



General organic chemistry-II



Objective

- **Introduction**
- **Nomenclature of hydrocarbons**
- **Organic compounds with functional groups**
- **Nomenclature of aromatic compounds**
- **Nomenclature of bicyclic compounds**



Introduction

- **The carbon atom is unique in its bonding in that it can form stable molecules consisting of chains of carbon atoms of any length**
- **Coupled with the observation that each carbon atom forms four bonds to other atoms this leads to incomprehensibly large numbers of possible molecules**

How?

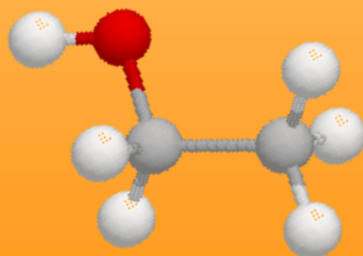
Because every organic compound contains carbon, and almost every one contains hydrogen, the names of these two elements do not appear directly in the compound names.

At its simplest, the name for an organic compound contains two parts:

(1) a root indicating the number of carbon atoms in the longest continuous chain of carbon atoms

(2) a prefix and/or suffix to indicate the functional group to which the compound belongs

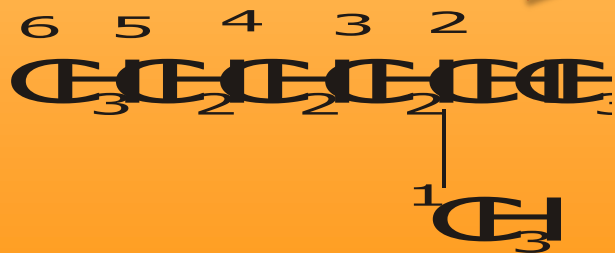
Example: “ethanol” indicates a carbon chain of length two (ethan-) and an OH functional group (-ol).



Nomenclature of branched alkanes

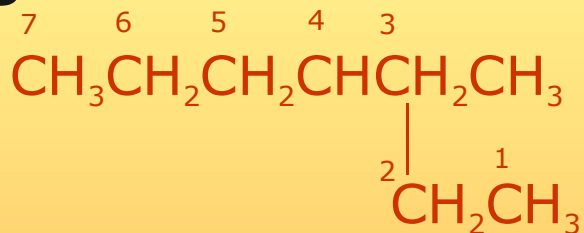
- (i) Locate the longest chain of carbon atoms; this chain determines the parent name for the alkane.
- (ii) Number the longest chain beginning with the chain nearer the substituent.

Substituent



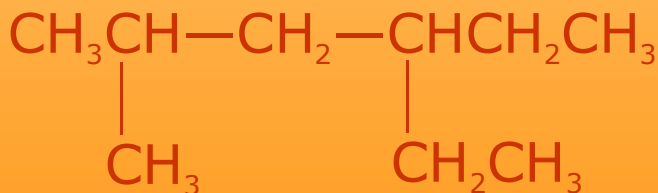
Nomenclature of branched alkanes

(iii) Use the number obtained by the application of rule 2 to designate the location of the substituents group.



4-ethyl-2-methylhexane

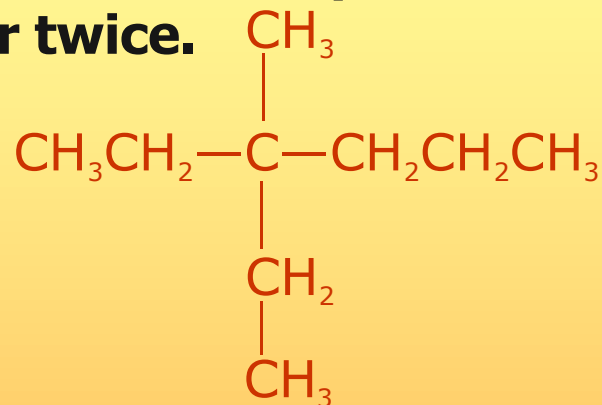
(iv) When two or more substituents are present, give each substituent a number corresponding to its location on the longest chain.



4-ethyl-2-methylhexane

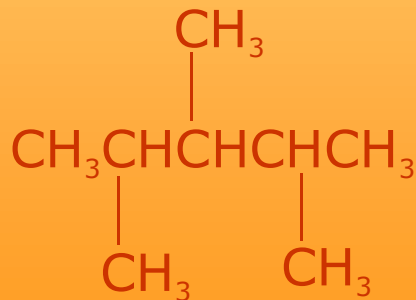
Nomenclature of branched alkanes

(v) When two substituents are present on the same carbon atom, use that number twice.



3-ethyl-3-methylhexane

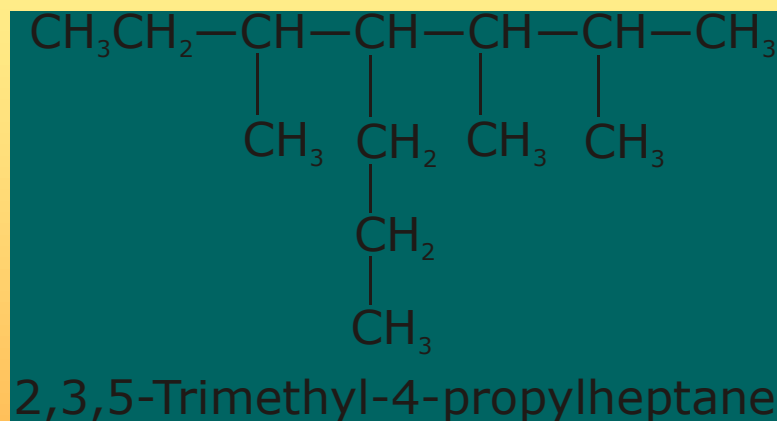
(vi) When two or more substituents are identified, indicate this by the use of the prefixes di-, tri-, tetra-, and so on.



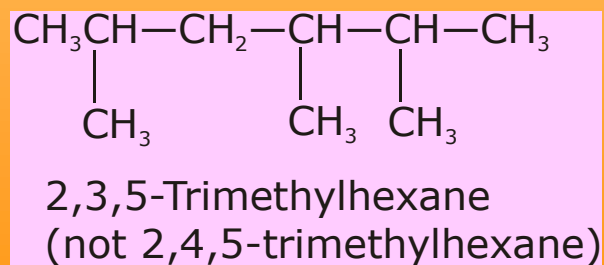
2,3,4-Trimethyl pentane

Nomenclature of branched alkanes

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



- (viii) 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.





