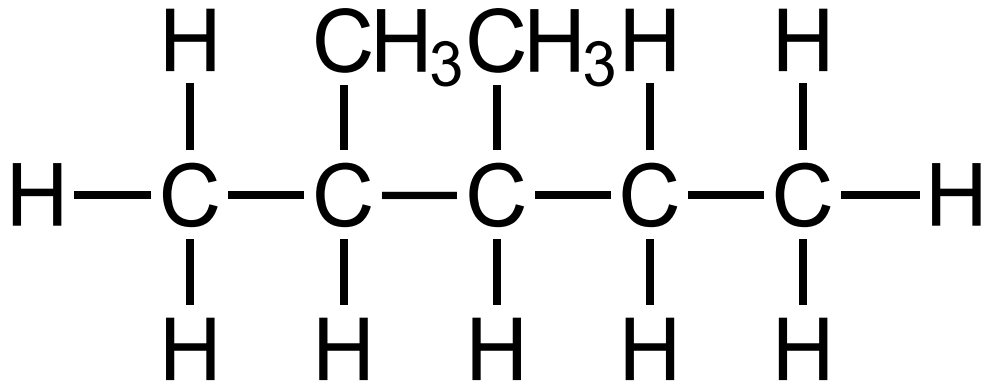
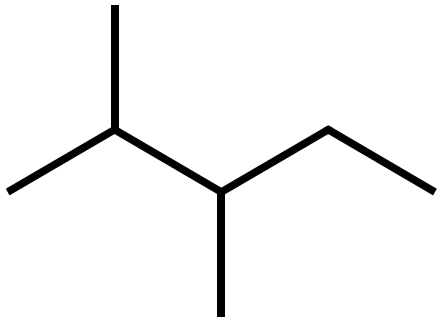
Branched-chain alkanes

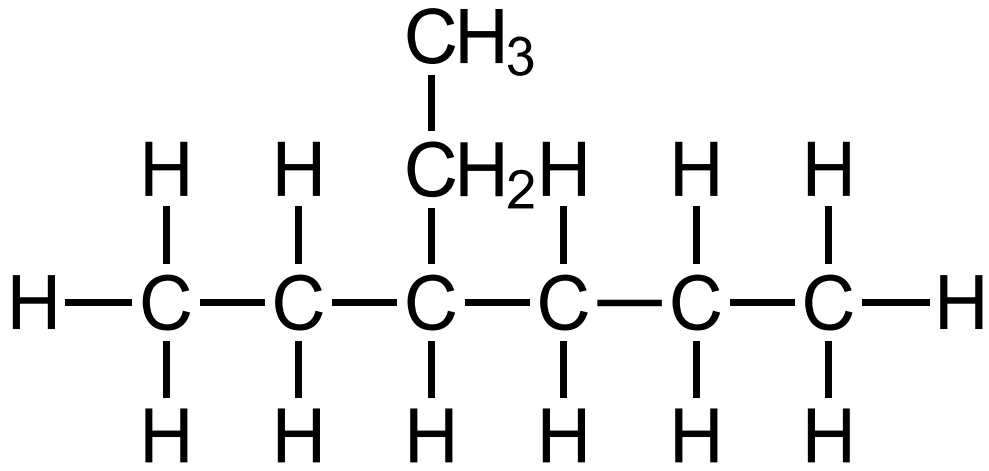
$CH_3CH(CH_3)CH(CH_3)CH_2CH_3$

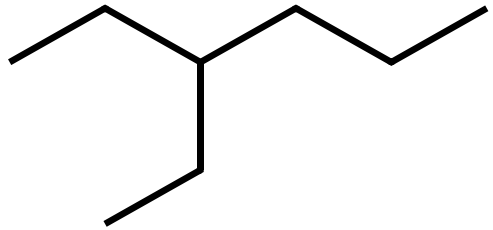




2,3-dimethylpentane

$CH_3CH_2CH(C_2H_5)CH_2CH_2CH_3$





3-ethylhexane

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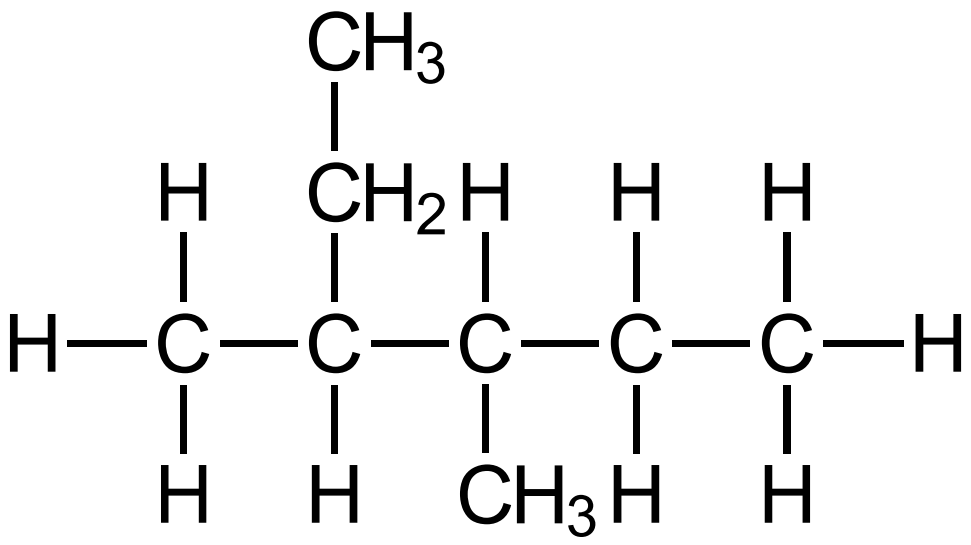
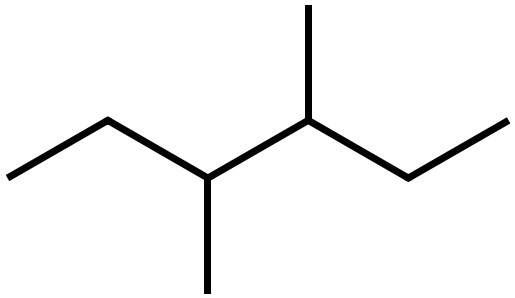
Branched-chain alkanes

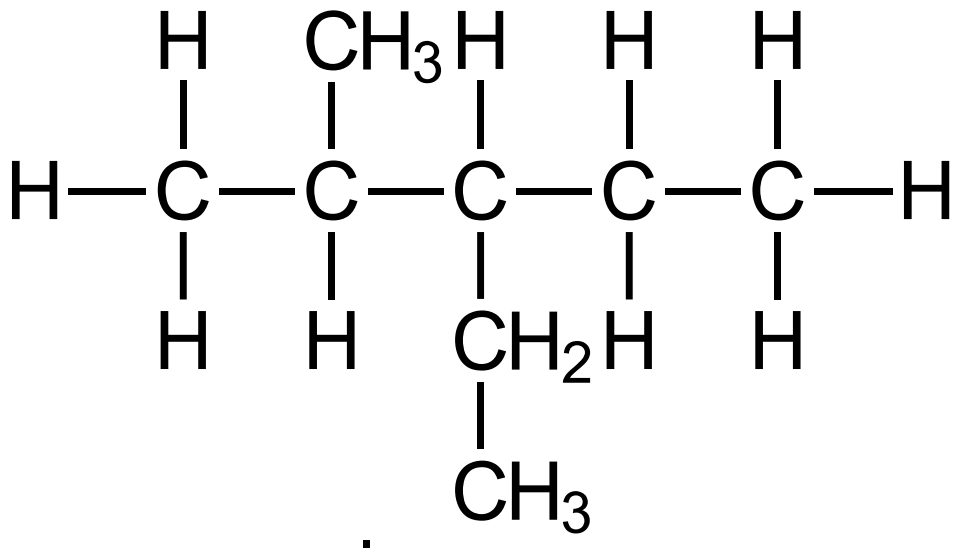
$CH_3CH_2CH(CH_3)CH(CH_3)CH_2CH_3$

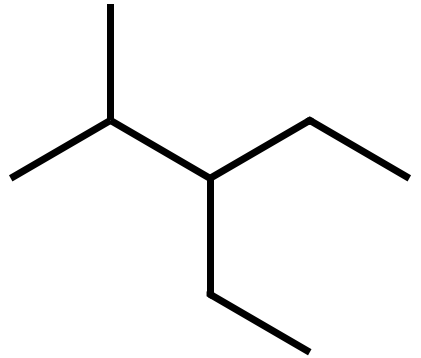




3,4-dimethylhexane

$CH_3CH(CH_3)CH(C_2H_5)CH_2CH_3$





3-ethyl-2-methylpentane

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Naming alkenes

Naming alkenes

Alkenes are unsaturated hydrocarbons (C-C double bonds).

They have the general formula C_nH_{2n}

Alkenes are more reactive than the alkanes for two reasons:

- the electron density of the C=C bond attracts electrophiles
- the pi bond is weaker than the sigma bond

Alkenes undergo electrophilic addition reactions.

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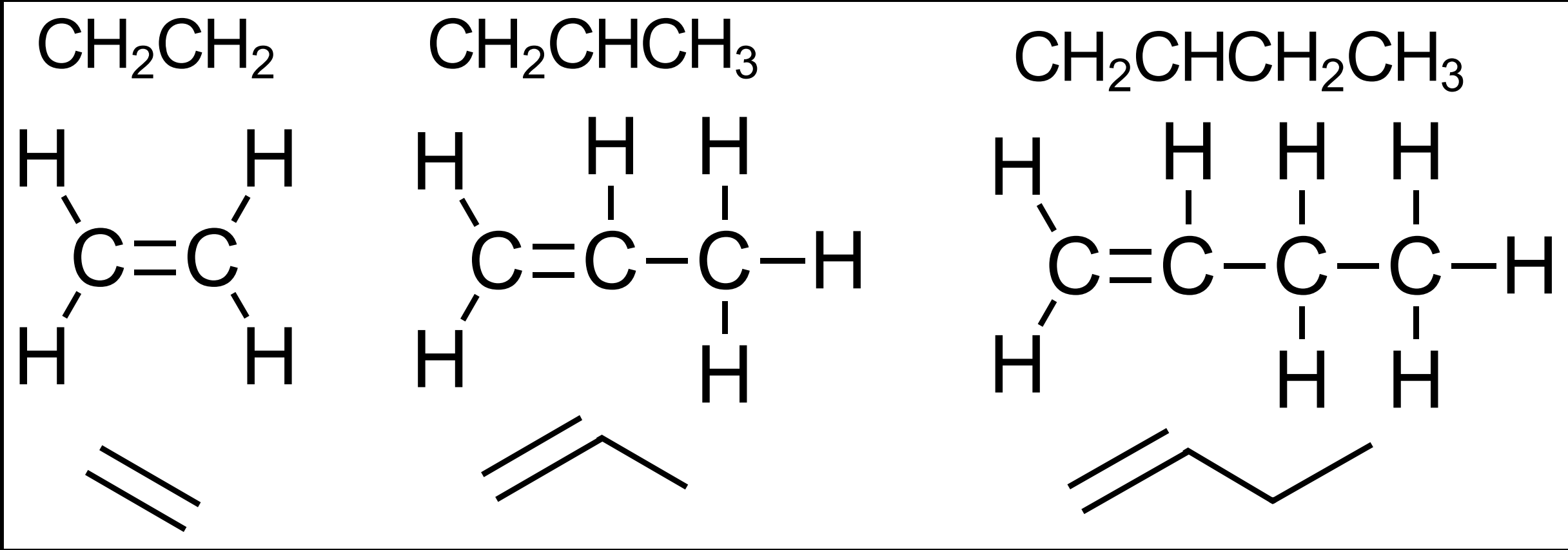
Naming alkenes



Ethene
C_2H_4

Propene
C_3H_6

But-1-ene
C_4H_8

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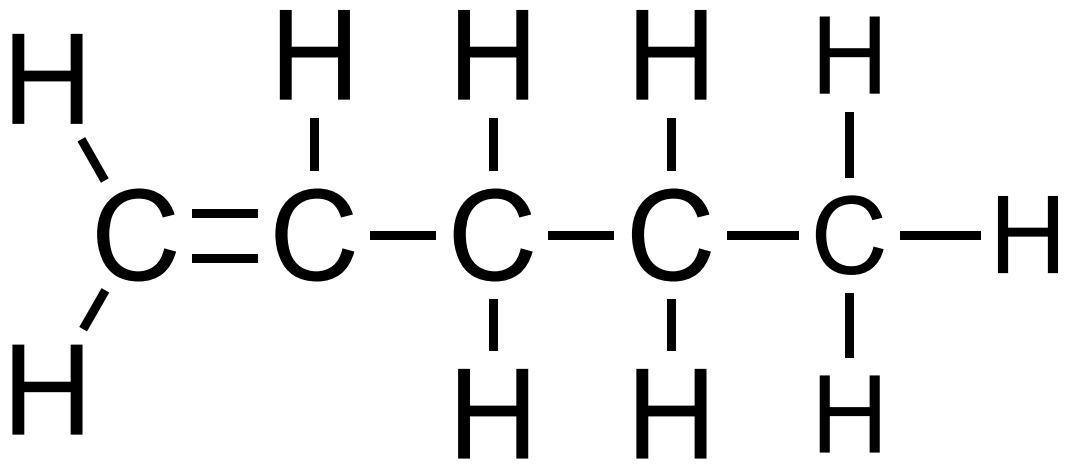
Naming alkenes

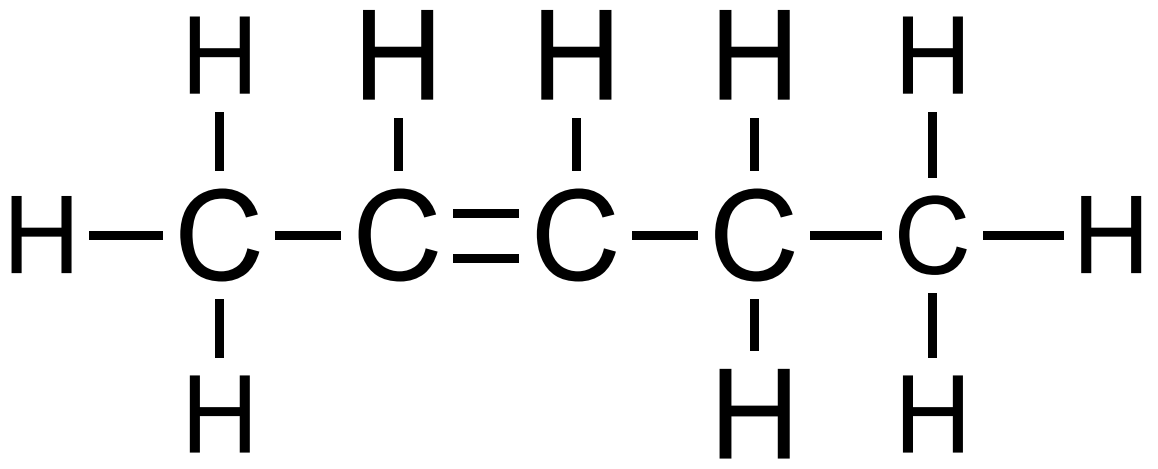
$CH_2CHCH_2CH_2CH_3$



Pent-1-ene

C_5H_{10}

$CH_3CHCHCH_2CH_3$



Pent-2-ene

C_5H_{10}

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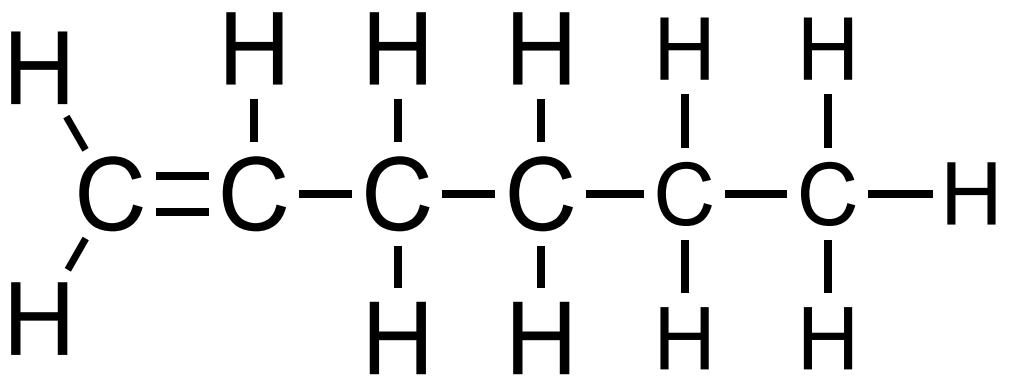
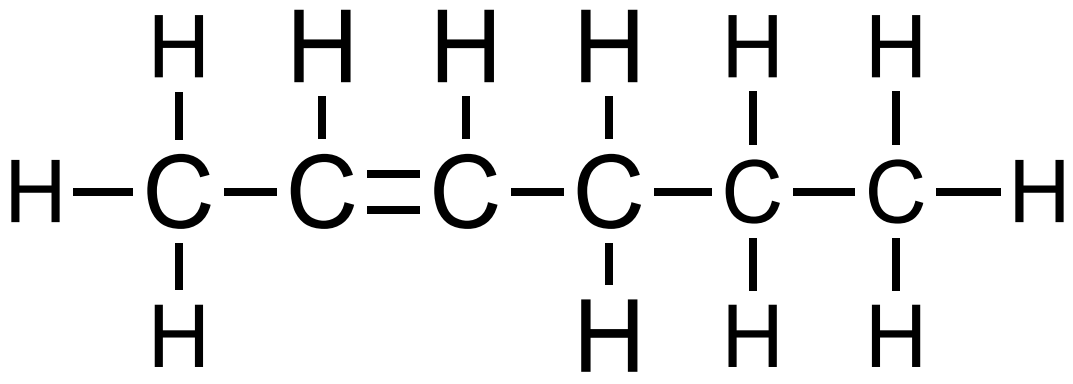
Naming alkenes

$CH_2CHCH_2CH_2CH_2CH_3$



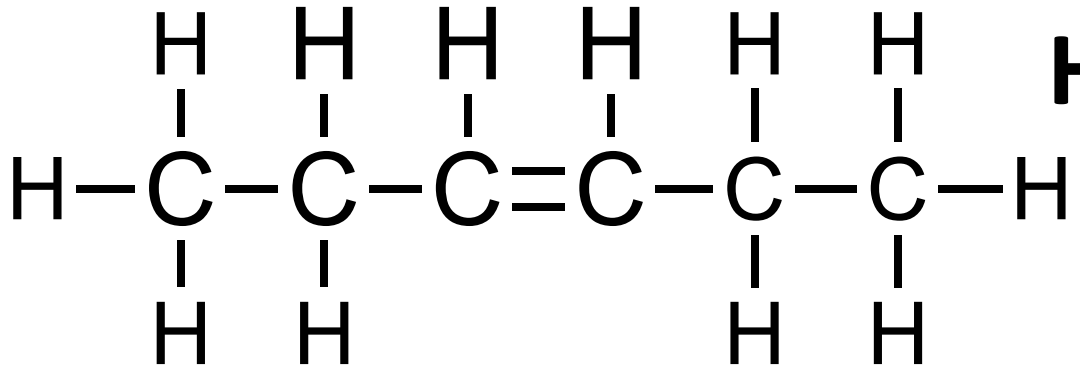
Hex-1-ene

$CH_3CHCHCH_2CH_2CH_3$



Hex-2-ene

$CH_3CH_2CHCHCH_2CH_3$



Hex-3-ene

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Naming alkynes

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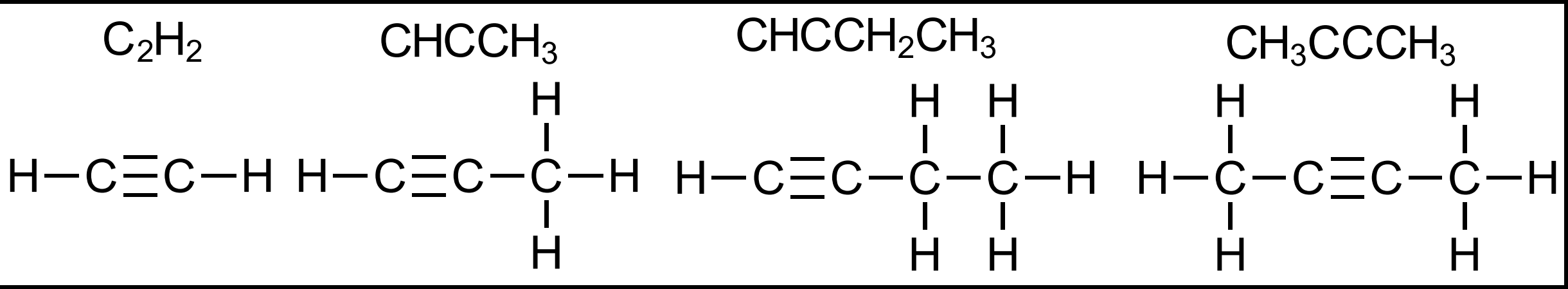
Naming alkynes

Alkynes are unsaturated hydrocarbons (C-C triple bonds).
They have the general formula C_nH_{2n-2}
Alkynes have similar reactivity to the alkenes.
Alkynes undergo electrophilic addition reactions.



