Chapter 2. Alkanes and Cycloalkanes

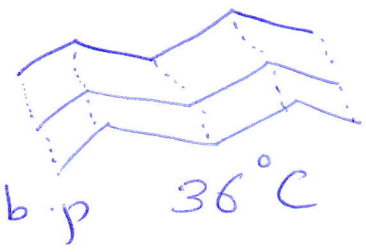
① **Alkanes:** Acyclic hydrocarbons which have a general formula C_nH_{2n+2} $n = 1, 2, 3, 4, \ldots$

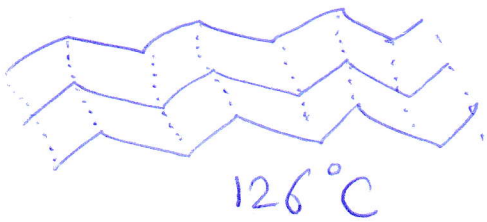
* Each carbon is sp^3 hybridized (4σ bonds).

physical properties:

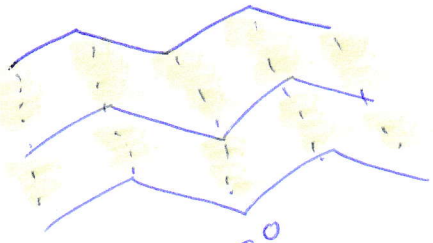
① Alkanes are insoluble in H_2O due to the absence of hydrogen bonding with H_2O molecules. (hydrocarbons are non-polar molecules).
alkanes are soluble in non-polar solvents.

② Boiling point (BP):- In general, alkanes have low b.p since intermolecular force among alkane molecules is: Van der Waals "Weak forces". However, as molar masses of alkanes increases ⟹ b.p ↑.

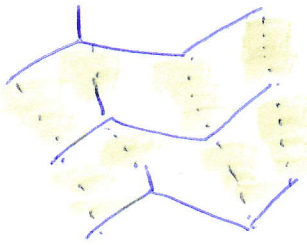




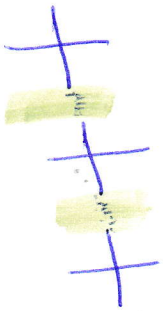
* For identical molar masses, as symmetrical increases ⟹ b.p ↓.



36°C



28°C



10°C

Nomenclature of alkanes

IUPAC system and common names are used.

① IUPAC Rules:-

First: for continous chain (Unbranched alkanes).

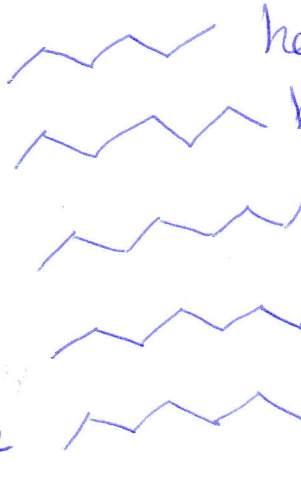
CH_4 methane CH_4

CH_3-CH_3 ethane C_2H_6

propane C_3H_8

butane C_4H_{10}

pentane C_5H_{12}



hexane

heptane

octane

nonane

decane

Second: For branched alkanes

① locate the longest continous carbon chain to determine the parent name.

② Number the chain from the end nearest to the first substituent.

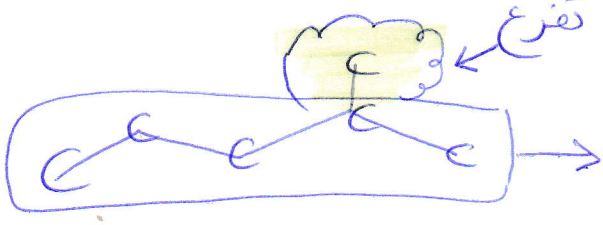
③ Determine the position of each substituent on the longest carbon chain

④ If 2 or more identical substituents are present, use the prefixes di for 2, tri for 3, tetra for 4.

⑤ Write substituents first then parent name.

based on alphabetical order.

Ex 1.