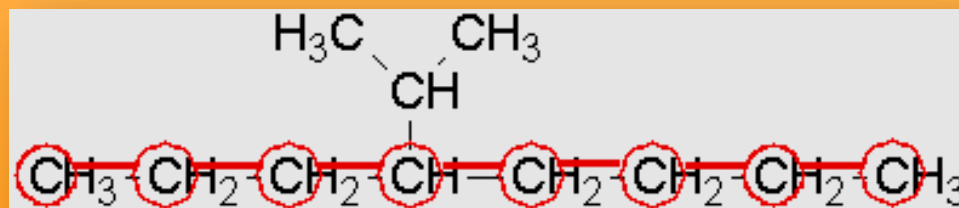
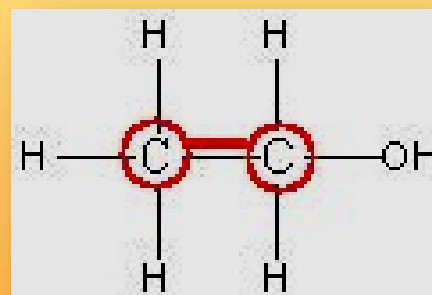
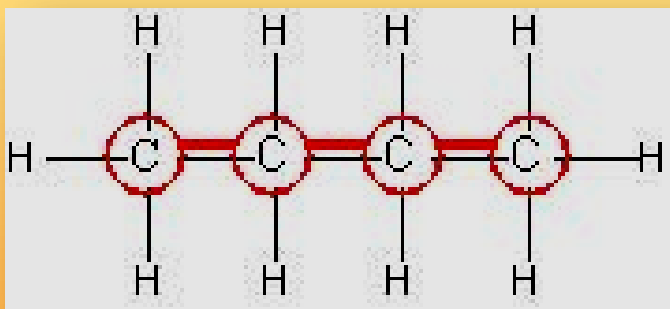
Nomenclature of organic compound: Six Step Process

- 1) Find the longest carbon chain**
- 2) Name it**
- 3) Determine any ending**
- 4) Numbering of the carbon atoms**
- 5) Separate and name side/substituent groups**
- 6) List side/substituent groups alphabetically**

Step 1: Find the longest carbon chain

Find the longest, uninterrupted, continuous carbon chain.

It is not required that in the picture or drawing of the carbon chain that atoms all are in line only that it is the longest continuous carbon chain

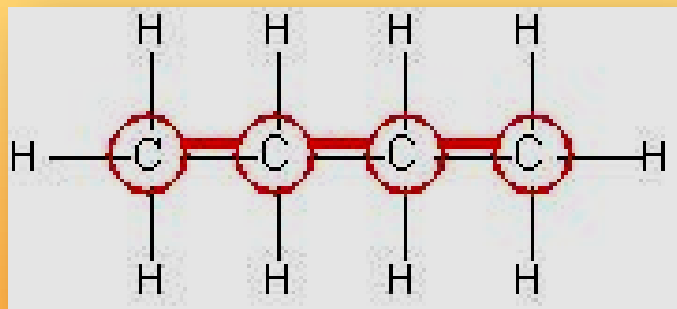


Step 2: Name it

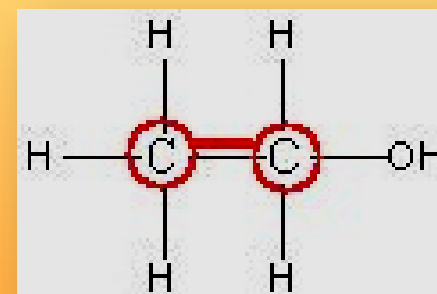
Name it.

Count the number of carbons in the chain and select the appropriate root name based on the number of carbon atoms on the chain

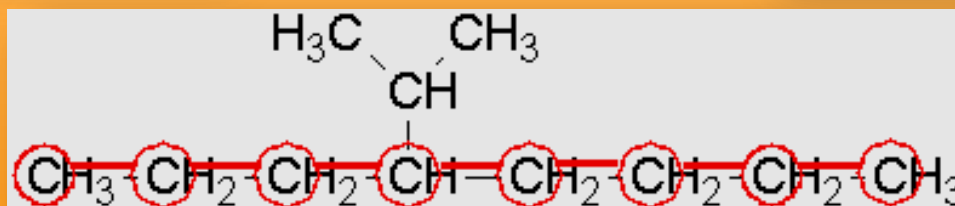
Butane



Ethane



Octane





Root Names

<u>Number of Carbon Atoms</u>	<u>Root Name</u>	<u>Number of Carbon Atoms</u>	<u>Root Name</u>
1	meth	11	undec
2	eth	12	dodec
3	prop	13	tridec
4	but	14	tetradec
5	pent	15	pentadec
6	hex	20	icos
7	hept	21	henicos
8	oct	22	docos
9	non	30	triacont
10	dec	40	tetracont

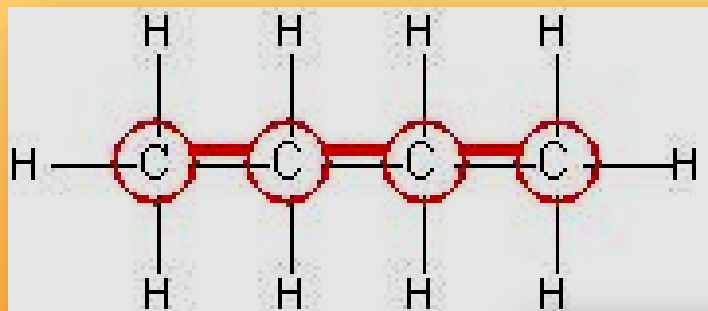
Step 3: Determine any ending

Determine if any ending needs to be added to the base name

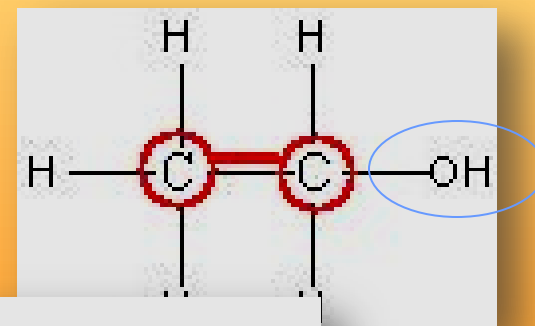
This is determined by the presence of a *functional group* on any of the carbon atoms