Ethyne Propyne But-1-yne But-2-yne

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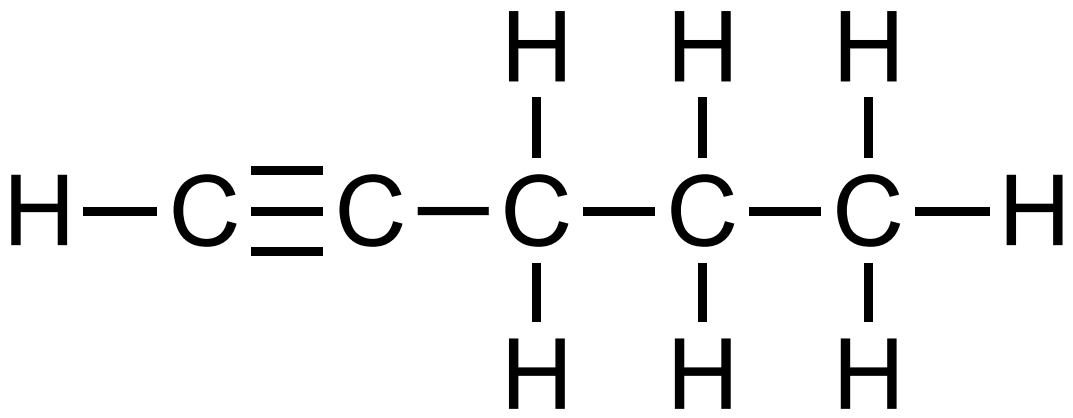
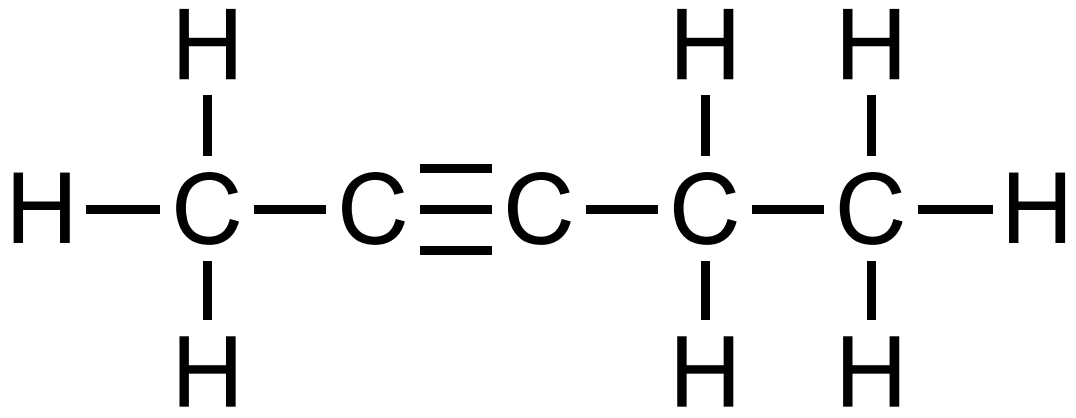
Naming alkynes

$CHCCH_2CH_2CH_3$



$CH_3CCCH_2CH_3$



Pent-1-yne

Pent-2-yne

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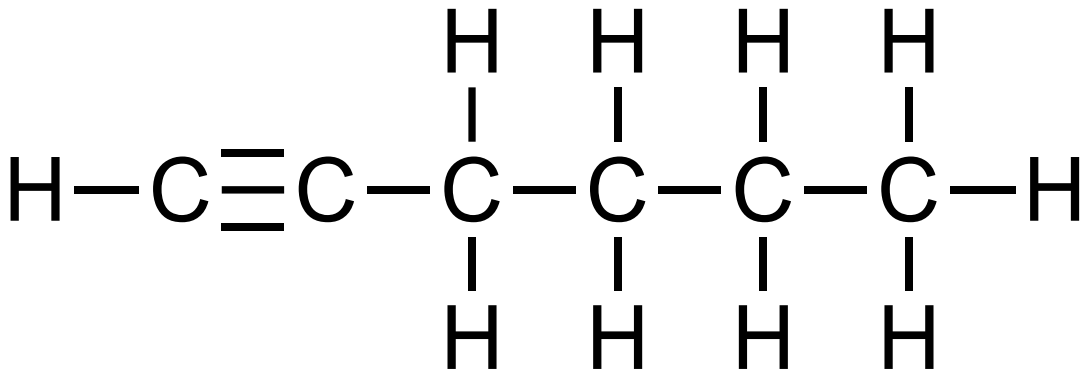
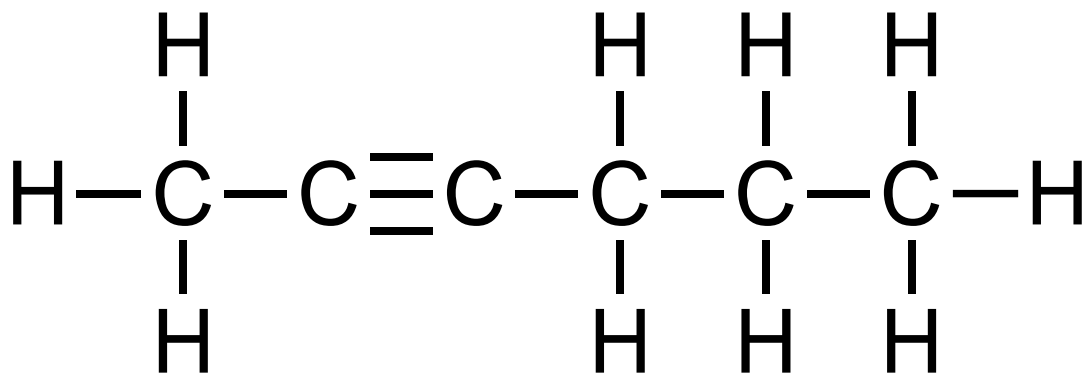
Naming alkynes

$CHCCH_2CH_2CH_2CH_3$



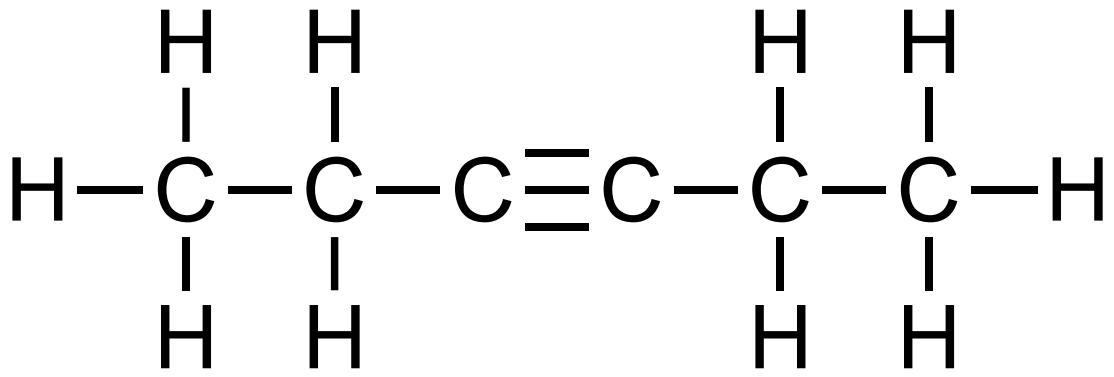
Hex-1-yne

$CH_3CCCH_2CH_2CH_3$



Hex-2-yne

$CH_3CH_2CCCH_2CH_3$



Hex-3-yne

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Naming alcohols

Naming alcohols

Alcohols are organic compounds composed of carbon, hydrogen and oxygen.

They have the hydroxyl functional group (-OH).

Alcohols have the general formula $C_nH_{2n+1}OH$

Alcohols undergo combustion reactions and oxidation reactions.

They also undergo nucleophilic substitution reactions with carboxylic acids to form esters.

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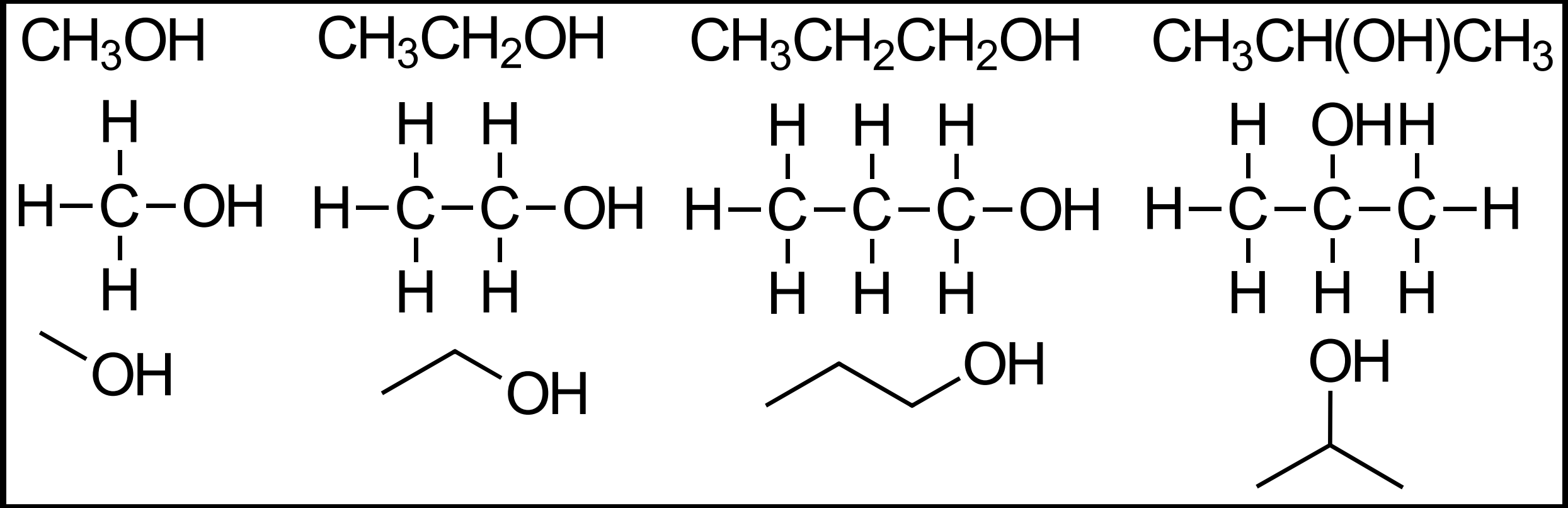
Naming alcohols



Methanol
CH_3OH

Ethanol
C_2H_5OH

Propan-1-ol
C_3H_7OH

Propan-2-ol
C_3H_7OH

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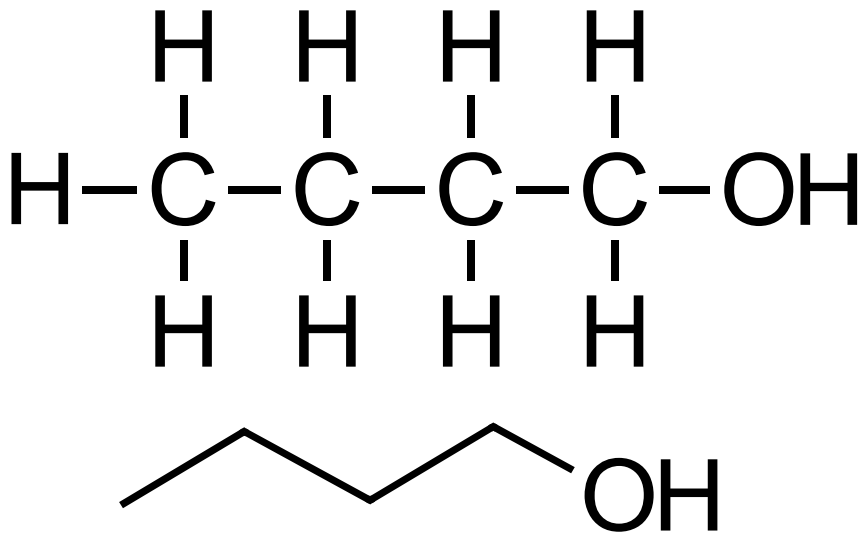
Naming alcohols

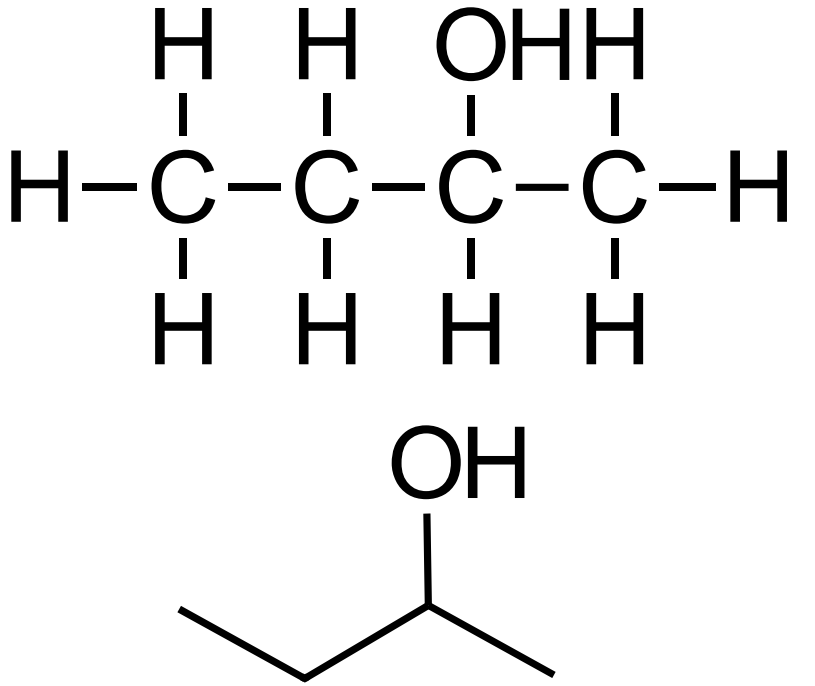
$CH_3CH_2CH_2CH_2OH$



Butan-1-ol

C_4H_9OH

$CH_3CH_2CH(OH)CH_3$



Butan-2-ol

C_4H_9OH

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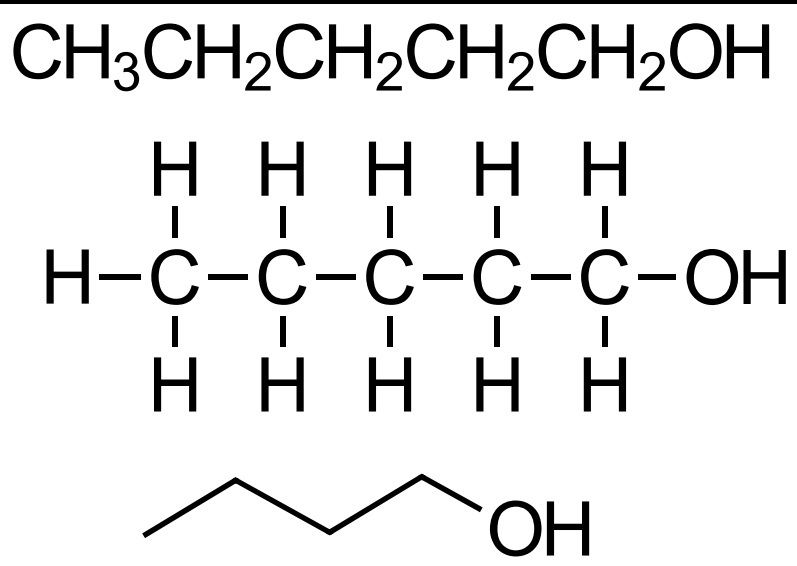
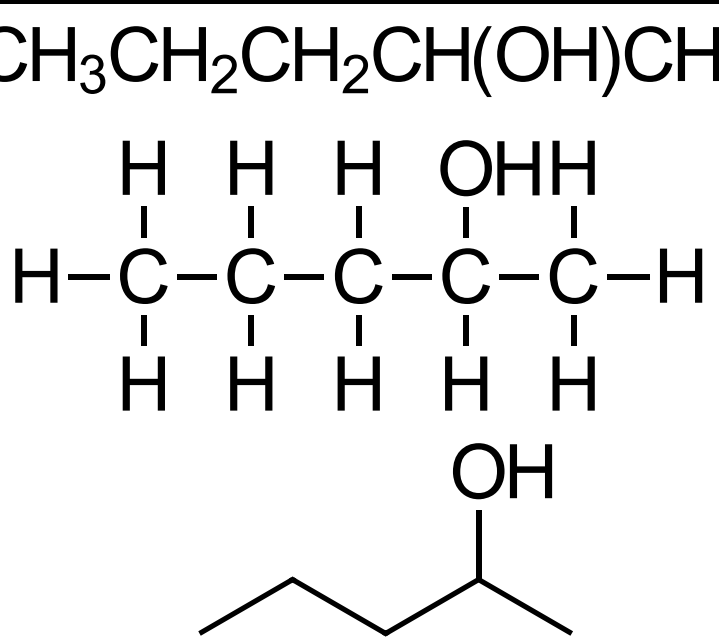
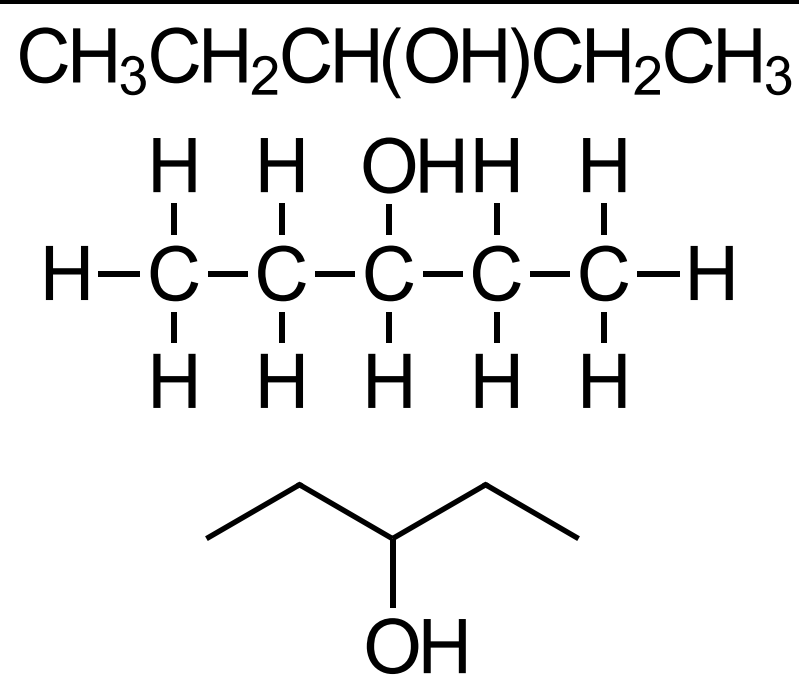
Naming alcohols



Pentan-1-ol
$C_5H_{11}OH$



Pentan-2-ol
$C_5H_{11}OH$



Pentan-3-ol
$C_5H_{11}OH$

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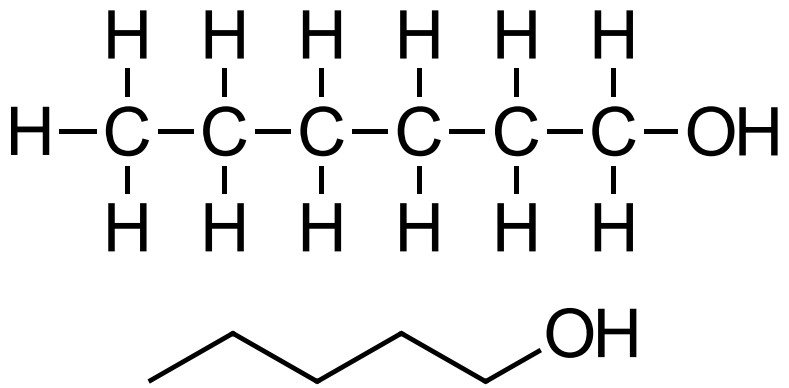
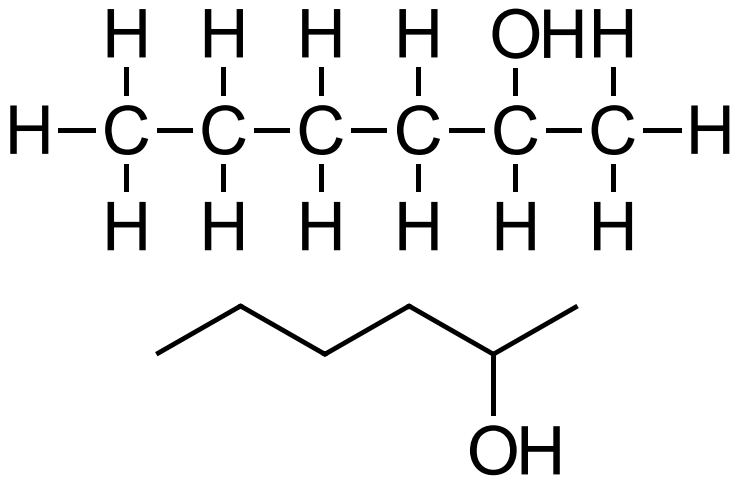
Naming alcohols

$CH_3CH_2CH_2CH_2CH_2CH_2OH$



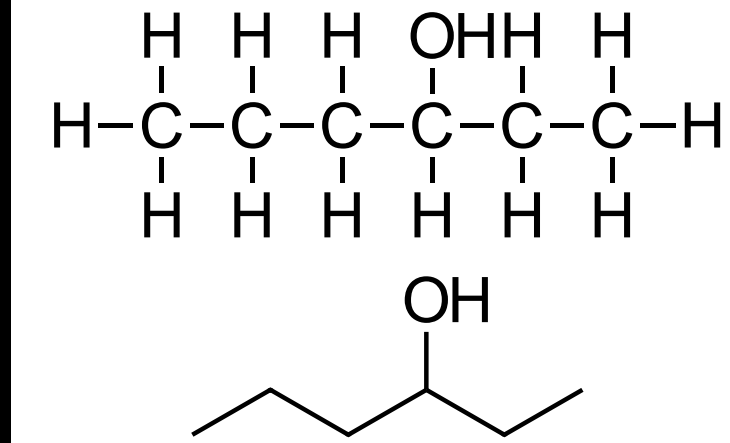
$CH_3CH_2CH_2CH_2CH(OH)CH_3$



Hexan-1-ol

$C_6H_{13}OH$

$CH_3CH_2CH_2CH(OH)CH_2CH_3$



Hexan-2-ol

$C_6H_{13}OH$

Hexan-3-ol

$C_6H_{13}OH$

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Tutorials for IB Chemistry

Naming aldehydes and ketones

Naming aldehydes and ketones

Aldehydes and ketones both contain a carbonyl group (C=O).