→ Continous chain: parent name is: Pentane

⑥ Naming of substituents:-

alkyl group:
C_nH_{2n+1}

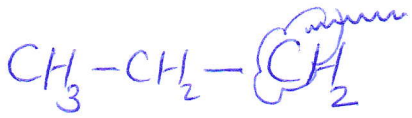
CH_3: methyl

C_2H_5: ethyl

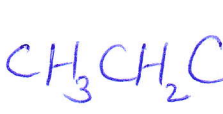
C_3H_7: } see page 4.
C_4H_9: }

halogens:

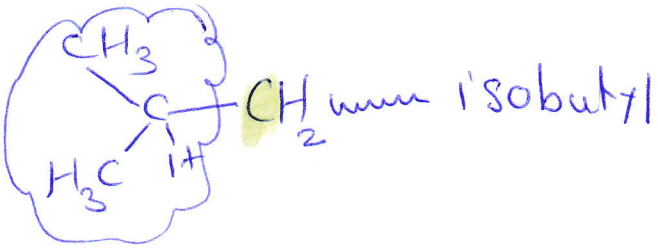
F—: fluoro
Cl—: chloro
Br—: bromo
I—: iodo

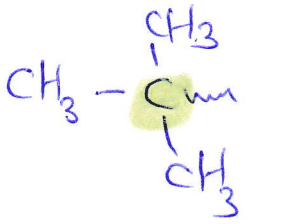

propyl


isopropyl


butyl


sec-butyl


isobutyl

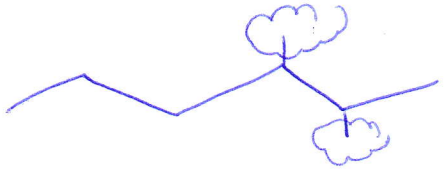

tert-butyl

Examples of alkanes naming :-

(1) 

3-methylhexane

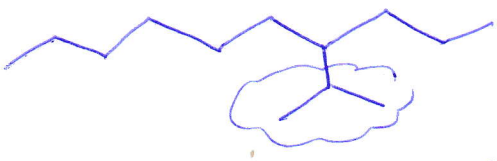
Position of subs. — subs. — parent

(2) 

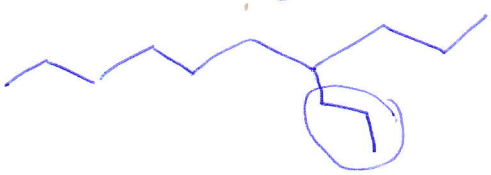
2,3-dimethylhexane

(3) 

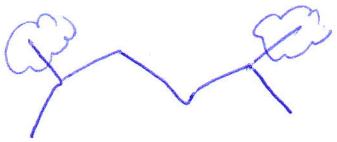
3,3-dimethylhexane

(4) 

4-isopropyldecane

(5) 

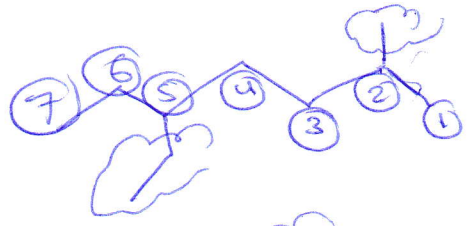
4-propyldecane

(6) 

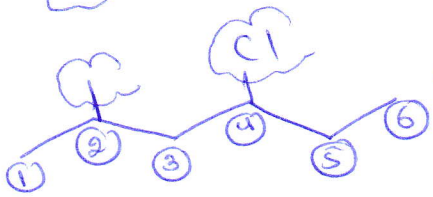
2,5-dimethylhexane

(7) 

2,2-dimethylpropane

(8) 

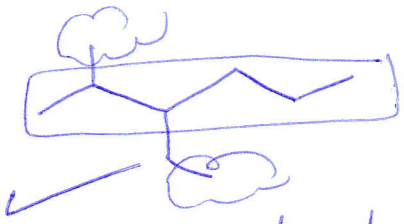
5-Ethyl-2-methylheptane

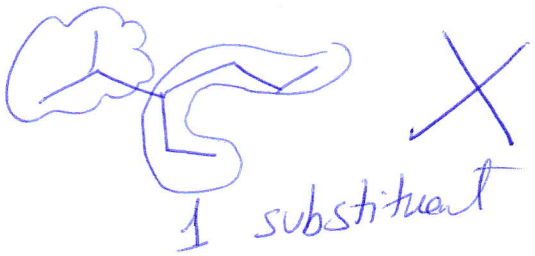
(9) 