A list of functional groups and their structure can be found on next slide

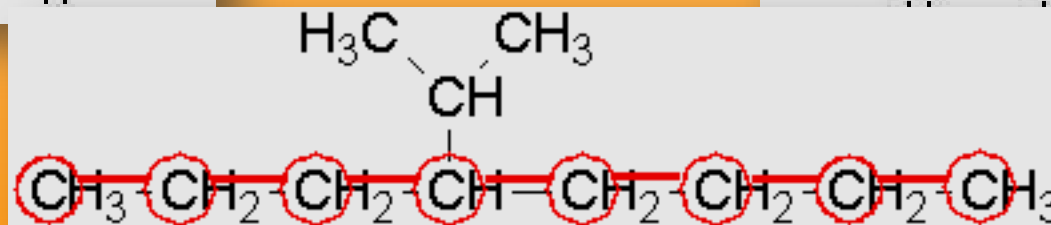
Butane



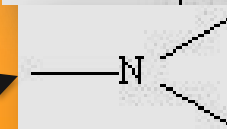
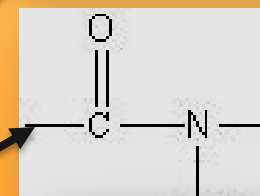
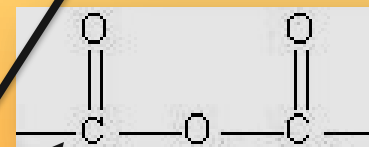
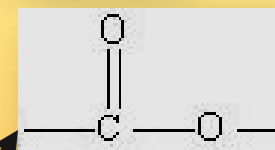
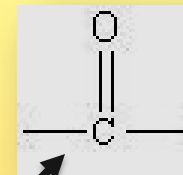
Ethanol



Octane



<u>Compound Class</u>	<u>Ending</u>	<u>Functional Group</u>
Alkanes	-ane	None
Haloalkanes	-ane	—X
Alcohols	-ol	—OH
Ethers	ether	—O—
Alkenes	-ene	—C=C—
Alkynes	-yne	—C≡C—
Aldehydes	-al	—CHO
Ketones	-one	—CO—
Carboxylic Acids	-oic acid	—COOH
Esters	-oate	—CO—O—
Anhydrides	anhydride	—CO—O—CO—
Amides	-ide	
Nitriles	-ile	—C≡N
Amines	-amine	





Priority of functional groups

If more than one functional group is present then we decide the parent functional group on the basis of the following priority basis.

Decreasing priority of the functional group

—COOH , $\text{—SO}_3\text{H}$, —COOR , —COCl , —CONH_2 , —CN ,
 —CHO , >CO , —OH , —NH_2 , >C=C< , $\text{—C}\equiv\text{C—}$.

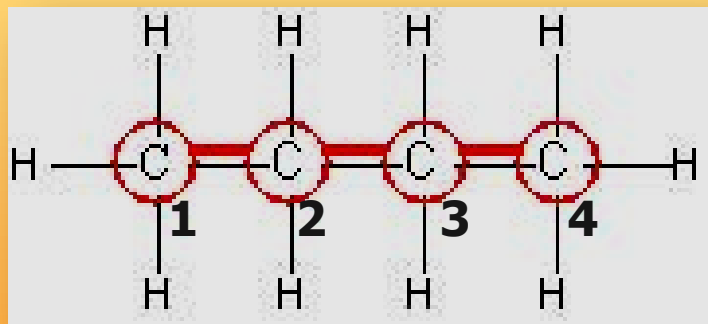
Step 4: Number the carbon atoms

Start at both ends of the carbon chain, naming the first carbon #1, the next #2, and so on

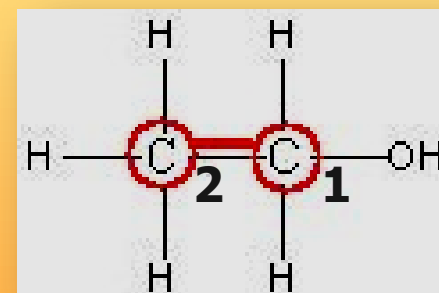
Find which end leads to or arrives at a side group first

That end then becomes the carbon #1 end

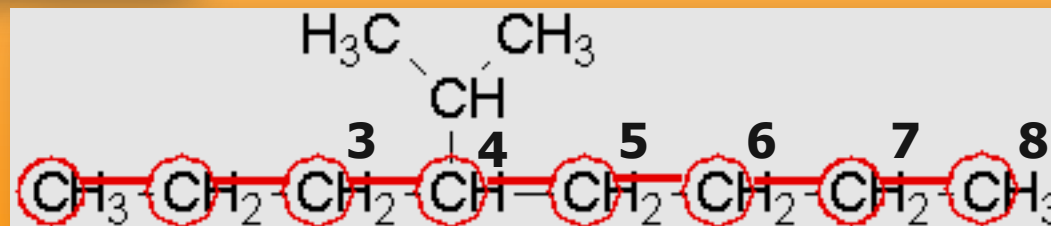
Number each carbon continuously through to the other end of the main chain starting with #1



Butane



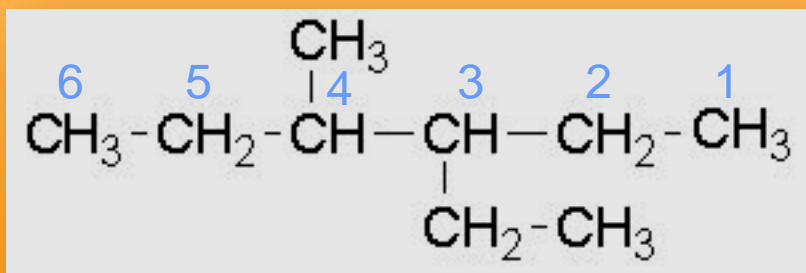
Ethanol



Octane

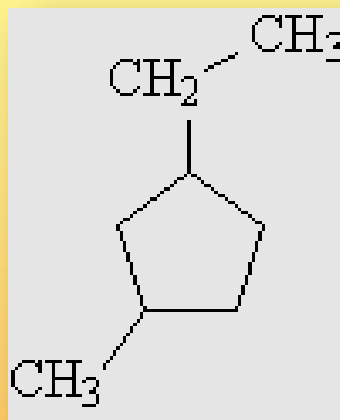
Step 4: Number the carbon atoms

- If both ends of the chain come to a side group with the same number of carbons, then the side with the more complex group (contains more atoms) becomes the end that receives the #1 label on its end carbon
 - If that also is a tie then the next tie breaker is alphabetizing the side groups
 - The higher order or first occurring alphabetical character side group becomes carbon #1