Aldehydes contain an aldehyde group (R-CHO) and ketones contain a ketone group (R-CO-R).

Aldehydes undergo oxidation to form carboxylic acids.

Ketones do not undergo oxidation.

Both are polar molecules because of the difference in electronegativity between the C and O of the carbonyl group.

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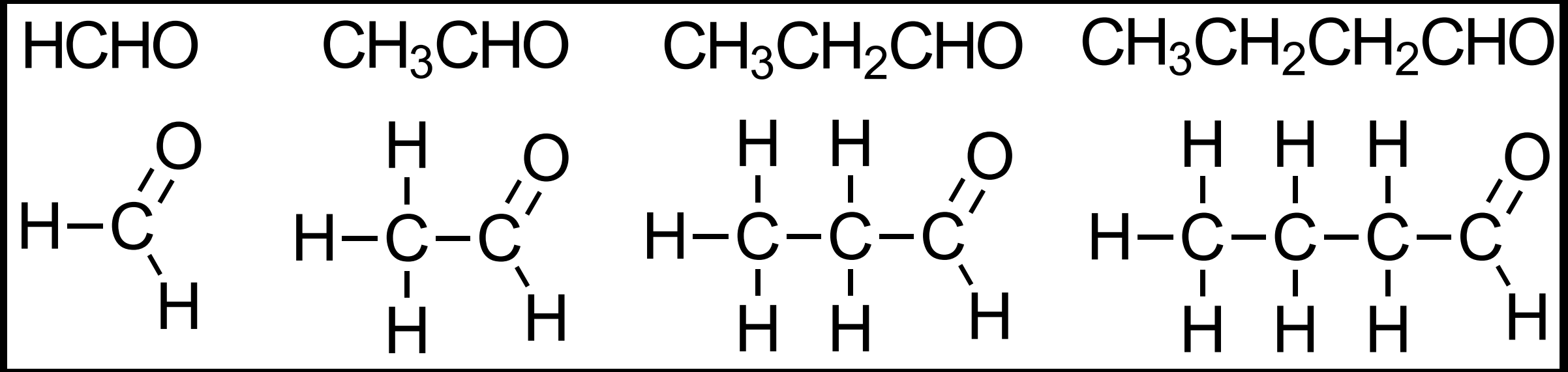
Naming aldehydes and ketones



Methanal
CH_2O

Ethanal
C_2H_4O

Propanal
C_3H_6O

Butanal
C_4H_7O

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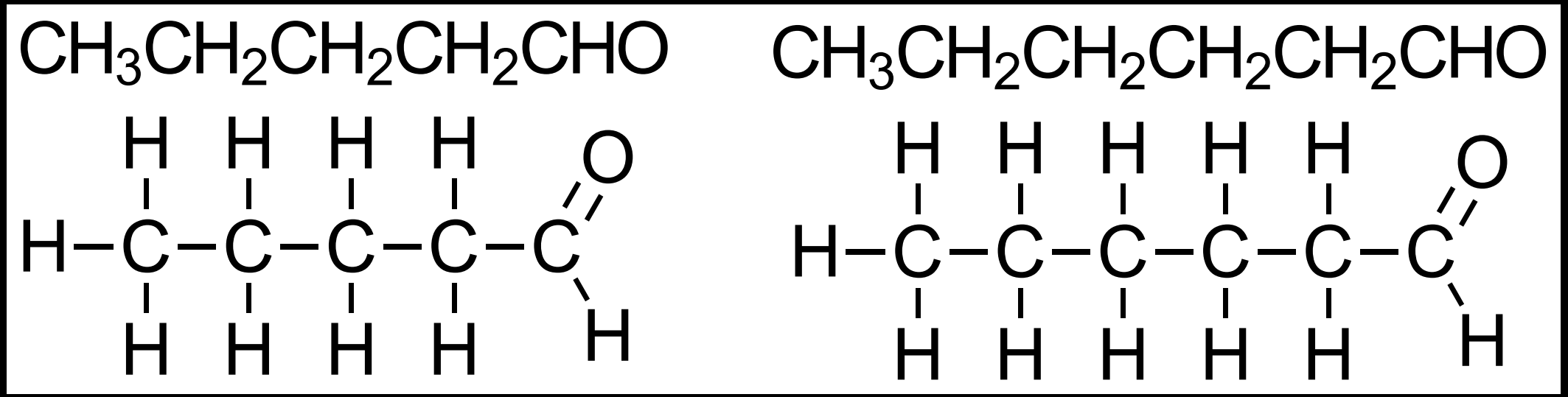
Naming aldehydes and ketones



Pentanal

$C_5H_{10}O$

Hexanal

$C_6H_{12}O$

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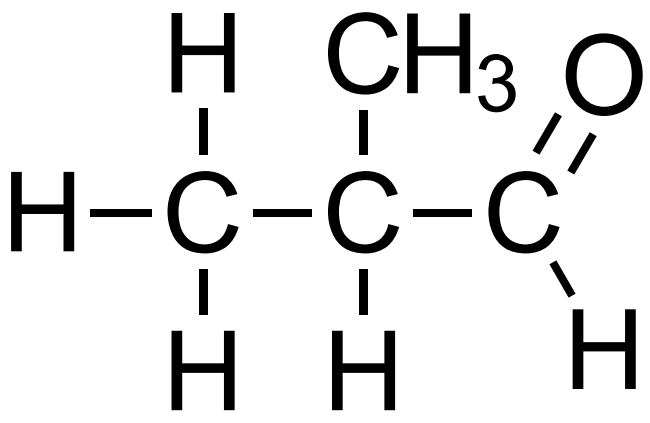
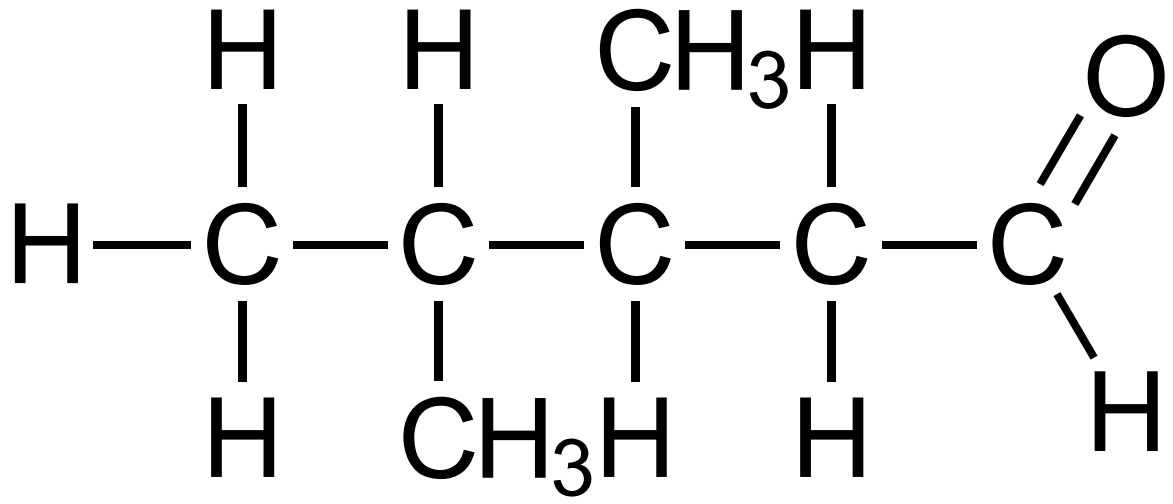
Naming aldehydes and ketones

$(CH_3)_2CHCHO$



2-methylpropanal

$(CH_3)_2CHCH(CH_3)CH_2CHO$



3,4-dimethylpentanal

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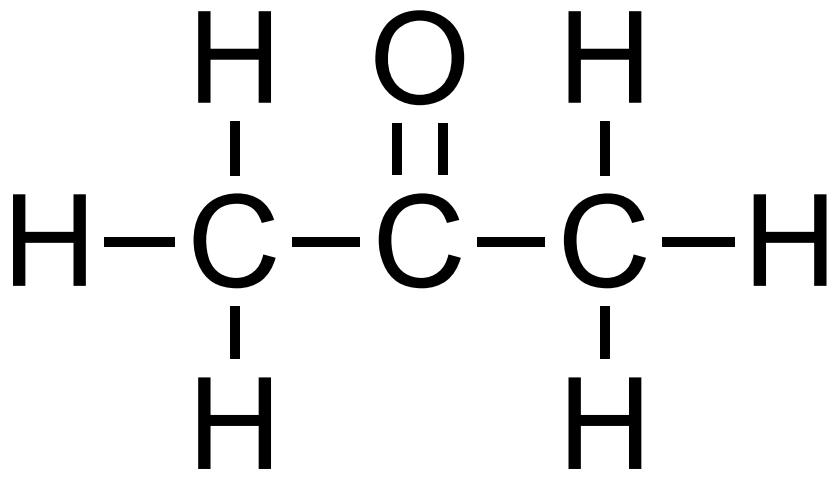
Naming aldehydes and ketones

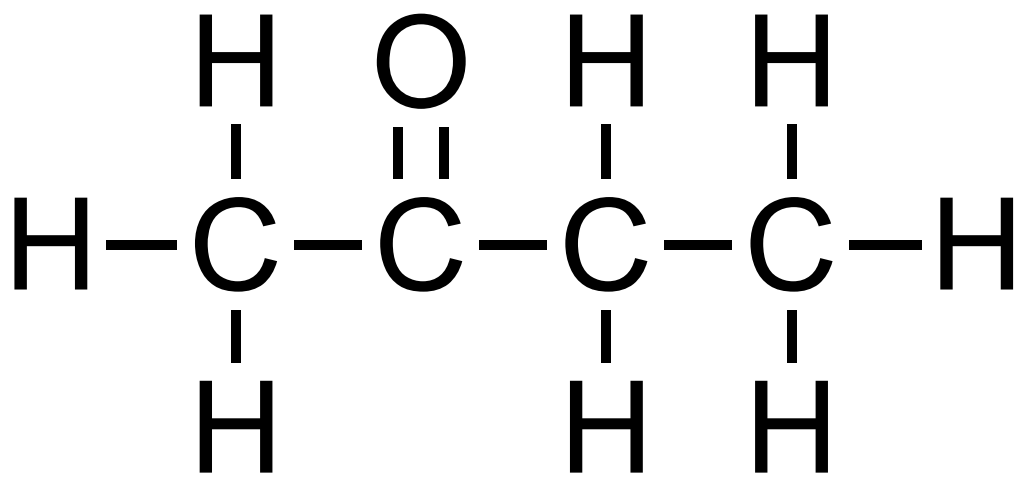
CH_3COCH_3



Propanone

C_3H_6O

$CH_3COCH_2CH_3$



Butan-2-one

C_4H_8O

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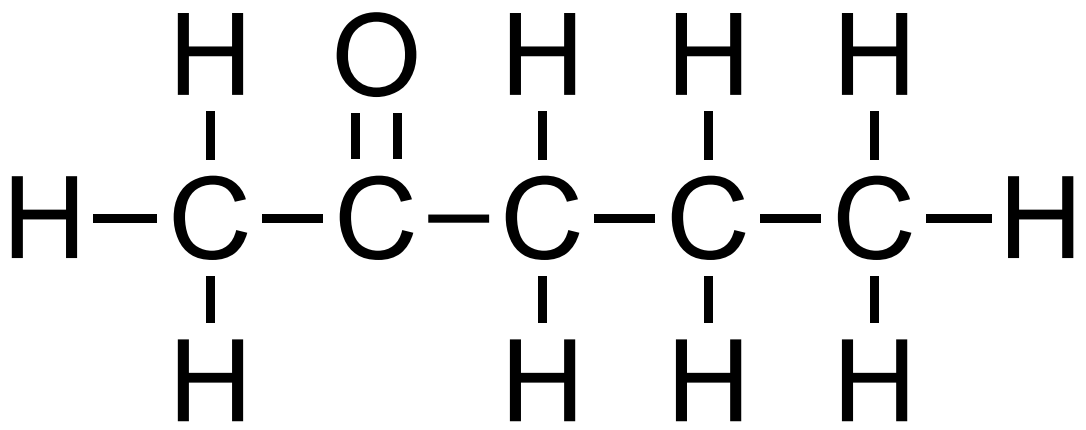
Naming aldehydes and ketones

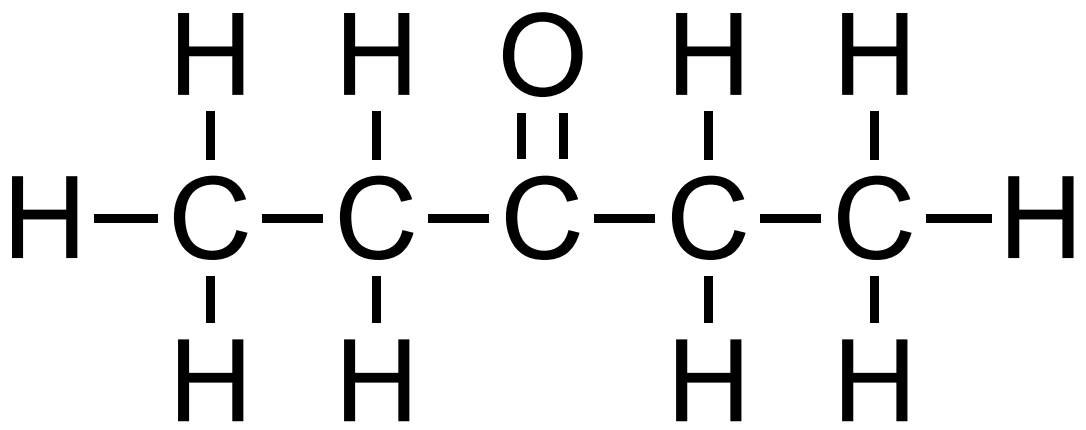
$CH_3COCH_2CH_2CH_3$



Pentan-2-one

$C_5H_{10}O$

$CH_3CH_2COCH_2CH_3$



Pentan-3-one

$C_5H_{10}O$

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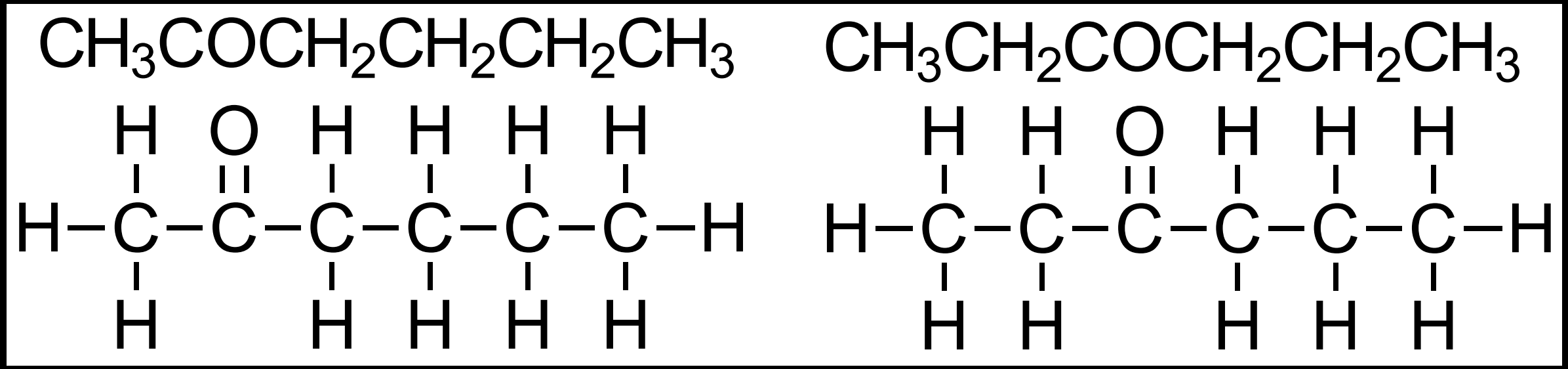
Naming aldehydes and ketones



Hexan-2-one

$C_6H_{12}O$

Hexan-3-one

$C_6H_{12}O$

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Tutorials for IB Chemistry

Naming carboxylic acids

Naming carboxylic acids

Carboxylic acids are organic acids that contain the carboxyl functional group (COOH or CO_2H).

They have the general formula $C_nH_{2n+1}COOH$.

Carboxylic acids can be produced by the complete oxidation of a primary alcohol.

They undergo nucleophilic substitution reactions with alcohols to produce esters.