4-Chloro-2-methylhexane

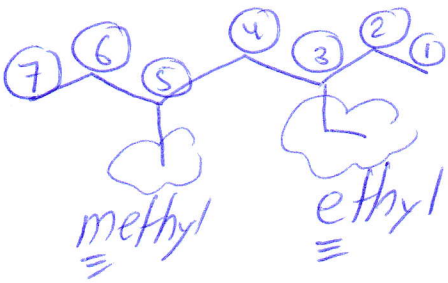
Important notes:

(10) If you have 2 equal long of carbon chain, select one with the most branches.


2-substituents


1 substituent

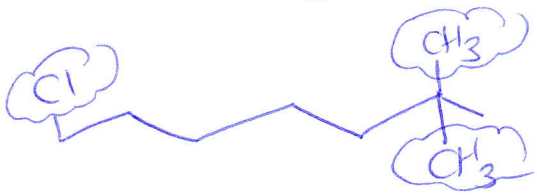
(11) If branching occurs at equidistant ⟹ number the chain from the end according to the alphabetical order of substituents.



methyl ethyl

from right, 3, 5
left 3, 5
} equidistant
⇓ in this case

(12) What is the correct numbering in the molecule?



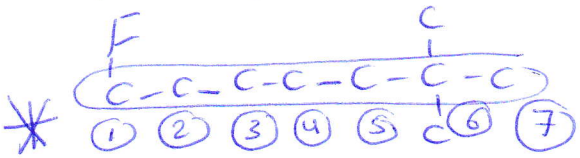
from right: 2, 2, 7 X

from left 1, 6, 6 ✓

Just compare the first digit in each case (1<2) then select a lower one. Don't do a summation. How???

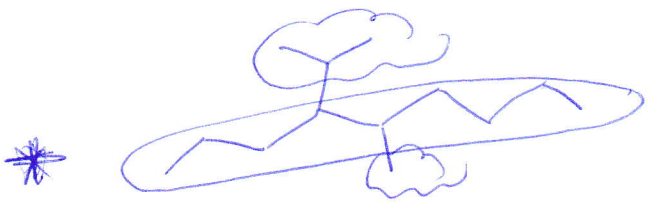
(13) Prefixes: di, tri, tetra, sec-, tert are <u>not</u> included in comparison of the alphabetical order of substituents <u>BUT</u> ISO is included.

Examples:



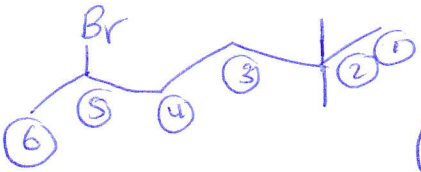
1-(F)luoro-6,6-di(me)thyl heptane ✓

or 6,6(D)imethyl-1-(f)luoroheptane X



4-(I)sopropyl-5-(m)ethyl nonane ✓

or 5-(M)ethyl-4-i'so(pr)opyl nonane X

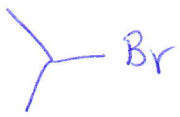
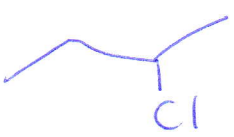
(14) 

5-Bromo-2,2-dimethyl hexane ✓

(Not 2-Bromo-5,5-dimethyl hexane.)

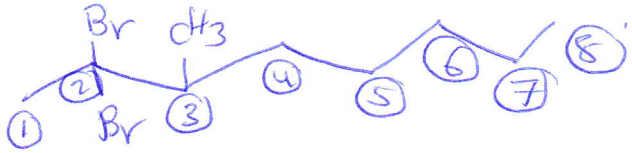
No equidistant.

* Common names: Write organic part first.

	IUPAC	Common
CH_3CH_2I	Iodoethane	Ethyl iodide
	2-Bromopropane	Isopropyl bromide
	2-Chlorobutane	sec-butyl chloride
	2-Bromo-2-methyl propane	tert-butyl bromide
CH_3F	Fluoromethane	Methyl fluoride.