Illustrative example

The correct name of the given compound will be



- (a) Cycloethylmethylpentane
- (b) 1-ethyl-3-methylpentane
- (c) 1-ethyl-3-methylcyclopentane
- (d) 1-methyl-3-ethylcyclopentane

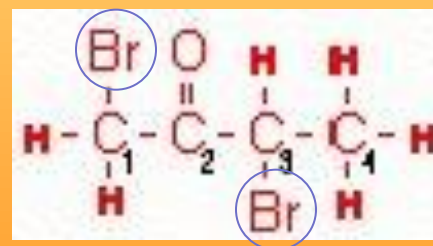
Solution

1-ethyl-3-methylcyclopentane

Hence correct option is (c).

Step 5: Separate and name substituent groups

- Separate out and individually name all the substituent side groups or chains, sometimes referred to as pendent groups
- The common names for side groups are
 - Cl = chloro
 - F = fluoro
 - Br = bromo
 - OH = hydroxy
 - NH₂ = amino
 - CN = cyano
 - NO₂ = nitro



1,3-dibromo-2-butanone

Names of branched alkyl Groups

Structure	Common Name	Systematic Name	Derived From	Designation
$ \begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{C}- \\ \\ \text{H} \end{array} $	Isopropyl	1-Methylethyl	Propane	Secondary
$ \begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{C}-\text{CH}_2- \\ \\ \text{H} \end{array} $	Isobutyl	2-Methylpropyl	2-Methylpropane (Isobutane)	Primary
$ \begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{C}- \\ \\ \text{CH}_2 \\ \\ \text{CH}_3 \end{array} $	sec-Butyl	1-Methylpropyl	Butane	Secondary
$ \begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{C}- \\ \\ \text{CH}_3 \end{array} $	tert-Butyl	1,1-Dimethylethyl	2-Methylpropane (Isobutane)	Tertiary
$ \begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{C}-\text{CH}_2- \\ \\ \text{CH}_3 \end{array} $	Neopentyl	2,2-Dimethylpropyl	2,2-Dimethylpropane (Neopentane)	Primary



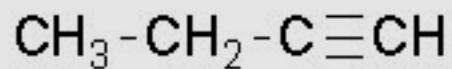
Step 5: Separate and name substituent groups

The presence of a double bond between two carbons gives the *-ene* ending to the root and the number of carbon of the pair is put proceeding the root.

A triple bond gives a *-yne* ending, and the same proceeding number system.



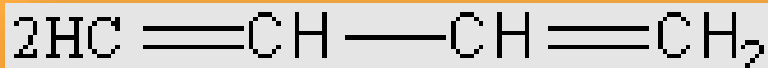
butadiene



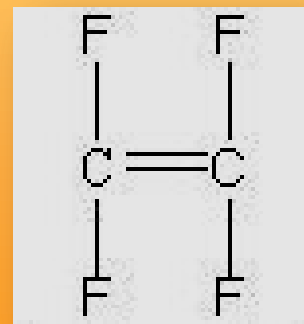
1-butyne

Step 5: Separate and name substituent groups

- If two of the same atoms appear in a molecule, the word "di" is used to describe it.
- If three similar atoms appear in a molecule, the word "tri" is used to describe it.
 - 4-tetra
 - 5-penta
- These prefixes are inserted directly before the name of the group.



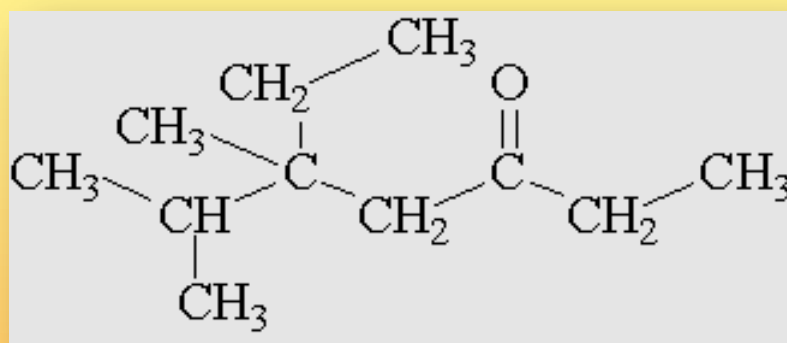
buta*di*ene



*tetra*flouroethylene

Illustrative example

The correct name of the given compound will be

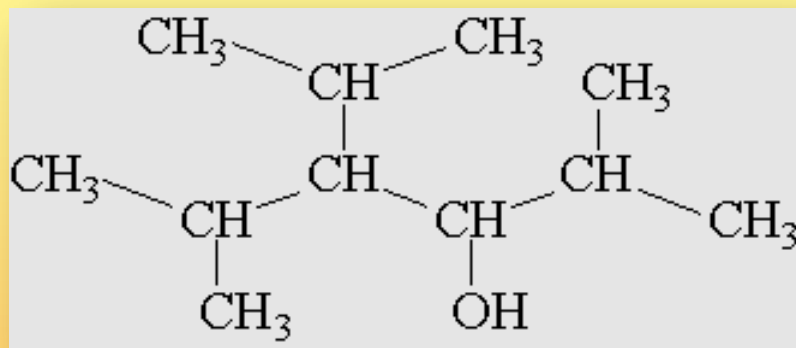


- (a) 5-isopropyl-5-methyl-3-heptanone
- (b) 3-isopropyl-5-methylheptanone
- (c) 5,6-dimethyl-5-ethyl-3-heptanone
- (d) 5-ethyl-5,6-dimethyl-3-heptanone

Correct option is (d).