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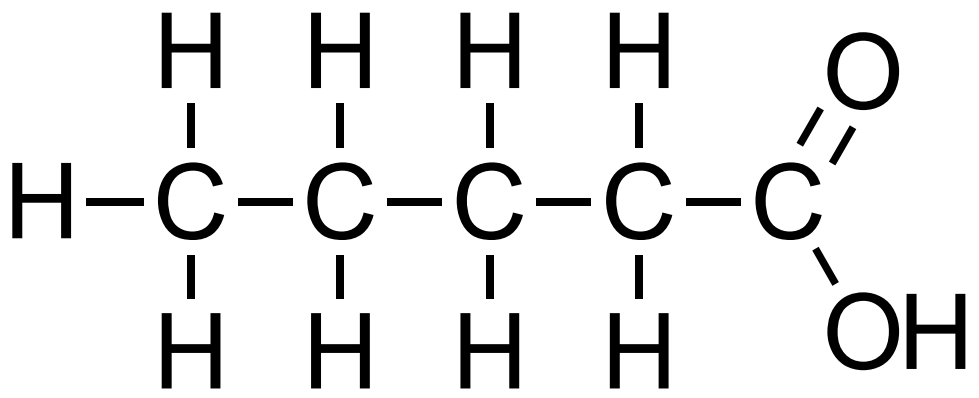
Naming carboxylic acids

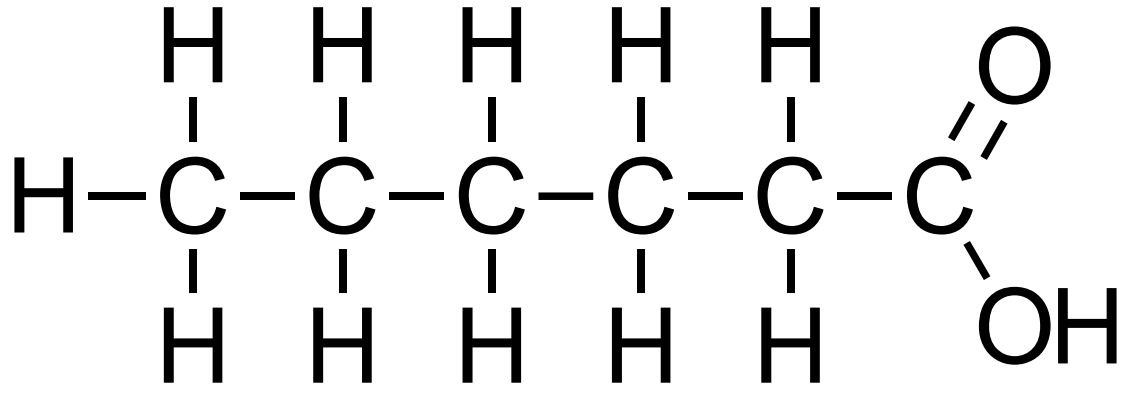
$CH_3CH_2CH_2CH_2COOH$



Pentanoic acid

C_4H_9COOH

$CH_3CH_2CH_2CH_2CH_2COOH$



Hexanoic acid

$C_5H_{11}COOH$

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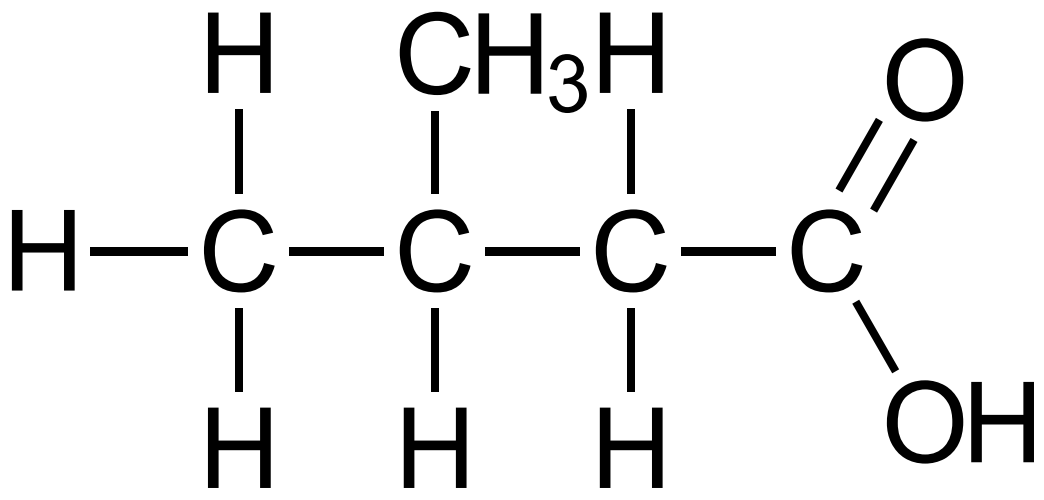
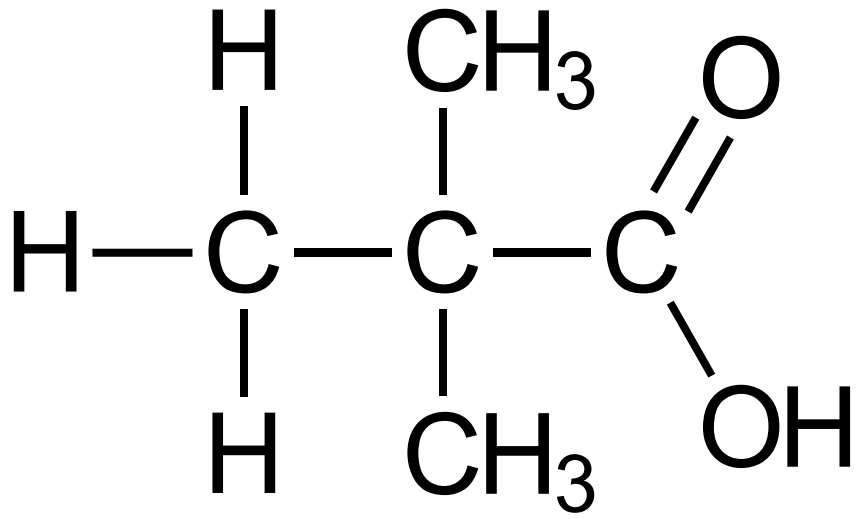
Naming carboxylic acids

$(CH_3)_2CHCH_2COOH$



3-methylbutanoic acid

$CH_3C(CH_3)_2COOH$



2,2-dimethylpropanoic acid

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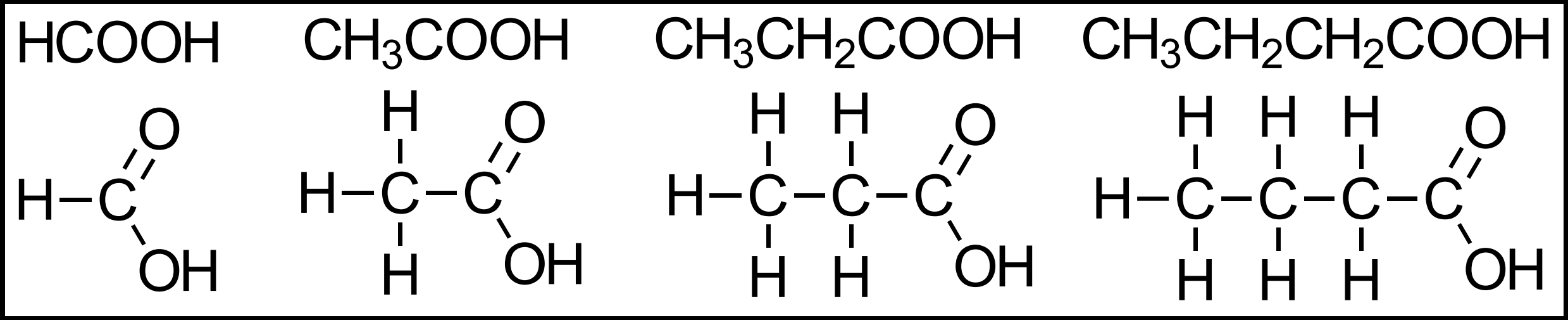
Naming carboxylic acids



Methanoic acid
HCOOH

Ethanoic acid
CH_3COOH

Propanoic acid
C_2H_5COOH

Butanoic acid
C_3H_7COOH

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Naming halogenoalkanes

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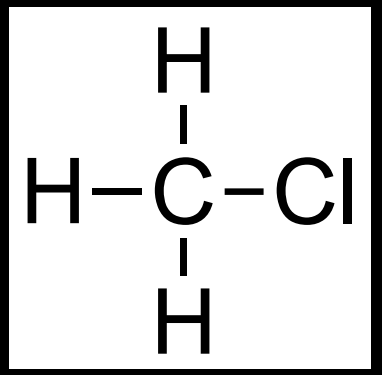
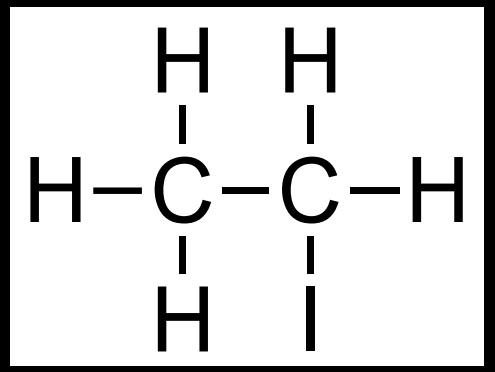
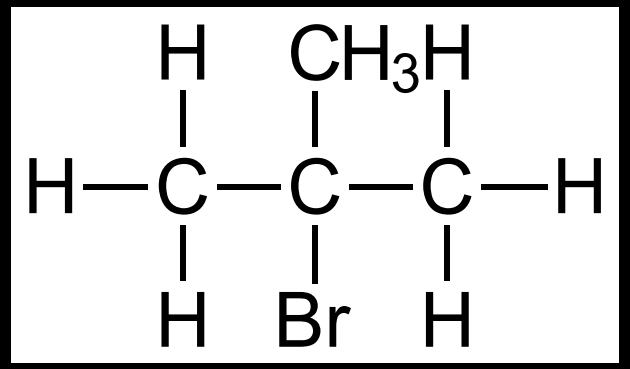
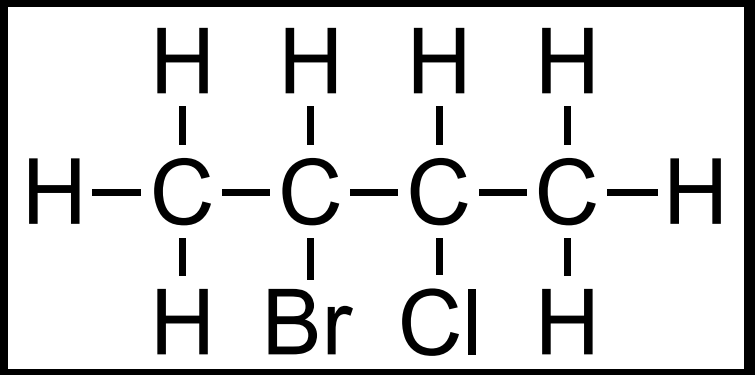
Naming halogenoalkanes

Halogenoalkanes are alkanes in which one (or more) hydrogen atoms have been replaced with halogen atoms (fluorine, chlorine, bromine, iodine).









Halogenoalkanes are produced in nucleophilic substitution reactions with alkanes and electrophilic addition reactions with alkenes.

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Naming halogenoalkanes

The root is based on the longest chain containing the halogen atom.
The halogen atom defines the halo prefix.
The chain is numbered to give the halogen the lowest possible number.

Halogen	Prefix
Fluorine	Fluoro-
Chlorine	Chloro-
Bromine	Bromo-
Iodine	Iodo-

Number of C atoms in the longest chain containing the halogen atom	Root/stem
1	methane
2	ethane
3	propane
4	butane
5	pentane
6	hexane

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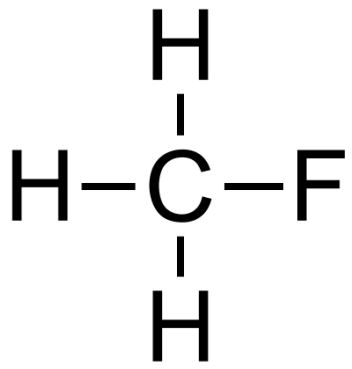
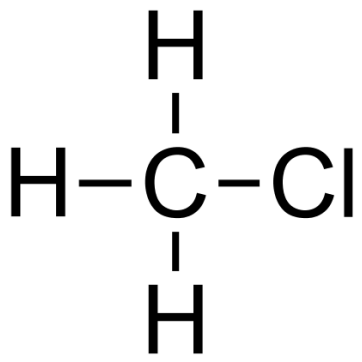
Naming halogenoalkanes



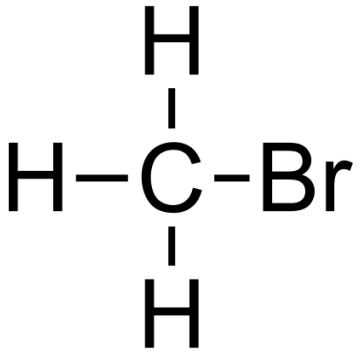
CH_3F

Fluoromethane



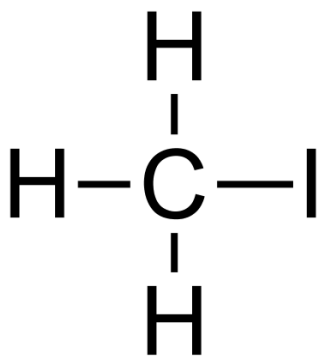
CH_3Cl

Chloromethane



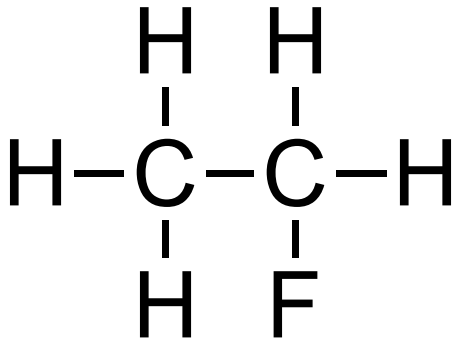
CH_3Br

Bromomethane



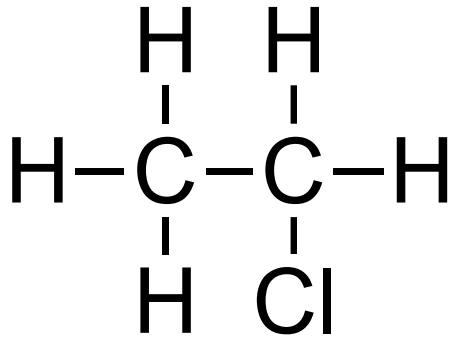
CH_3I

Iodomethane



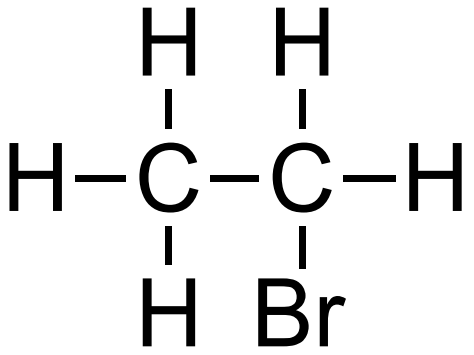
CH_3CH_2F

Fluoroethane



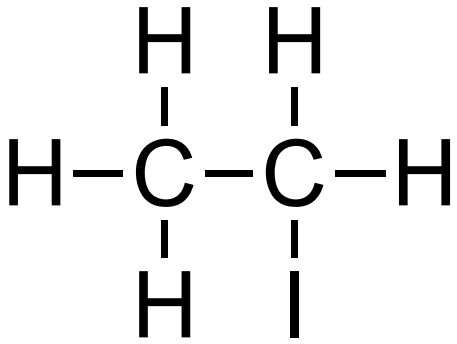
CH_3CH_2Cl

Chloroethane



CH_3CH_2Br

Bromoethane



CH_3CH_2I

Iodoethane

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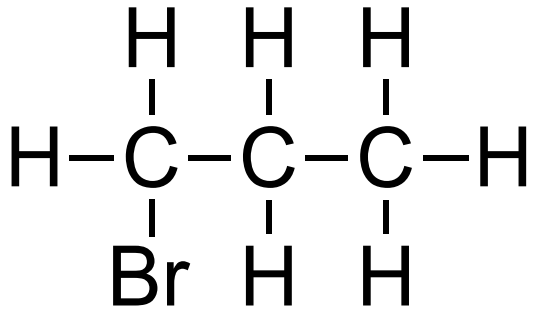
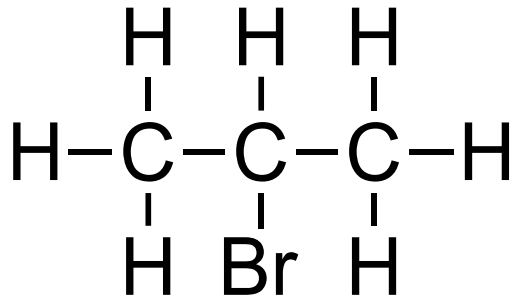
Naming halogenoalkanes



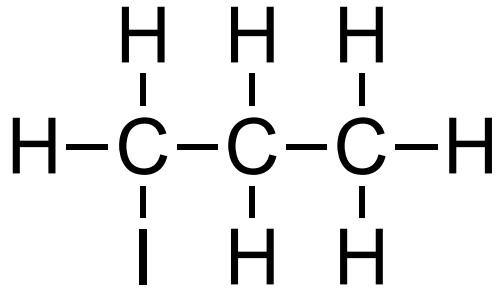
$CH_2BrCH_2CH_3$

1-bromopropane



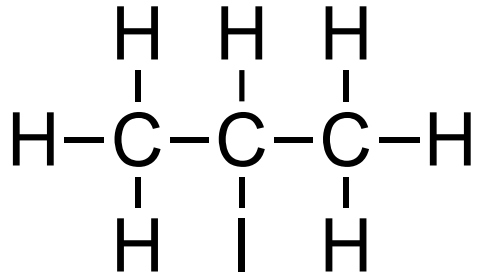
$CH_3CHBrCH_3$

2-bromopropane



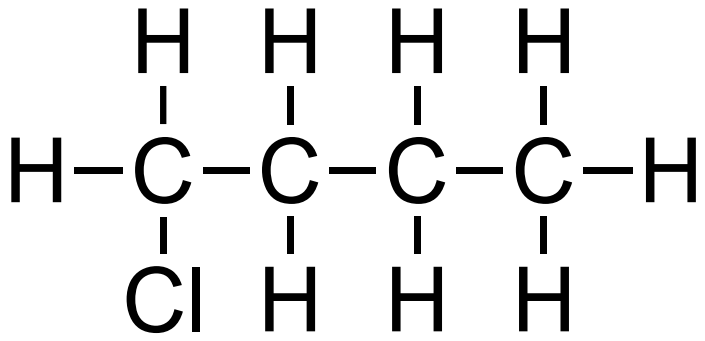
$CH_2ICH_2CH_3$

1-iodopropane



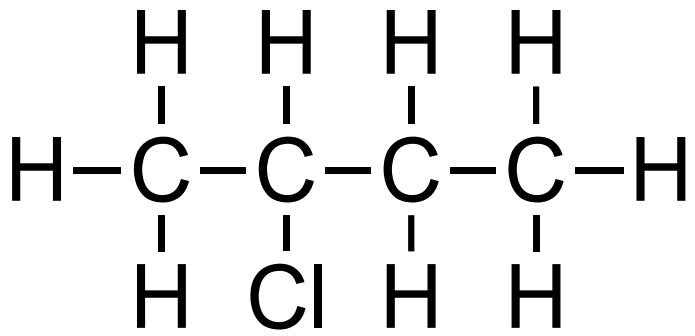
CH_3CHICH_3

2-iodopropane



$CH_2ClCH_2CH_2CH_3$

1-chlorobutane



$CH_3CHClCH_2CH_3$

2-chlorobutane

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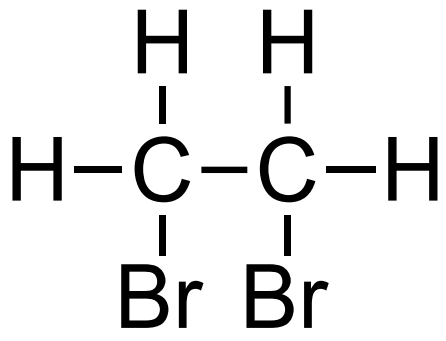
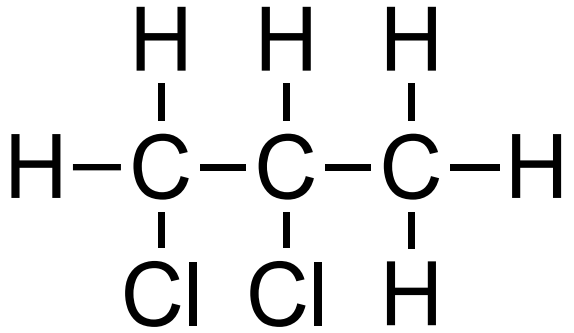
Naming halogenoalkanes