Illustrative example

The correct name of the given compound will be



- (a) 4-isopropyl-2,5-dimethylhexanol
- (b) 2,5-dimethyl-4-isopropyl-3-hexanol
- (c) 2,5-dimethyl-4-isopropylhexanol
- (d) 4-isopropyl-2,5-dimethyl-3-hexanol

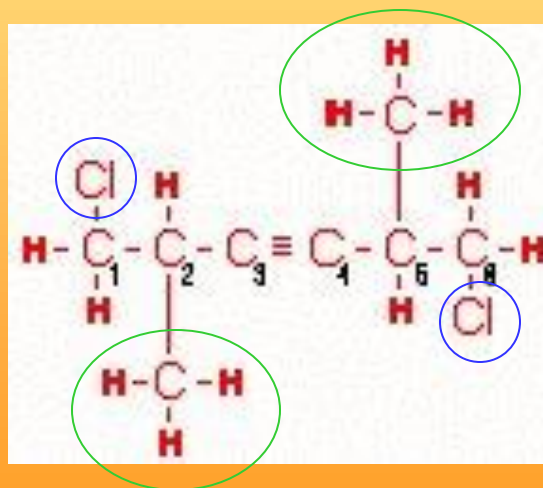
solution

4-isopropyl-2,5-dimethyl-3-hexanol

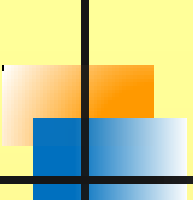
Hence correct option is (d).

Step 6: List substituent chains in alphabetical order

Write in alphabetical order all substituent chains or groups preceded by the carbon atom number where they are attached



1,6-Dichloro-2,5-dimethyl-3-hexyne



Step 6: List substituent chains in alphabetical order

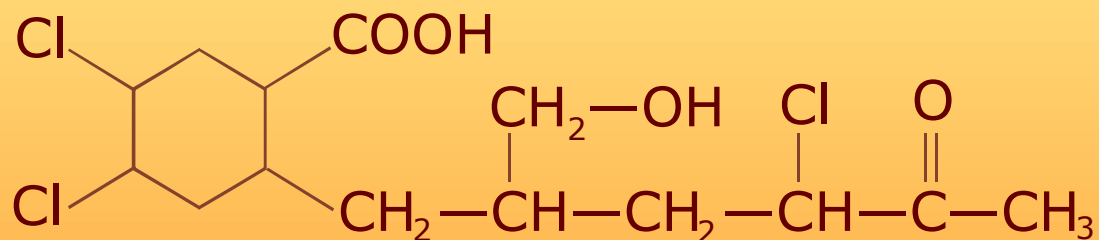
The convention requires a parenthesis to be placed around the substituent chains or groups if it is more than a single atom or molecule

Commas are placed between numbers and dashes are placed between numbers and letters and in front of the parenthesis

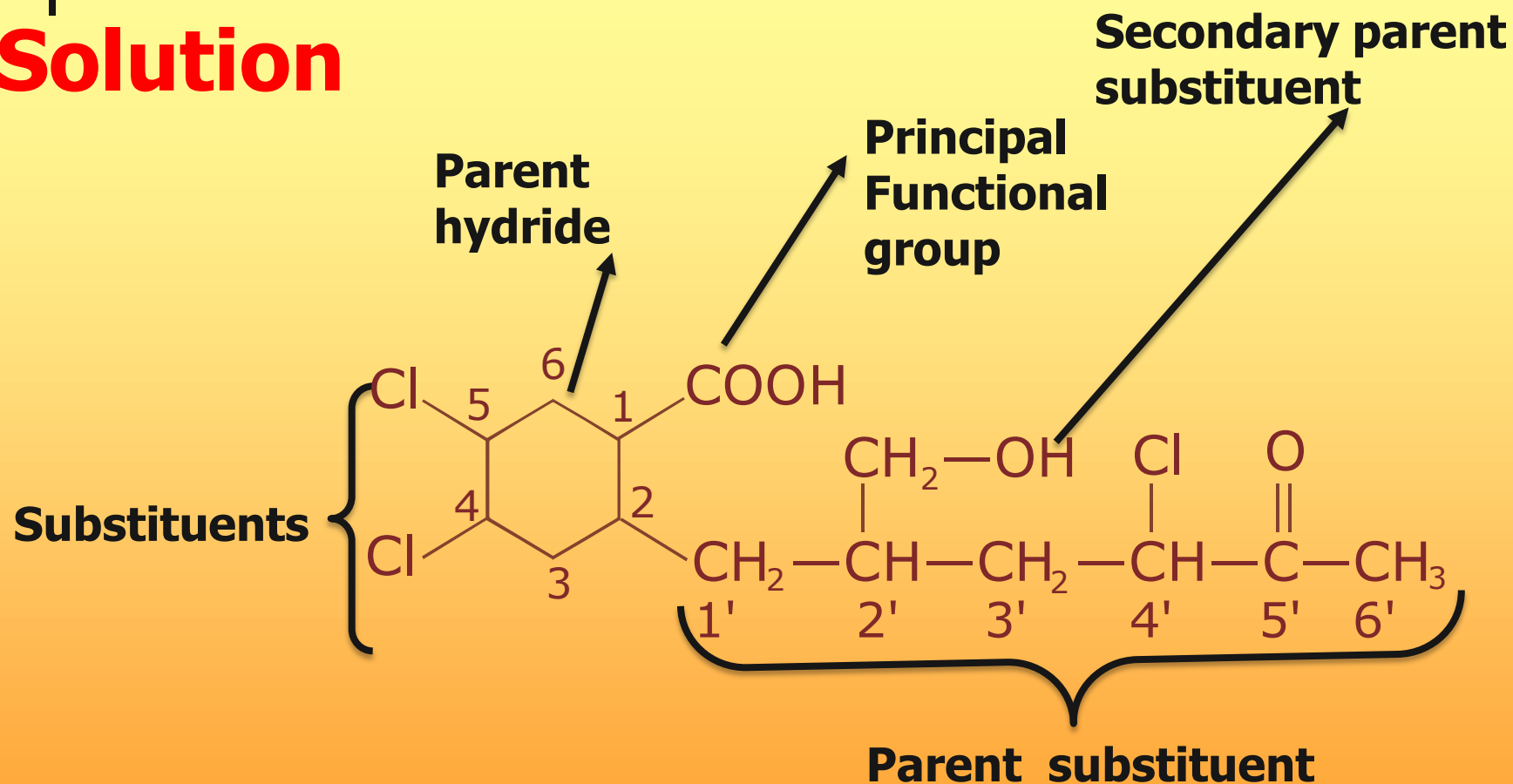
A group of atoms appearing in the brackets is alphabetized by the real first letter of the group, whereas, normal convention does not treat the di's or tri's as part of the alphabetizing process

Illustrative example

Write the IUPAC name of the following compound.



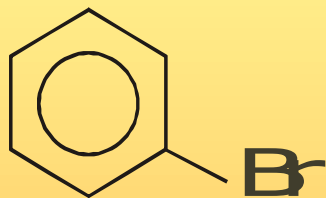
Solution



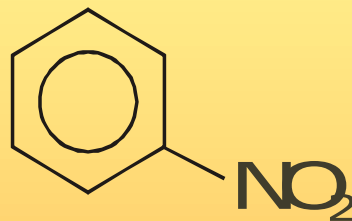
4,5-Dichloro-2-[4'-chloro-2'-(hydroxymethyl)-5'-oxohexyl]cyclohexane-1-carboxylic acid

Nomenclature of substituted benzene compounds

Substituent is placed as prefix to the word benzene.



~~Bromobenzene~~
Bromobenzene

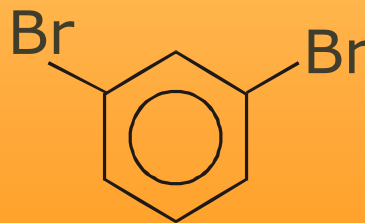


~~Nitrobenzene~~
Nitrobenzene

If benzene ring is disubstituted, the position of substituents is defined by numbering the carbon atoms of the ring such that the substituents are located at the lowest numbers possible.



~~1,2-Dibromobenzene~~
1,2-Dibromobenzene



1,3-Dibromobenzene



Nomenclature of substituted benzene compounds

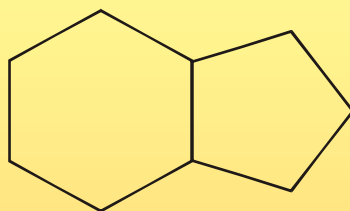
In trivial system of nomenclature the terms *ortho(o)*, *meta(m)*, and *para(p)* are used as prefixes to indicate the relative positions of the substituents.

Nomenclature of bicyclic compounds

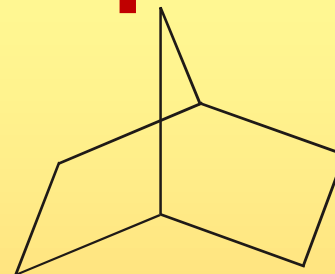
Named as bicycloalkanes



Spirocyclic



Condensed



Bridgehead

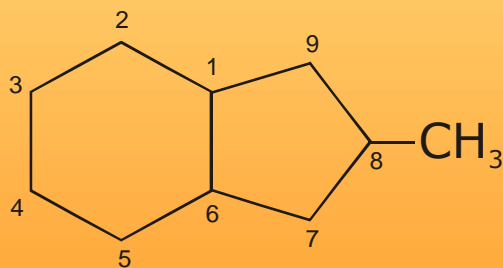
- First of all we count the total number of carbon atom (name derived from the number of total carbon atom).
- Identify the bridged carbon atoms to decide the number of carbon atoms in each bridge.
- Interpose in the name an expression in bracket that denote the number of carbon atoms in each bridge



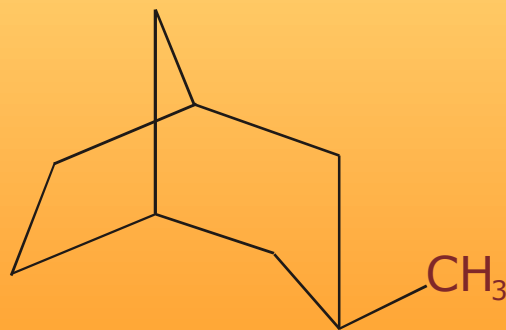
Bicyclo[5.3.0]decane

Nomenclature of bicyclic compounds

If substituents are present, we start numbering from a bridged carbon atom and move in the direction of longest bridge.



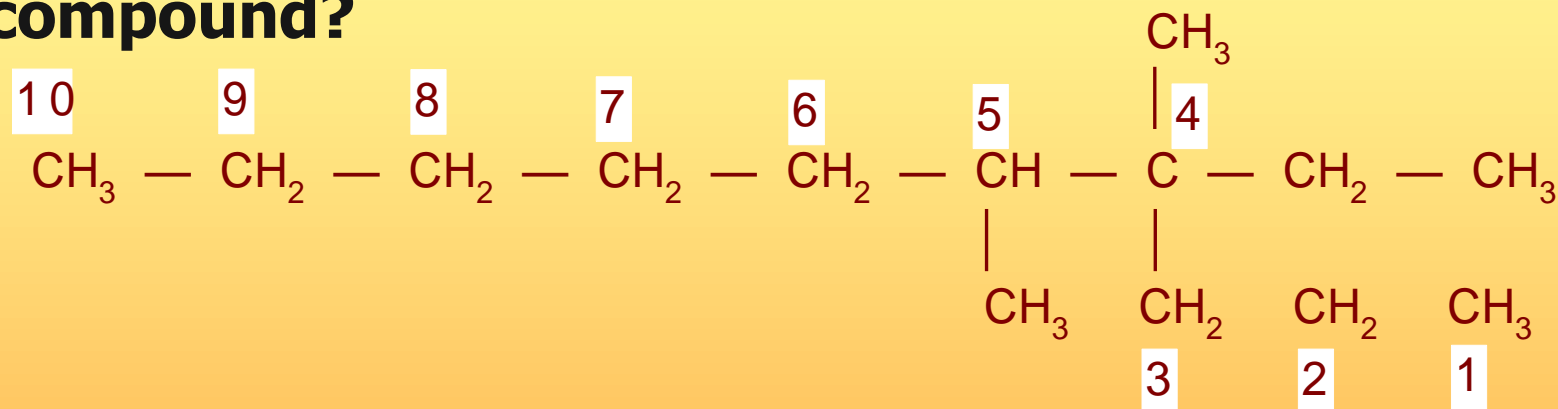
8-methylbicyclo[5.3.0]nonane



3- Methylbicyclo[3.2.1]octane

Class exercise 1

Which is the correct IUPAC name for the following compound?