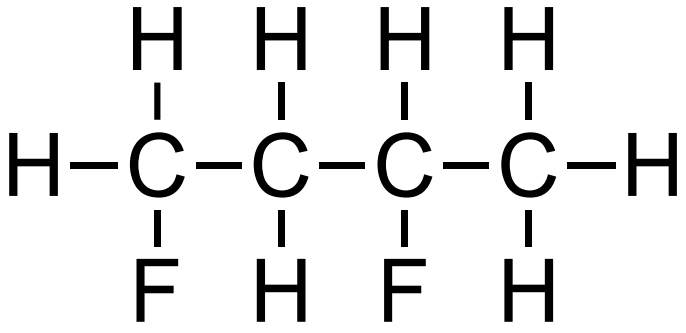
CH_2BrCH_2Br

1,2-dibromoethane



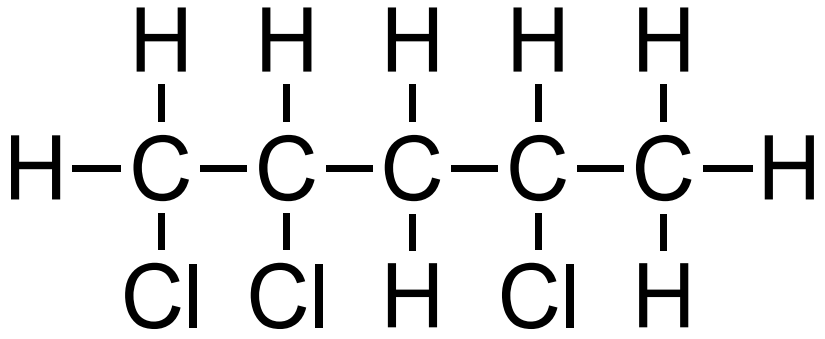
$CH_2ClCHClCH_3$

1,2-dichloropropane



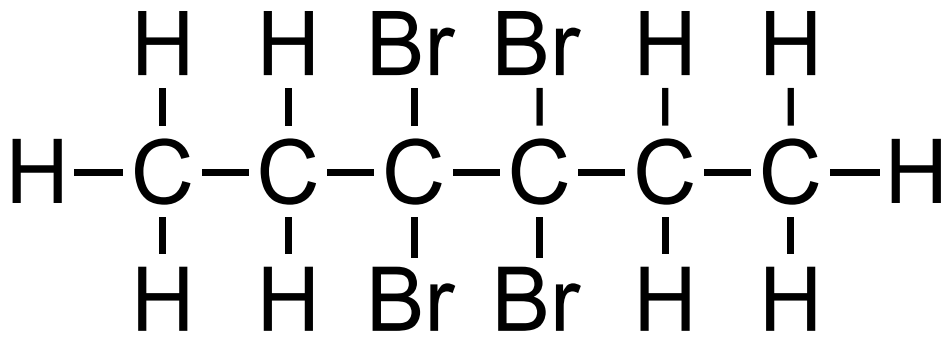
$CH_2FCH_2CHFCH_3$

1,3-difluorobutane



$C_5H_9Cl_3$

1,2,4-trichloropentane



$C_6H_{10}Br_4$

3,3,4,4-tetrabromohexane

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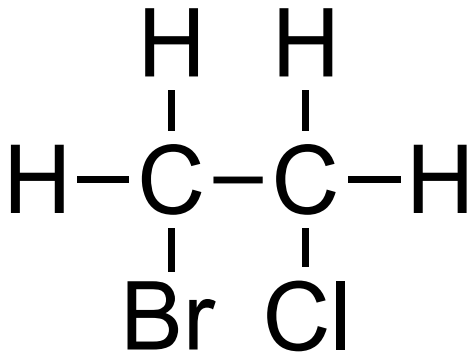
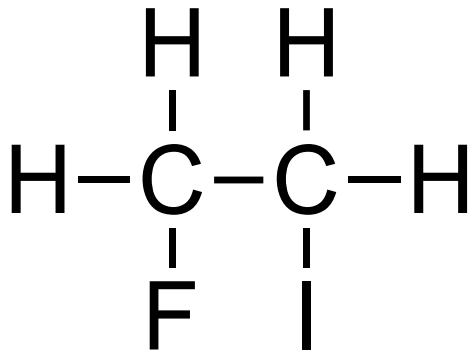


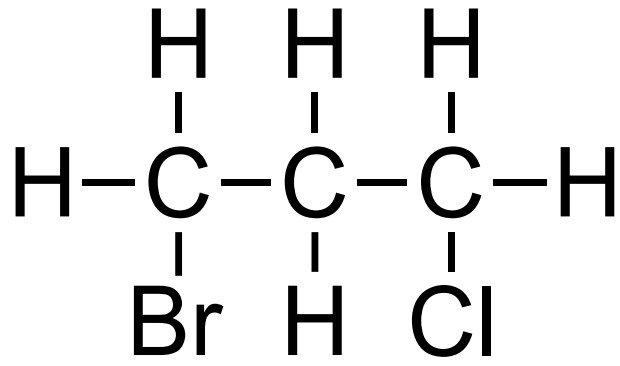
CH_2BrCH_2Cl

1-bromo-2-chloroethane



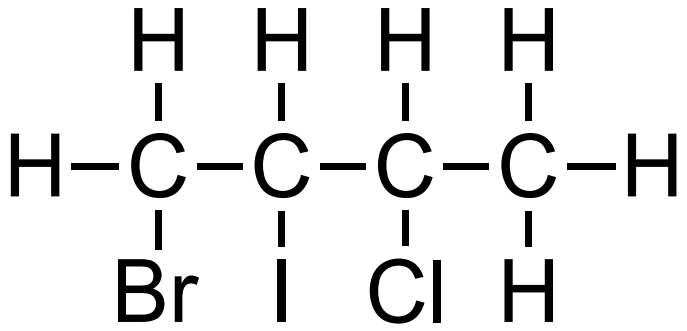
CH_2FCH_2I

1-fluoro-2-iodoethane



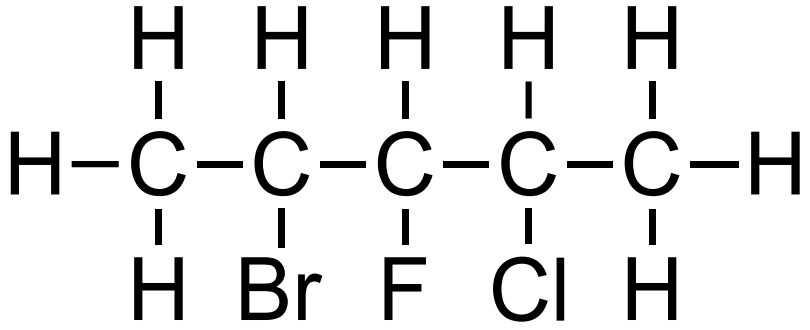
$CH_2BrCH_2CH_2Cl$

1-bromo-3-chloropropane



C_4H_7BrClI

1-bromo-3-chloro-2-iodobutane



C_5H_9BrClF

2-bromo-4-chloro-3-fluoropentane

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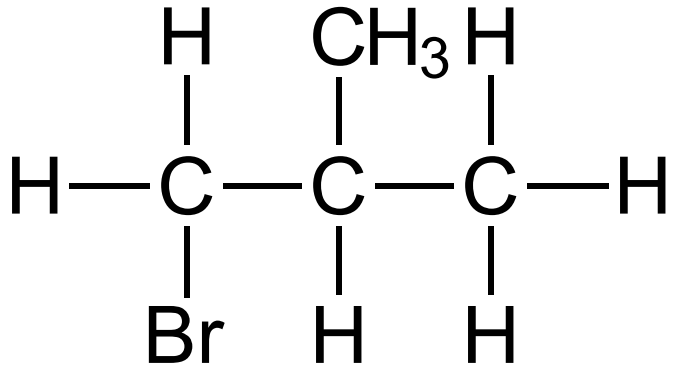
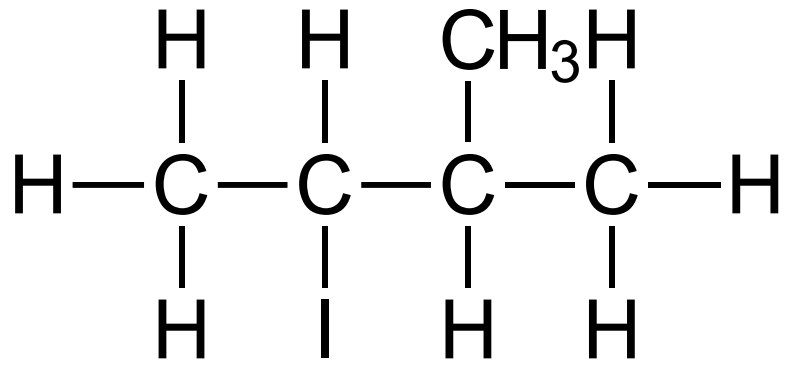


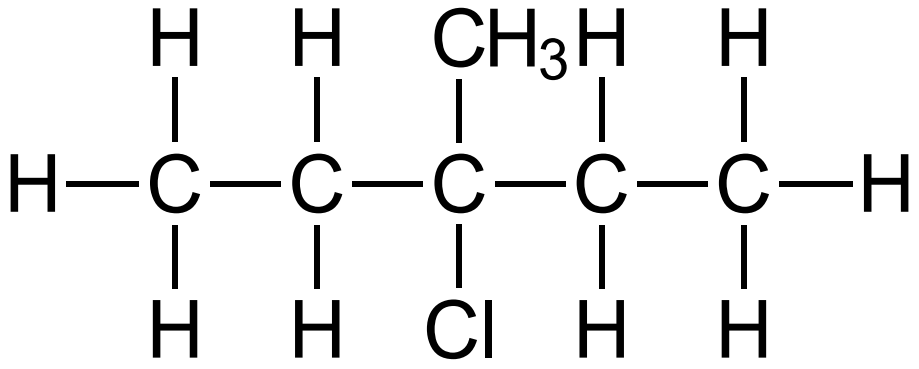
$CH_2BrCH(CH_3)CH_3$

1-bromo-2-methylpropane



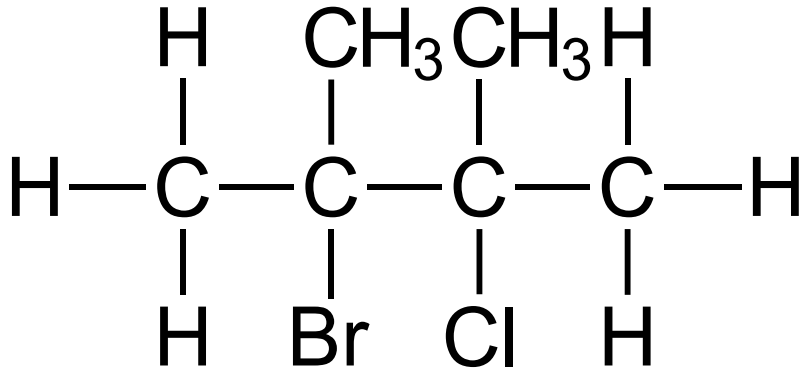
$CH_3CHICH(CH_3)CH_3$

2-iodo-3-methylbutane



$CH_3CH_2CCl(CH_3)CH_2CH_3$

3-chloro-3-methylpentane



$CH_3CBr(CH_3)CCl(CH_3)CH_3$

2-bromo-3-chloro-2,3-dimethylbutane

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Diols and dicarboxylic acids

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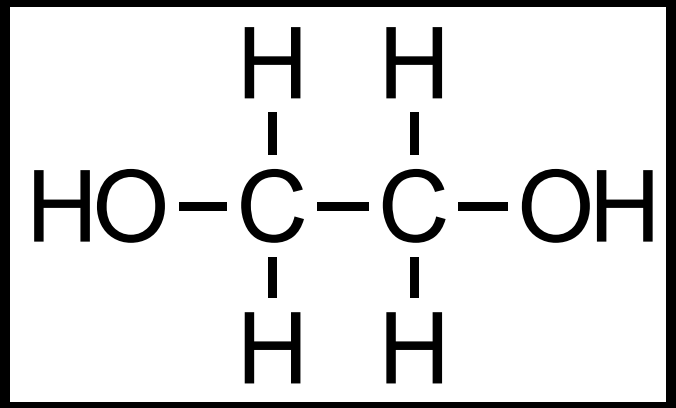
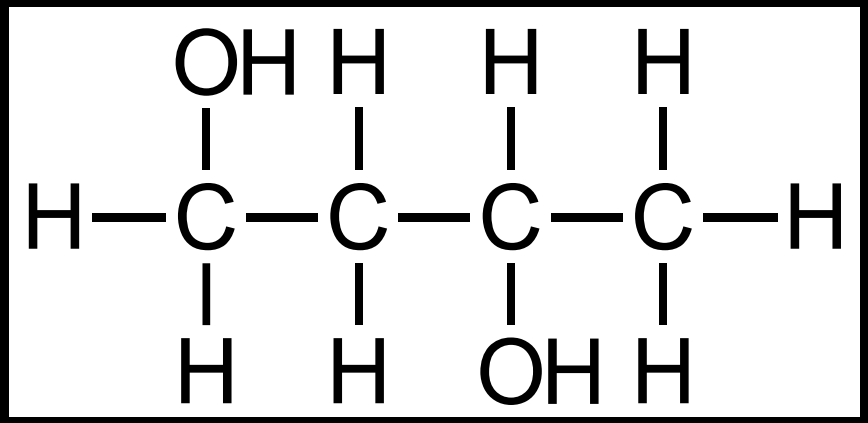
Diols

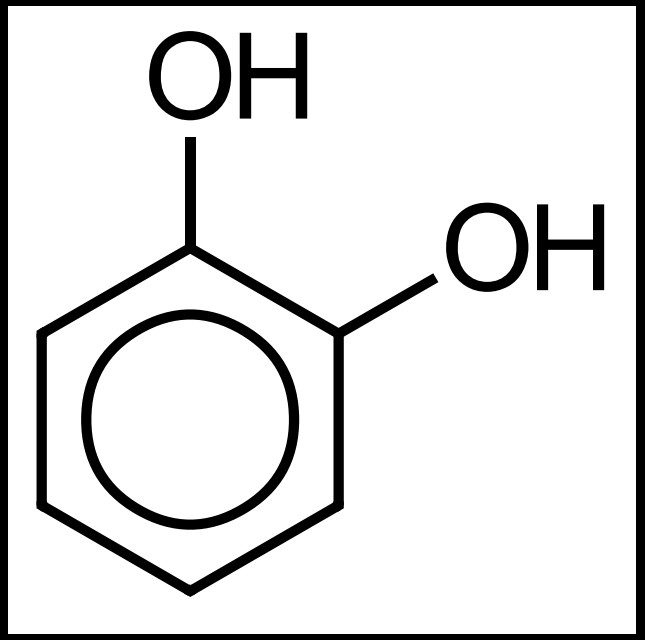
A diol is a compound that contains two hydroxyl (OH) groups.



Ethane-1,2-diol



Butane-1,3-diol



Benzene-1,2-diol

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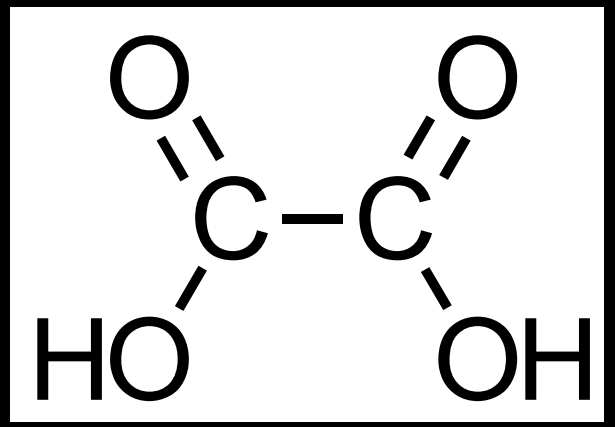
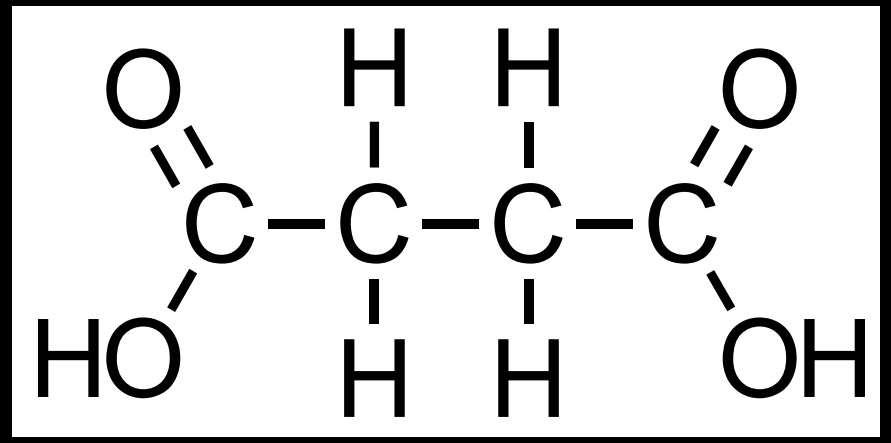
Dicarboxylic acids

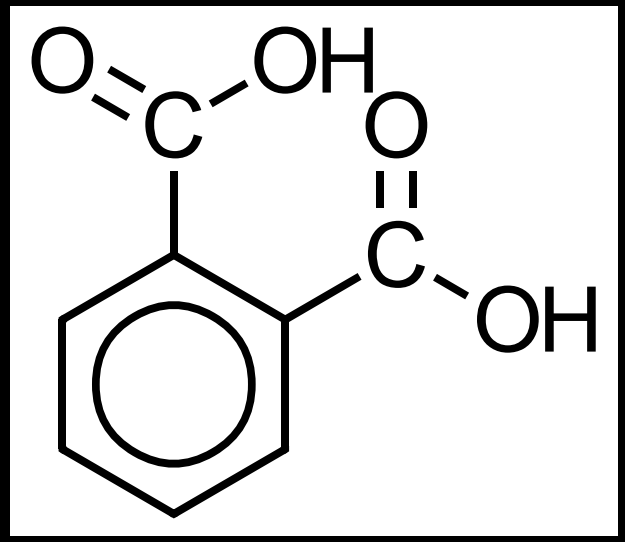
A dicarboxylic acid is a compound that contains two carboxyl (COOH) groups.



Ethanedioic acid



Butanedioic acid



Benzene-1,2-dicarboxylic acid

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Naming unsaturated compounds

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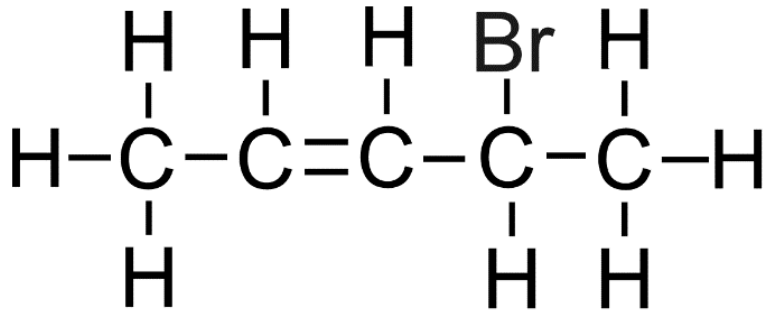
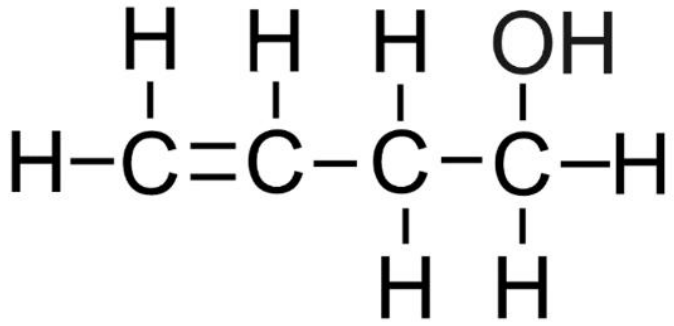
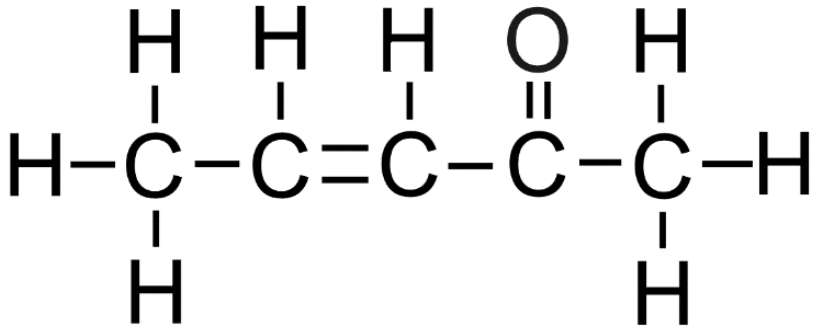
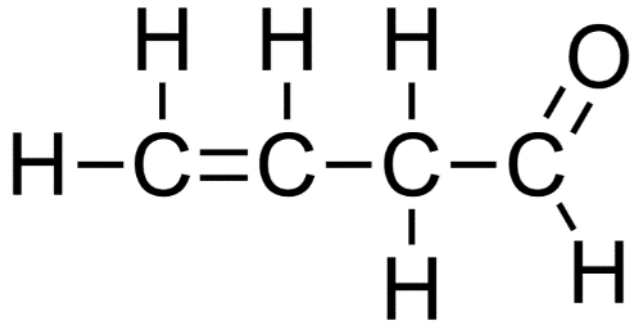
Naming unsaturated compounds

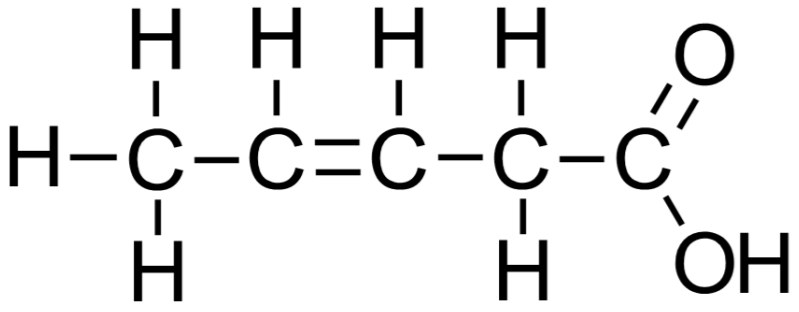
Apply IUPAC nomenclature to mono-unsaturated compounds that have up to six carbon atoms in the parent chain and contain one type of the following functional groups: halogeno, hydroxyl, carbonyl, carboxyl.