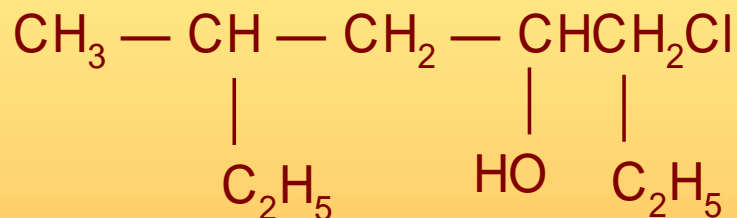
- (a) 3, 4 - Dimethyl 3 - n - propylnonane
- (b) 6, 7 - Dimethyle - n - propylnonane
- (c) 4-Ethyl - 4, 5 – dimethyldecane
- (d) 6, 7 - Dimethyl 7 - ethyldecane

Solution

Correct option is (c).

Class exercise 2

The IUPAC name of the compound having the structure



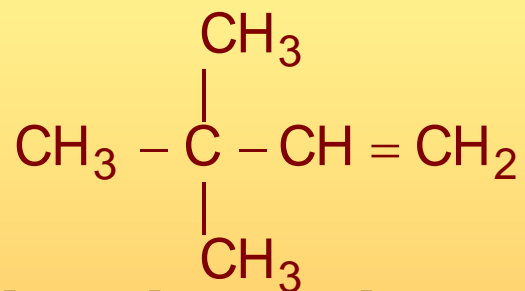
- (a) 1 - Chloro -4- methylhexanol -2
- (b) 3 - Chloro - 6 - methyl - 2 – octanol
- (c) 1 - Chloro - 4 -methyl-2-hexanol
- (d) 1 - Chloro-2-hydroxy-4- methylhexane

Solution

Correct option is (b).

Class exercise 3

The IUPAC name of the compound having the formula



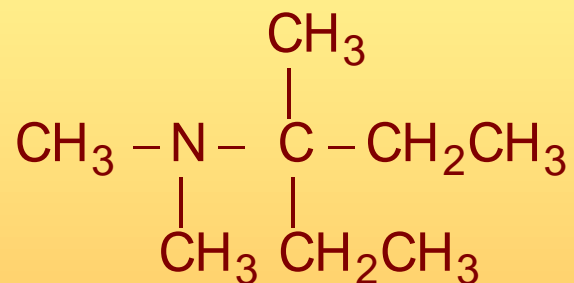
- (a) 1, 1- Dimethyl-1- butene
- (b) 3, 3, 3 - Trimethyl - 1 - propene
- (c) 1, 1, 1 - Trimethyl - 3 - propene
- (d) 3, 3 - Dimethyl - 1 - butene

Solution

Correct option is (d).

Class exercise 4

The IUPAC name of



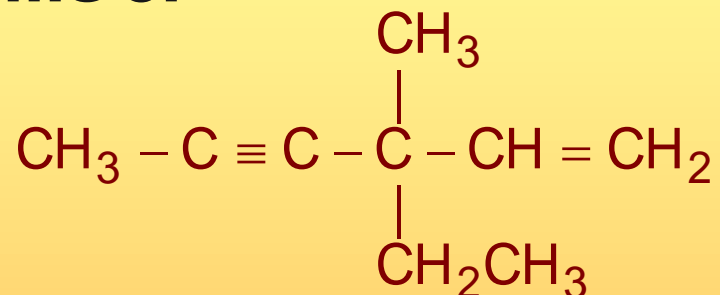
- (a) 3-Dimethylamino-3-methylpentane
- (b) 3- N,N- Dimethylamino) -3-ethylbutane
- (c) 3-Dimethylamino-3- ethylbutane
- (d) 3, N,N-Trimethyl -3 pentanamine

Solution

Correct option is (d).

Class exercise 5

The IUPAC name of



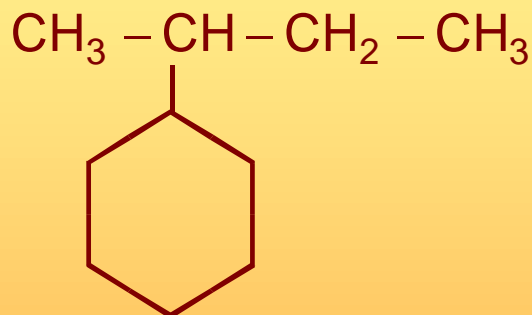
- (a) 3-Methylene-4-methylhepta-5-yne
- (b) 4-Ethyl-4-methylhex-5-en-2-yne
- (c) 3-Ethyl-3-methylhex-1-ene-4-yne
- (d) 5-Methylene-5-ethyl-4-methylhepta-2 yne

Solution

Correct option is (c).

Class exercise 6

The IUPAC name of



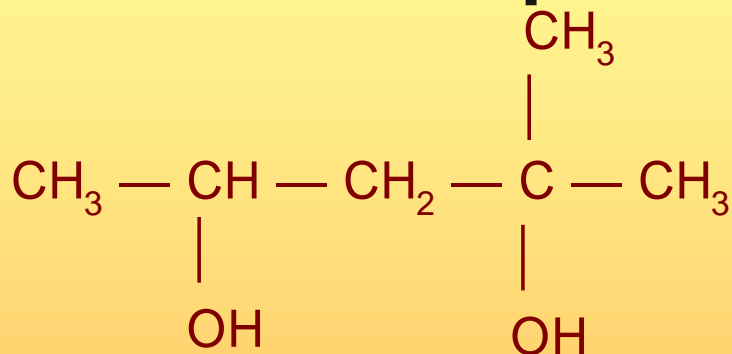
- (a) 2 - Cyclohexylbutane (b) 2 - Phenylbutane
(c) 3 - Cyclohexylbutane (d) 3 - Phenylbutane

Solution

Correct option is (a).

Class exercise 7

The IUPAC name of the compound



(a) 2 - Methyl - 2, 4 – pentanediol

(b) 1, 1-Dimethyl -1, 3- butanediol

(c) 4 - Methyl - 2, 4 - pentanediol

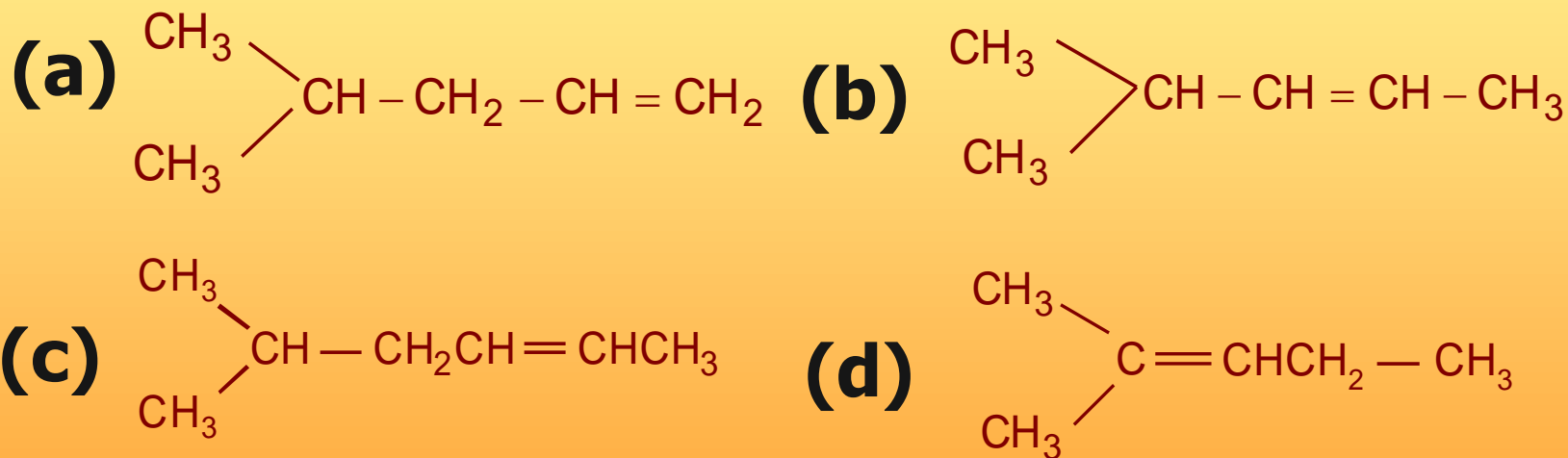
(d) 1, 3, 3 - Trimethyl -1, 3 - propanediol

Solution

Correct option is (a).

Class exercise 8

The structure of 4 - methylpent -2 -ene is



Solution

Correct option is (b).

Class exercise 9

Write the structural formula of

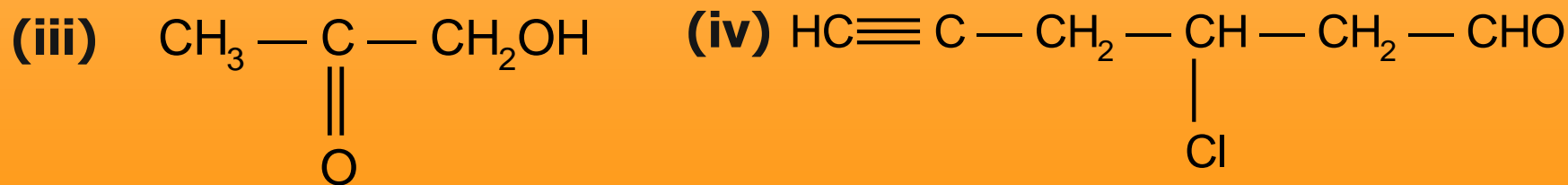
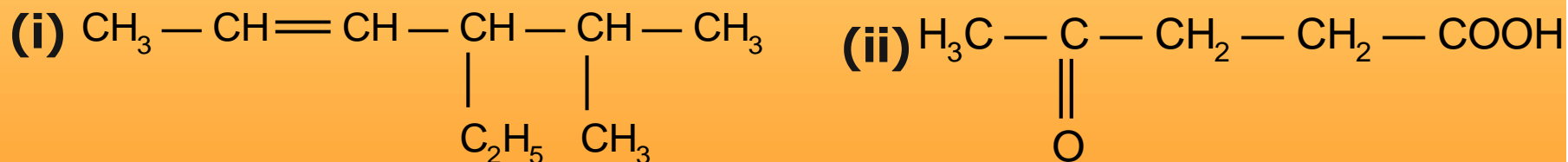
(i) 4 - Ethyl - 5 - methyl - 2 - hexene

(ii) 4 - oxo - pentane - 1 - oic acid

(iii) 1 - Hydroxy - 2 - Propanone

(iv) 3 - Chloro - 5 - yne - hexa - 1 - al

Solution



Write the structures of

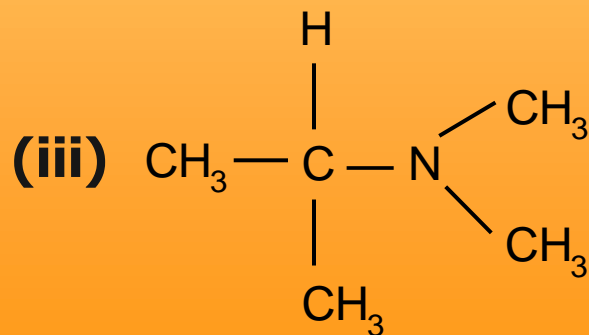
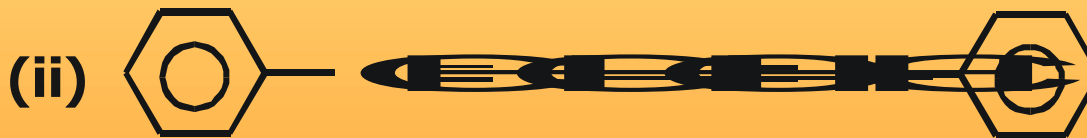
Class exercise 10

(i) 2 - Phenyl ethane - 1- ol

(ii) 1, 4 - Diphenyl - 1, 3, buta diene

(iii) N, N-Dimethyl - 2 - propanamine

Solution





Thanks...