Naming unsaturated compounds

Priority	Class / functional group	Suffix / prefix
1	Carboxylic acid / carboxyl	-oic acid
2	Aldehyde / carbonyl	-al
3	Ketone / carbonyl	-one
4	Alcohol / hydroxyl	-ol
5	Alkene	-ene
6	Halogenoalkane / halogeno	chloro / bromo / iodo

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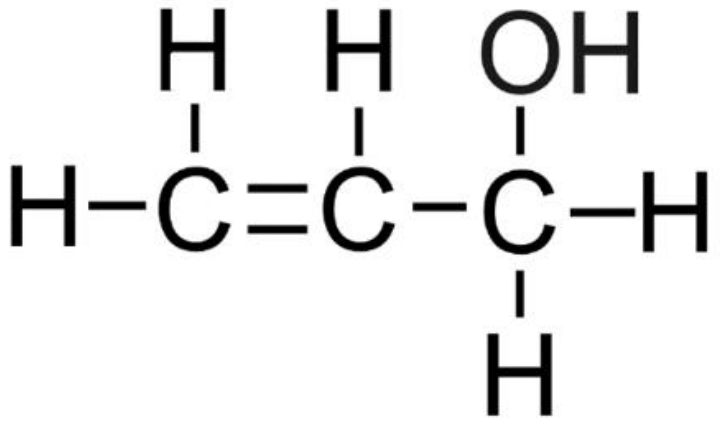
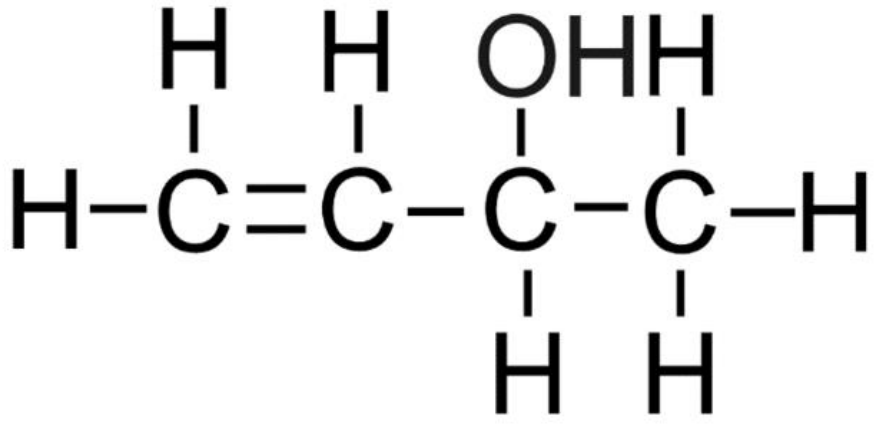
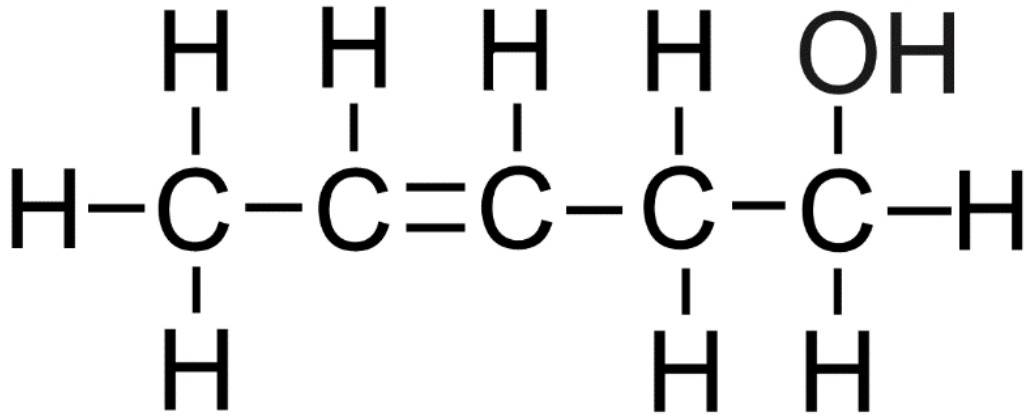
Naming unsaturated compounds



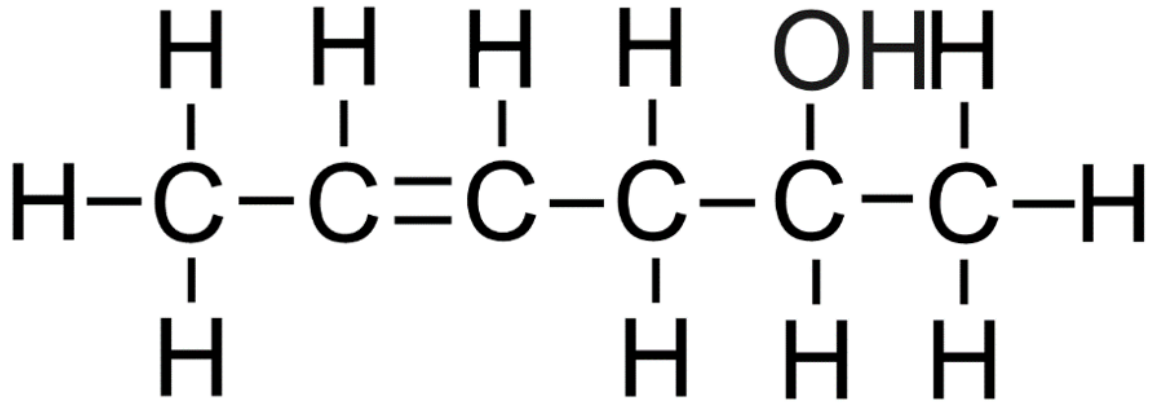
Prop-2-en-1-ol



But-3-en-2-ol



Pent-3-en-1-ol



Hex-4-en-2-ol

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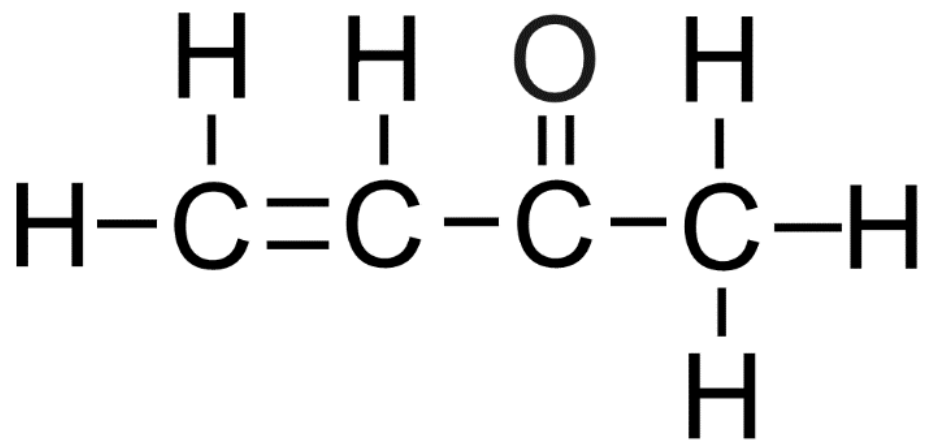
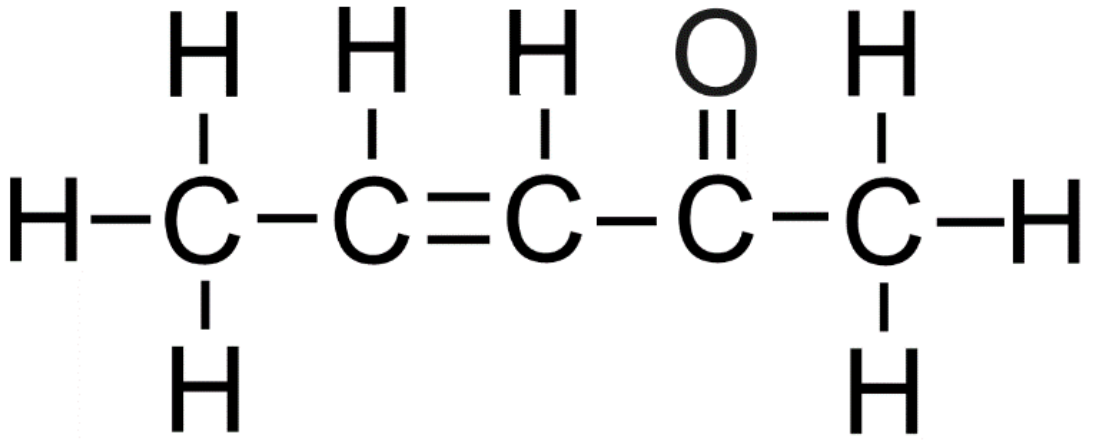
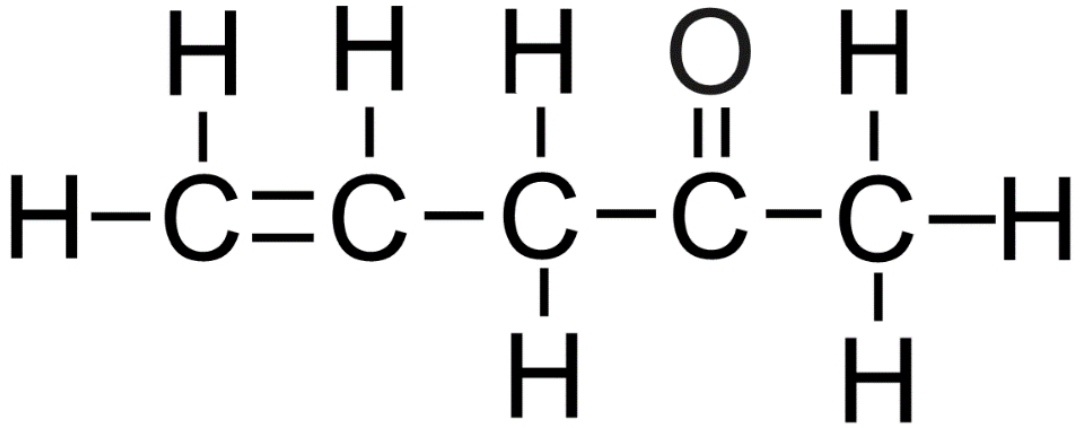
Naming unsaturated compounds



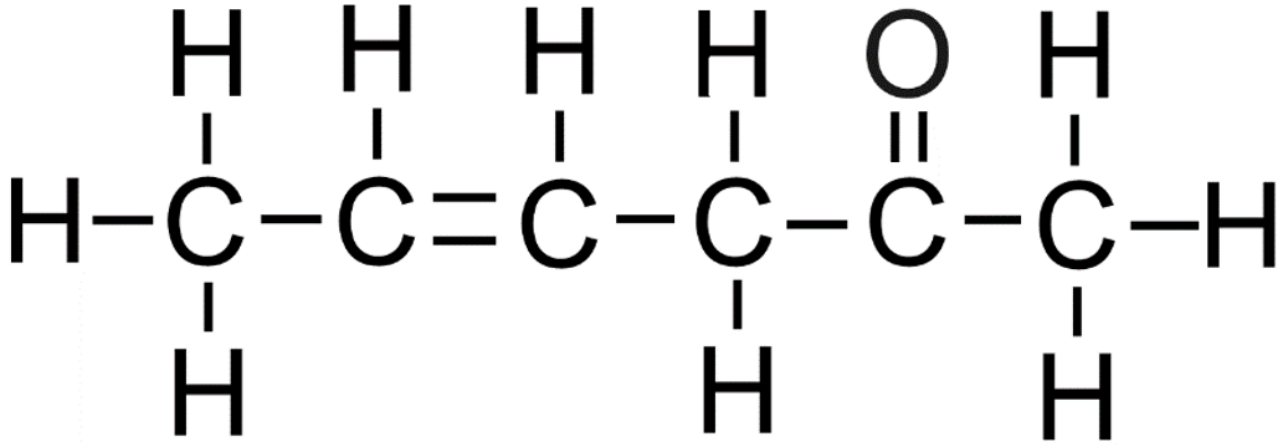
But-3-en-2-one



Pent-3-en-2-one



Pent-4-en-2-one



Hex-4-en-2-one

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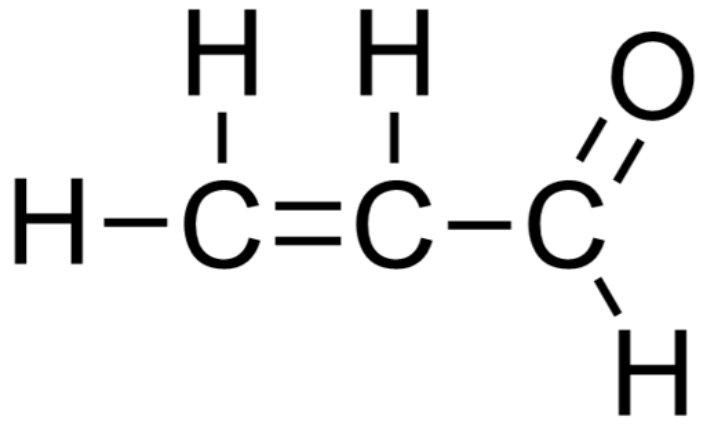
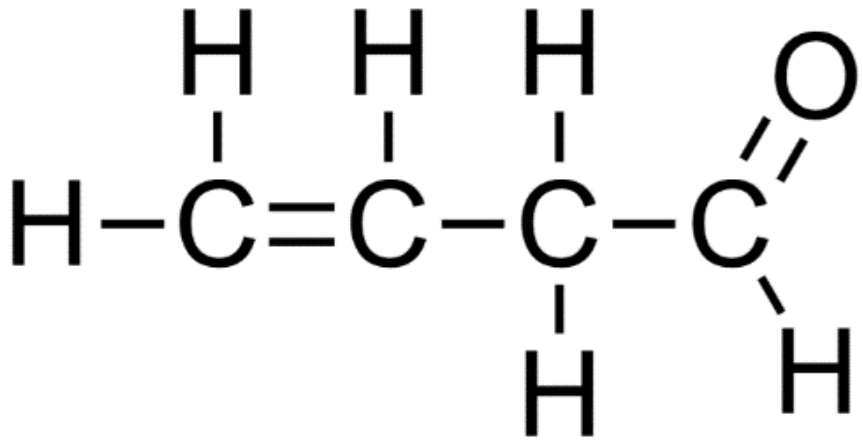
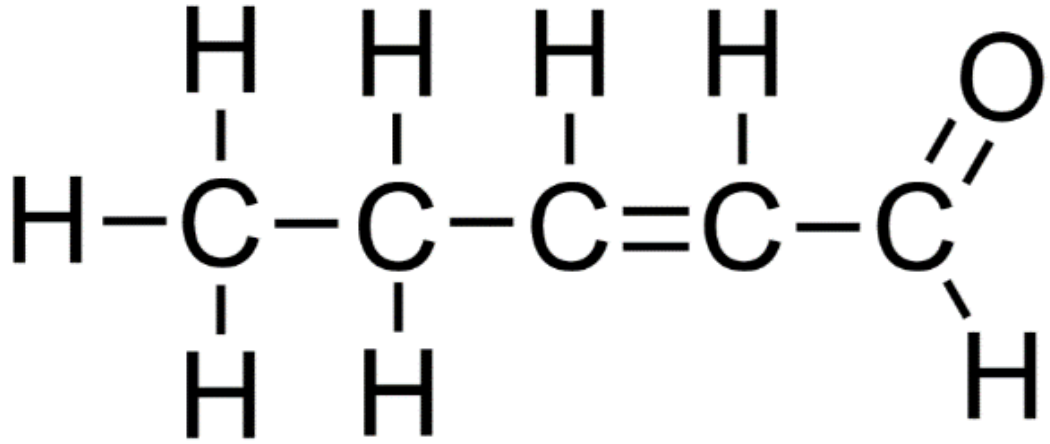
Naming unsaturated compounds



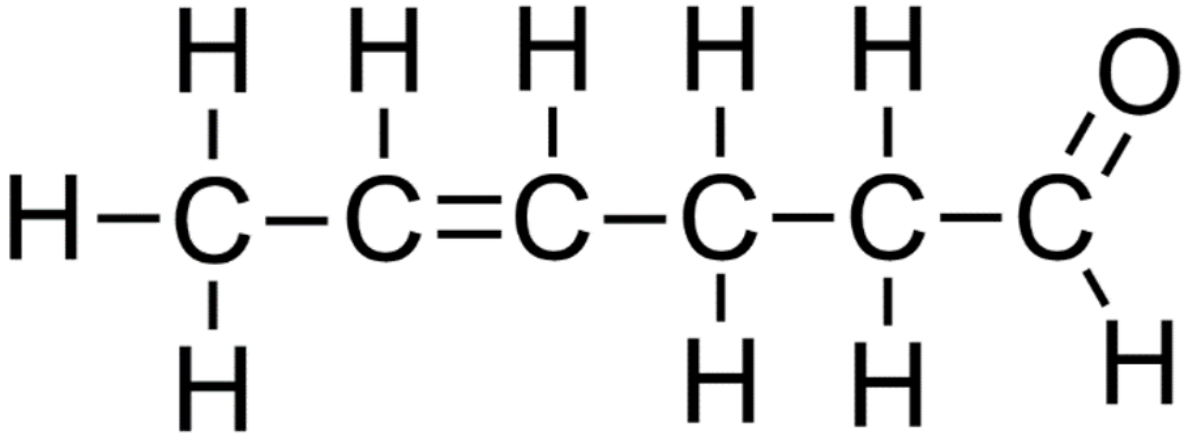
Prop-2-enal



But-3-enal



Pent-2-enal



Hex-4-enal

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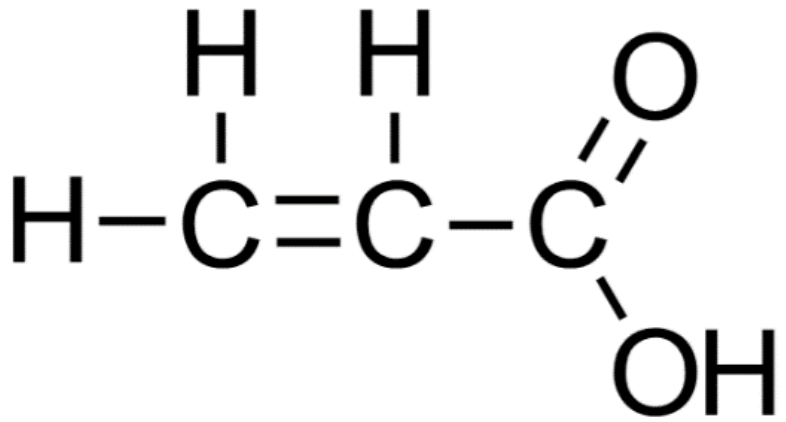
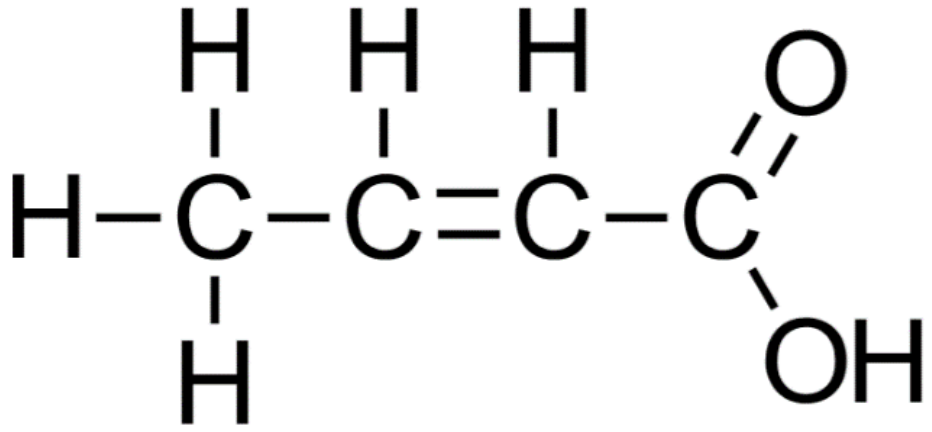
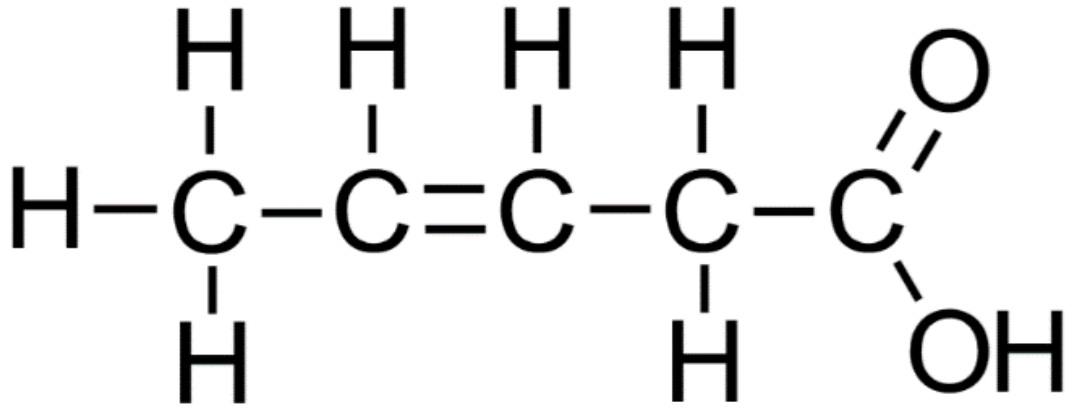
Naming unsaturated compounds



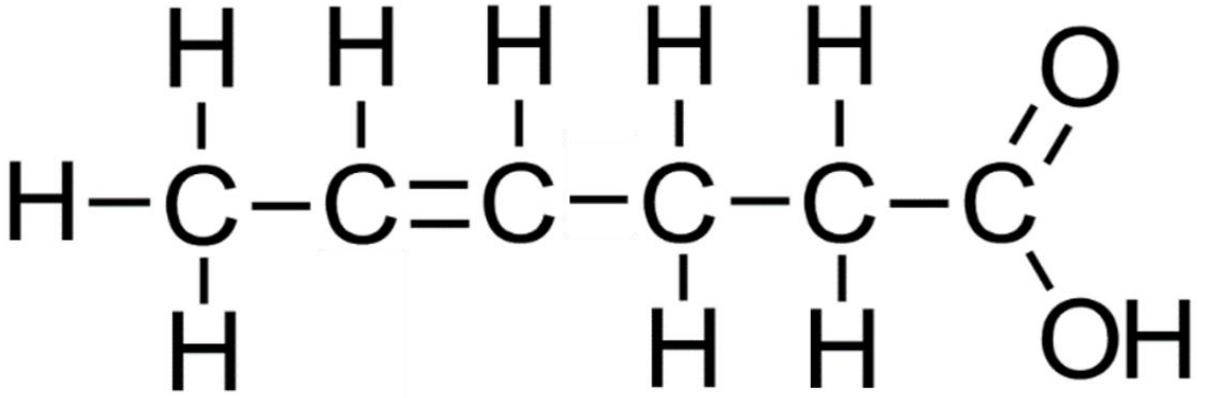
Prop-2-enoic acid



But-2-enoic acid



Pent-3-enoic acid



Hex-4-enoic acid

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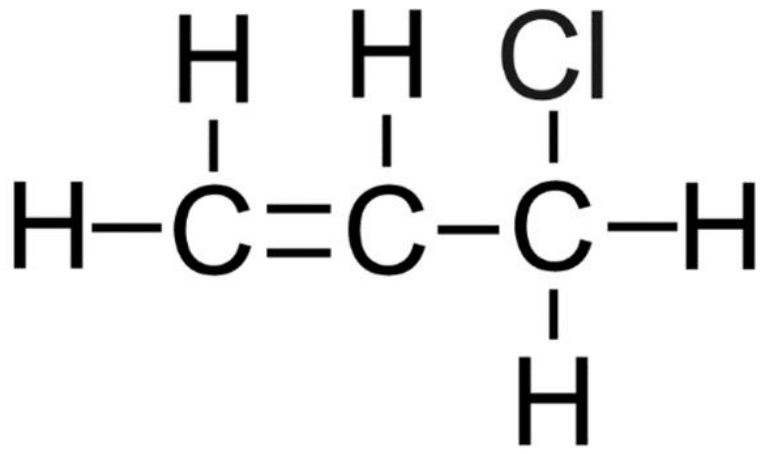
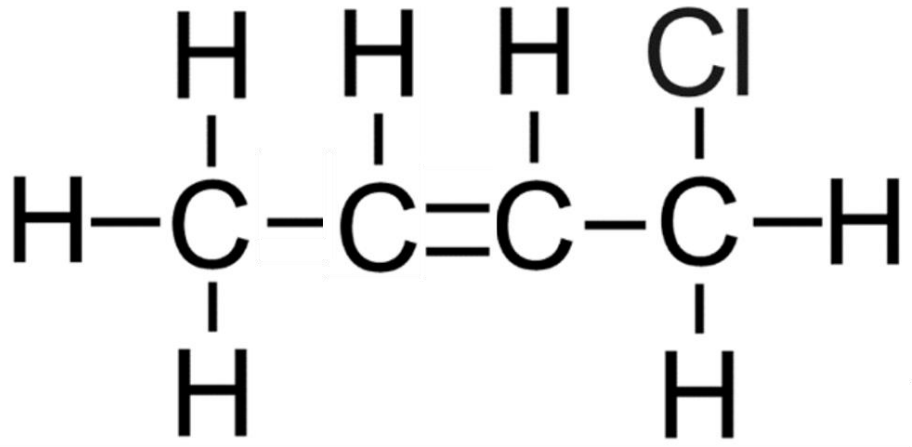
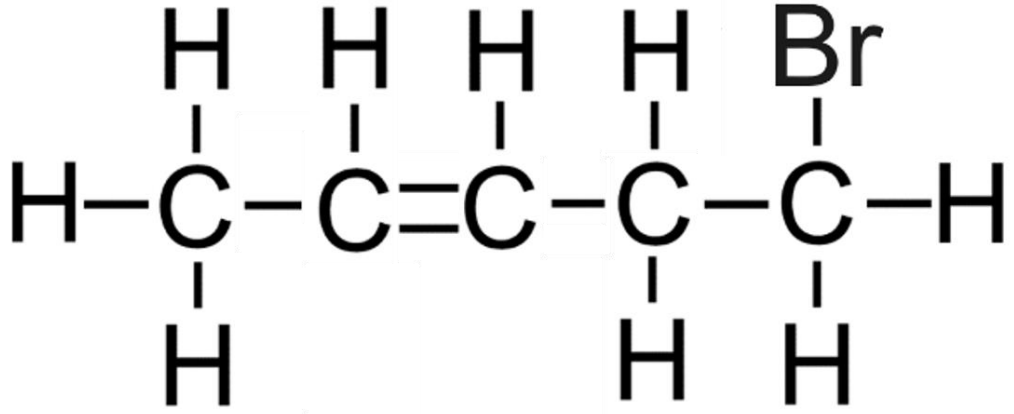
Naming unsaturated compounds



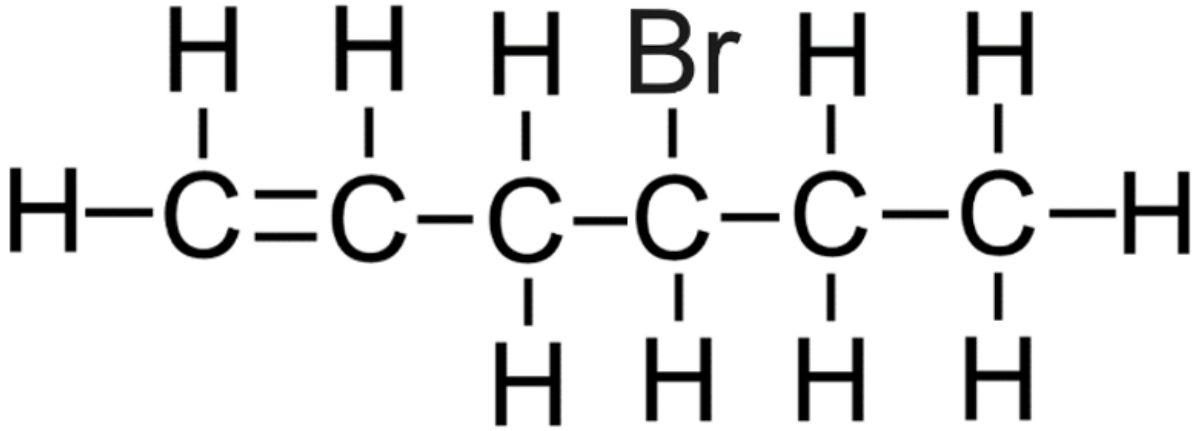
3-chloroprop-1-ene



1-chlorobut-2-ene



5-bromopent-2-ene



4-bromohex-1-ene

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Structural isomerism

Structural isomerism

Structural isomers are compounds with the same molecular formula but different arrangements of atoms (different structural formulas).

- Chain isomerism: straight-chain and branched-chain molecules
- Position isomerism: functional group attached in a different position
- Functional group isomerism: molecules with different functional groups

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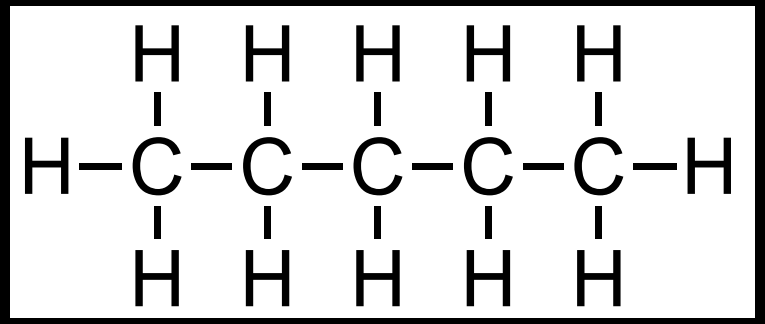
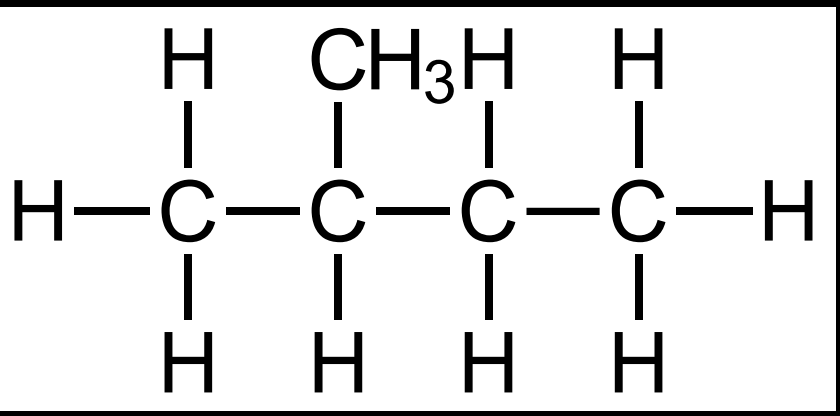
Structural isomerism

Structural isomers of C_5H_{12}



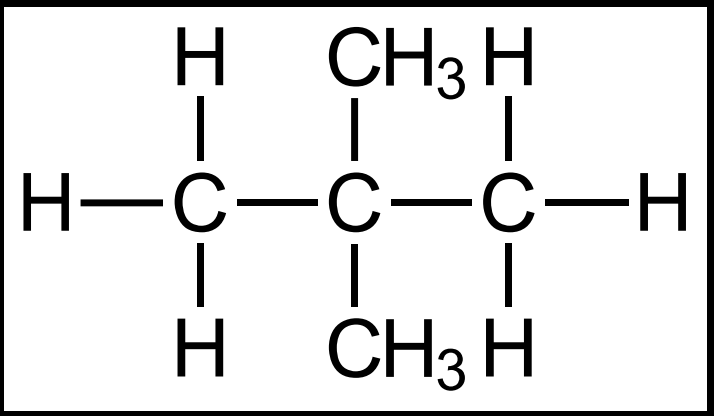
pentane

$CH_3(CH_2)_3CH_3$



2-methylbutane

$CH_3CH(CH_3)CH_2CH_3$



2,2-dimethylpropane

$CH_3C(CH_3)_2CH_3$

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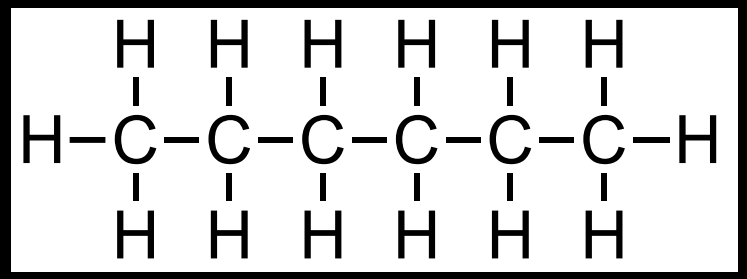
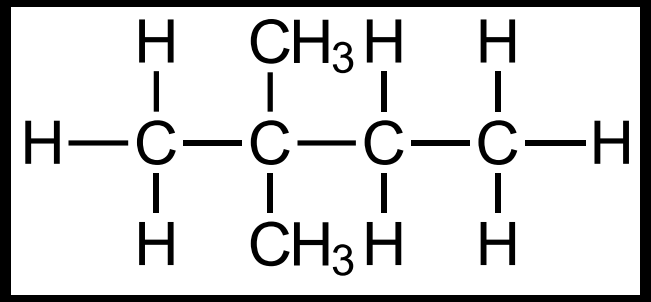
Structural isomerism

Structural isomers of C_6H_{14}



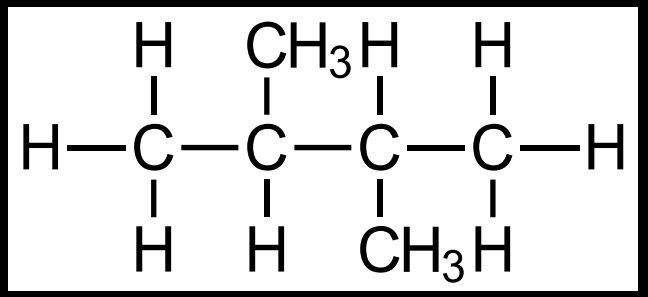
hexane

$CH_3(CH_2)_4CH_3$



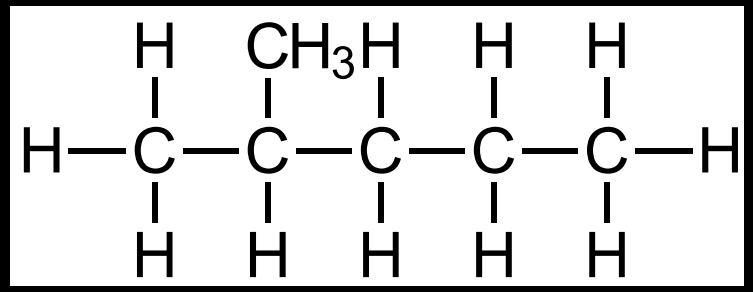
2,2-dimethylbutane

$(CH_3)_3CCH_2CH_3$



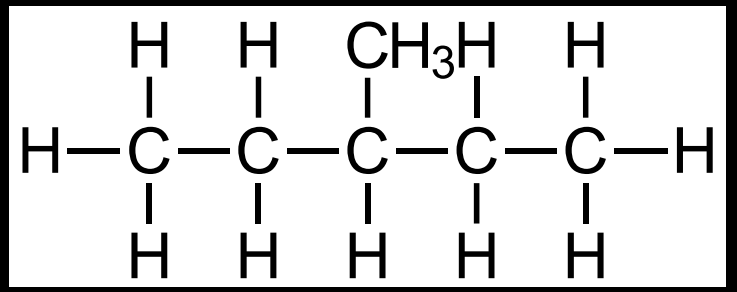
2,3-dimethylbutane

$(CH_3)_2CHCH(CH_3)_2$



2-methylpentane

$(CH_3)_2CHCH_2CH_2CH_3$



3-methylpentane

$CH_3CH_2CH(CH_3)CH_2CH_3$

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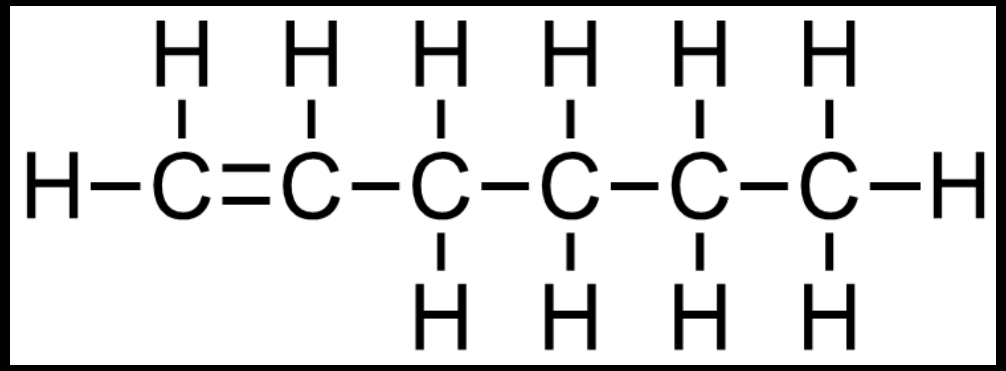
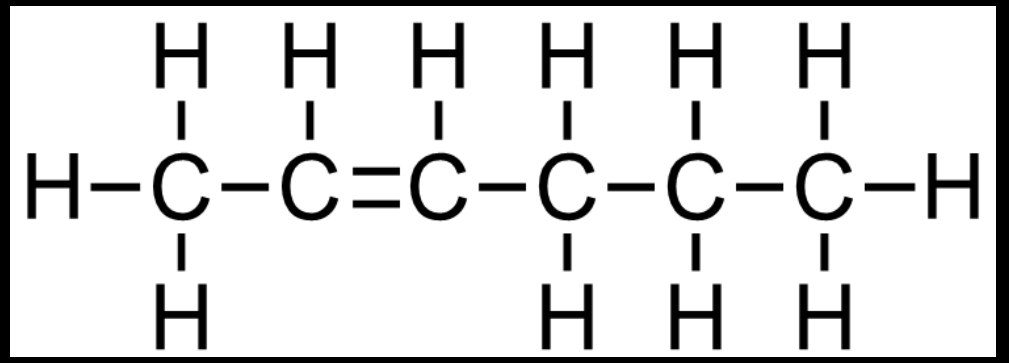
Structural isomerism

Structural isomers of C_6H_{12}



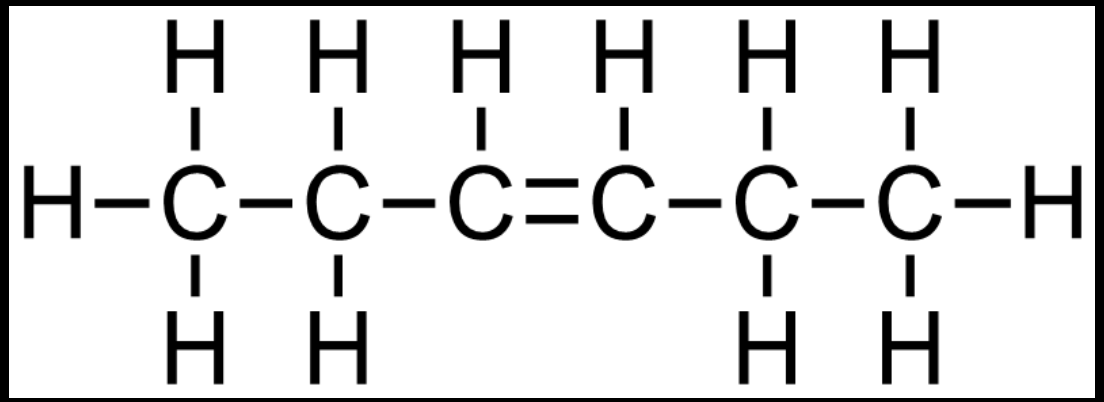
hex-1-ene

$CH_2CH(CH_2)_3CH_3$



hex-2-ene

$CH_3CHCH(CH_2)_2CH_3$



hex-3-ene

$CH_3CH_2CHCHCH_2CH_3$

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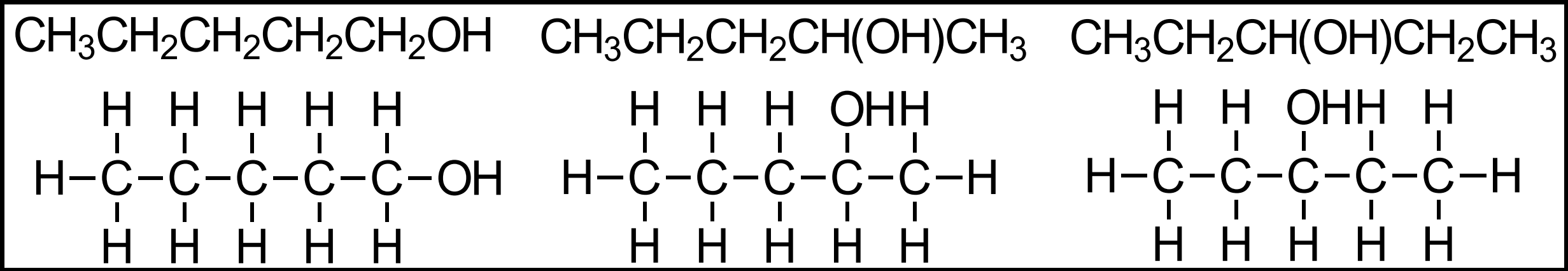
Structural isomerism

Structural isomers of $C_5H_{12}O$



Pentan-1-ol
$C_5H_{11}OH$

Pentan-2-ol
$C_5H_{11}OH$

Pentan-3-ol
$C_5H_{11}OH$

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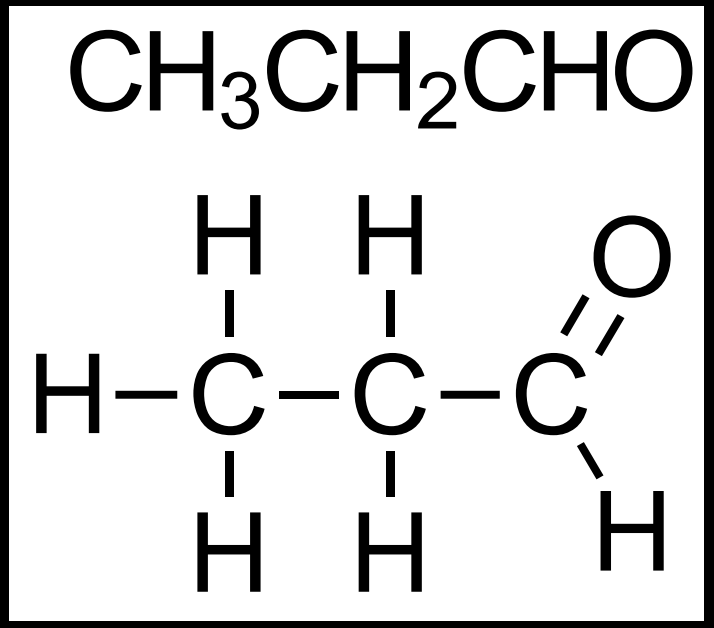
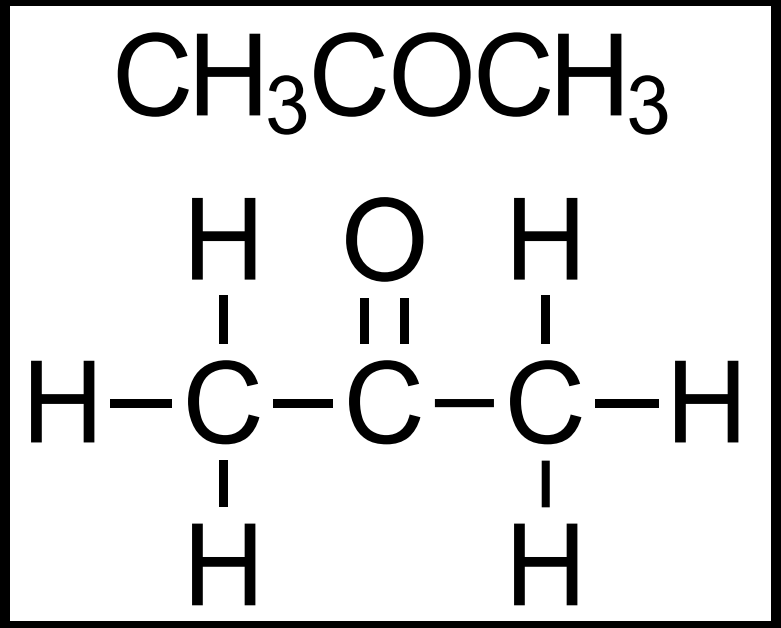
Structural isomerism

Structural isomers of C_3H_6O



Propanal



Propanone

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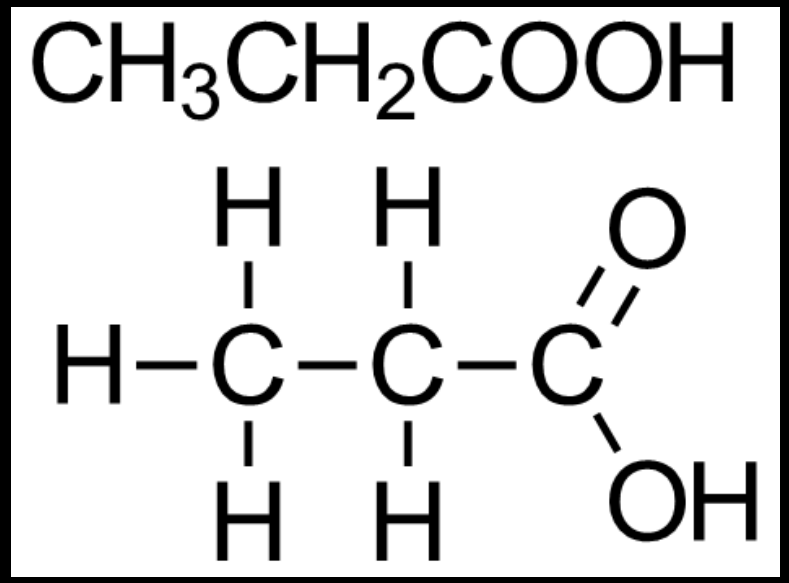
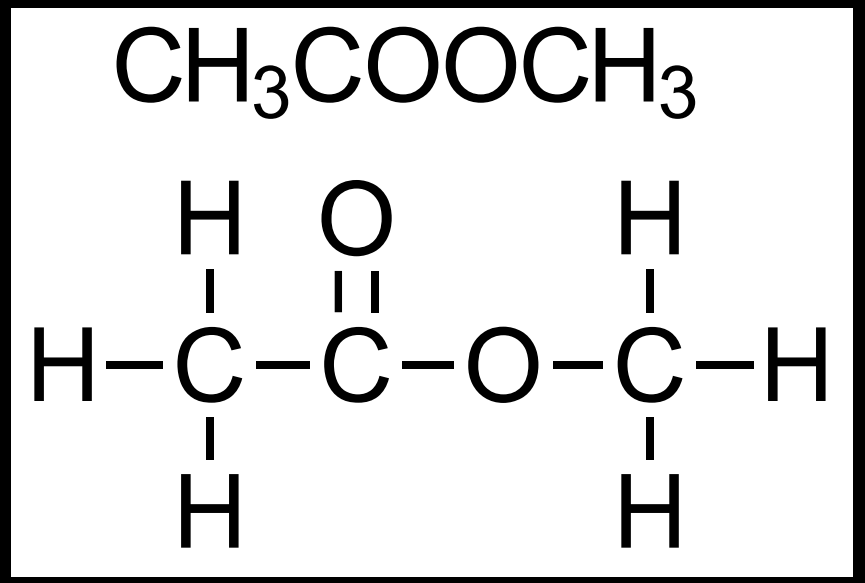
Structural isomerism

Structural isomers of $C_3H_6O_2$



Propanoic acid



Methyl ethanoate

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Classification of organic compounds

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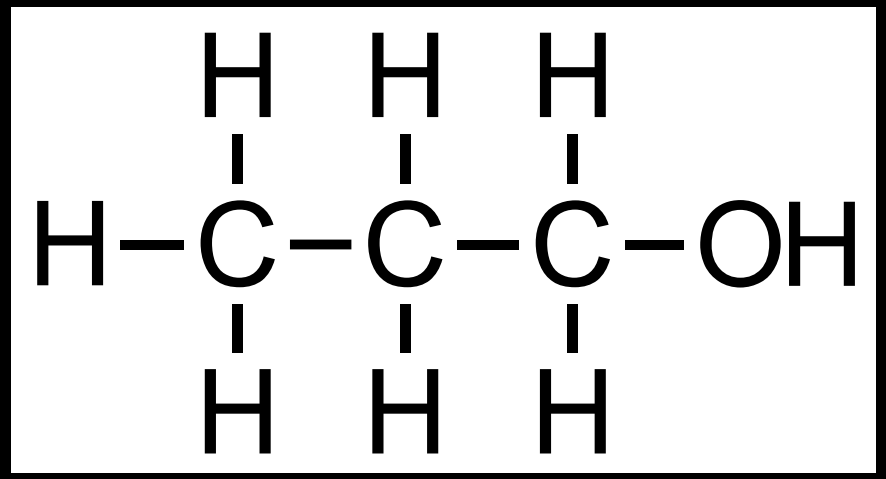
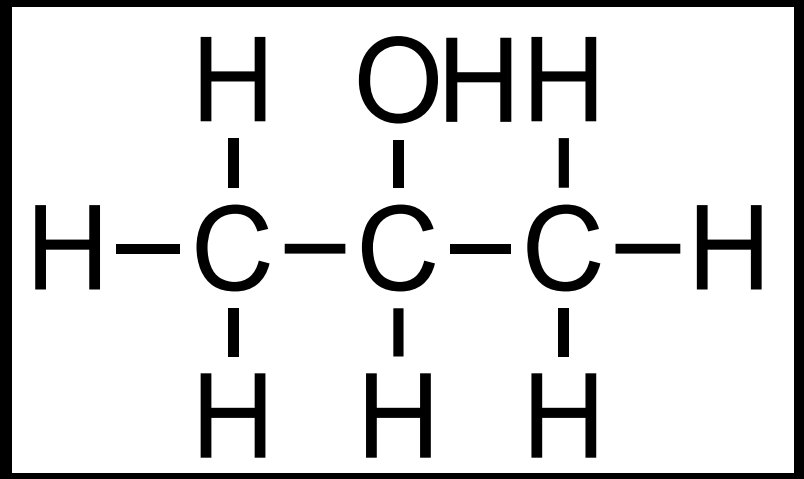
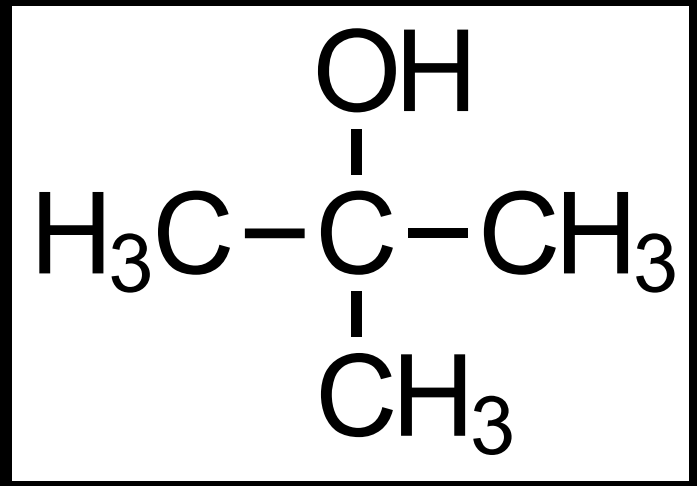
Classification of alcohols



propan-1-ol
primary (1°) alcohol



propan-2-ol
secondary (2°) alcohol



2-methylpropan-2-ol
tertiary (3°) alcohol

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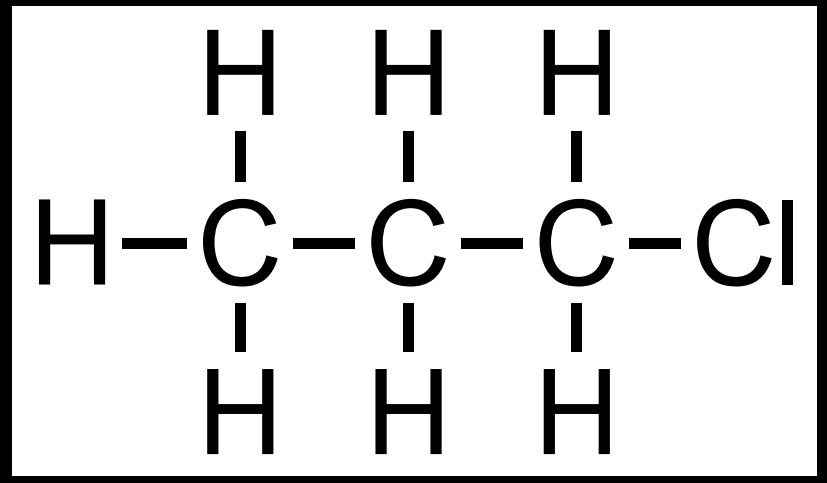
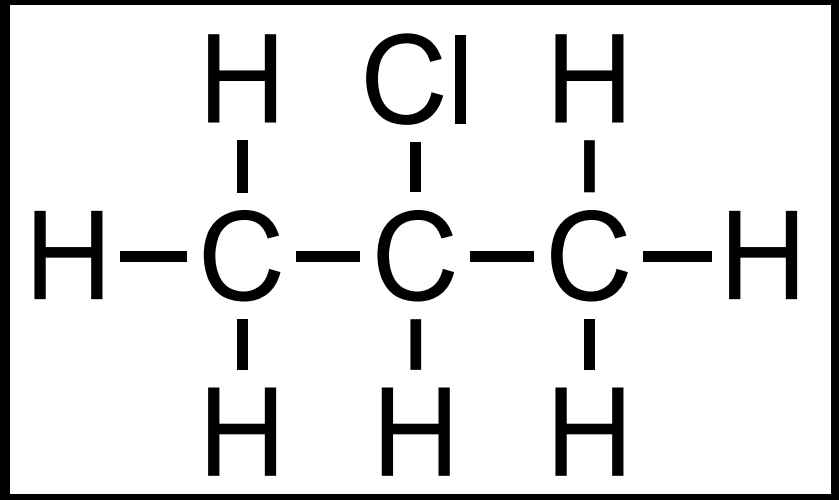
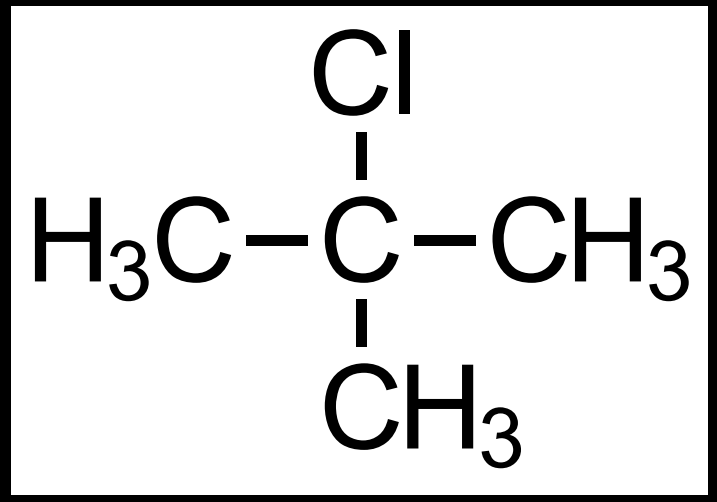
Classification of halogenoalkanes



1-chloropropane
primary halogenoalkane



2-chloropropane
secondary halogenoalkane



2-chloro-2-methylpropane
tertiary halogenoalkane

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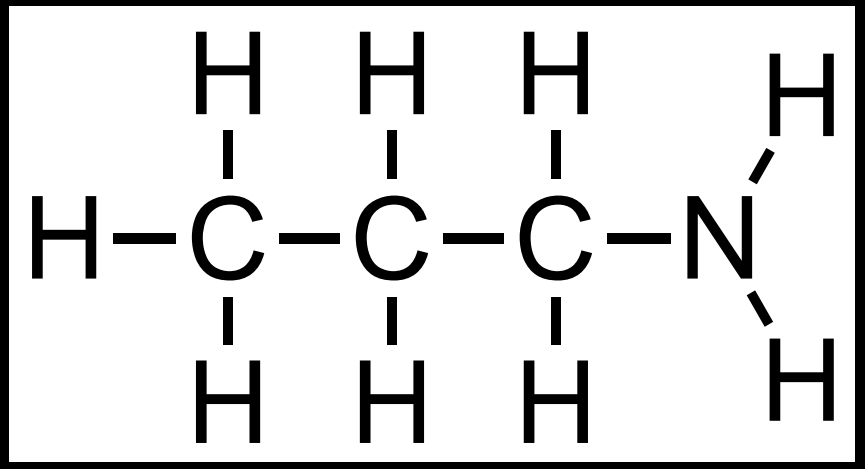
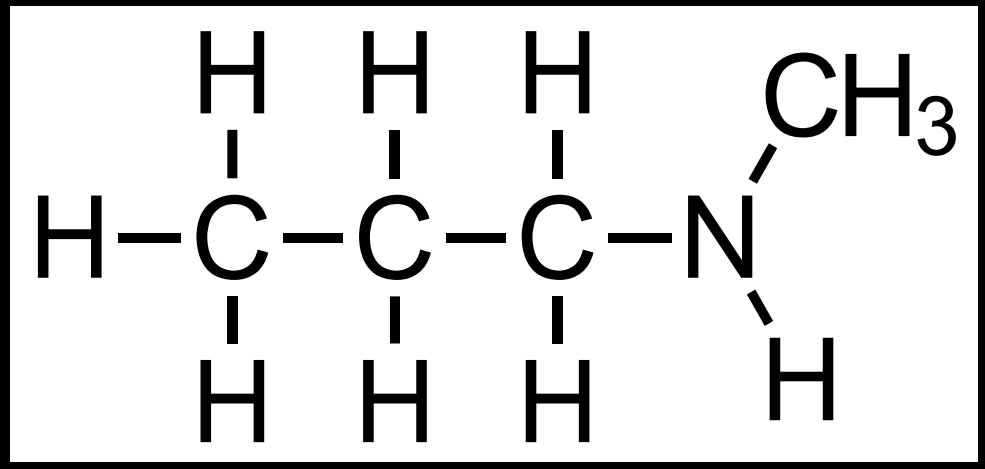
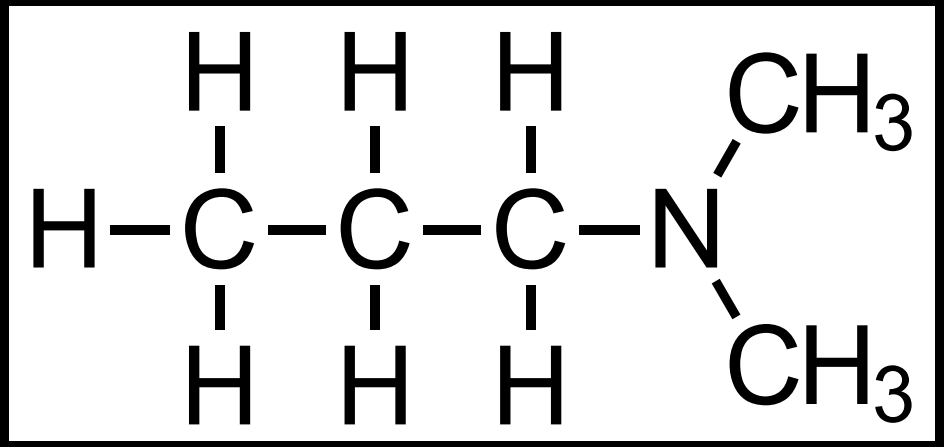
Classification of amines



Propanamine
primary amine



N-methylpropanamine
secondary amine



N,*N*-dimethylpropanamine
tertiary amine