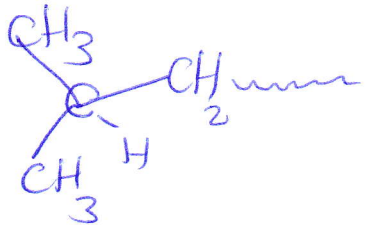
* Drawing of molecules:- Start drawing at parent name, then number the chain from any end and finally, draw substituents.

a) 2,2-dibromo-3-methyloctane



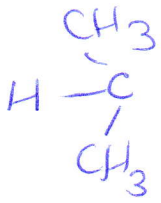
b) n-hexane 

n = normal (no branching).

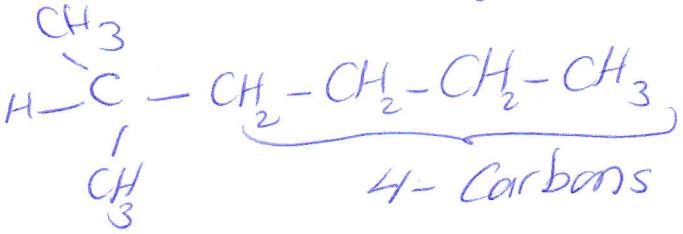
* Isobutyl 

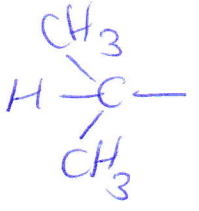
* Propyl $CH_3-CH_2-CH_2-$

* Isoheptane: first draw iso



then draw 4- carbon atoms (7-3=4)



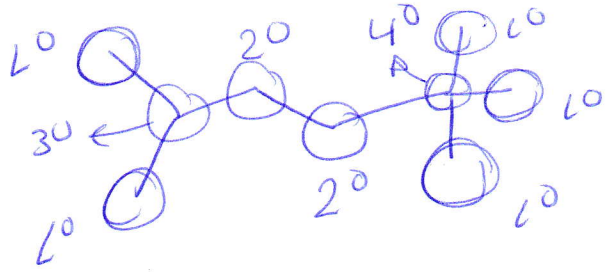
* Iso butane  (4-3=1)

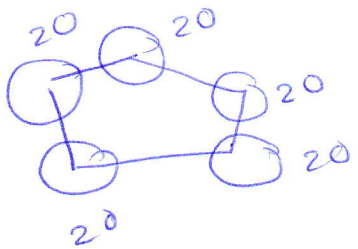
Classification of Carbon atoms:-

1^0 2^0 3^0 4^0

primary secondary tertiary quaternary

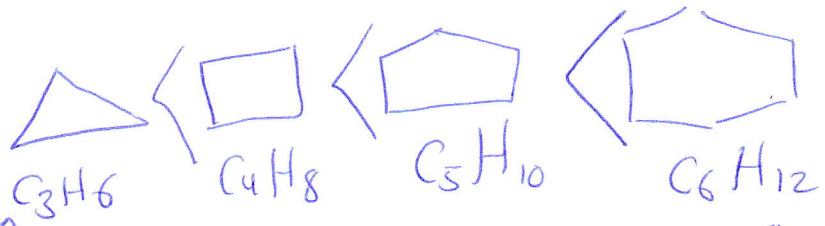
How ?





Cycloalkanes: They are cyclic hydrocarbons with a general formula C_nH_{2n}.

Examples:



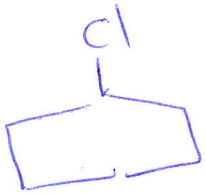
the least stable (the most strained)

the most stable (the least strained).

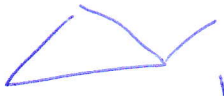
Naming of cycloalkanes:

① Presence of 1 substituent (No need for numbering).

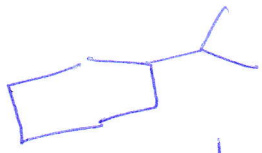
Ethylcyclopentane



chlorocyclohexane



methylcyclopropane

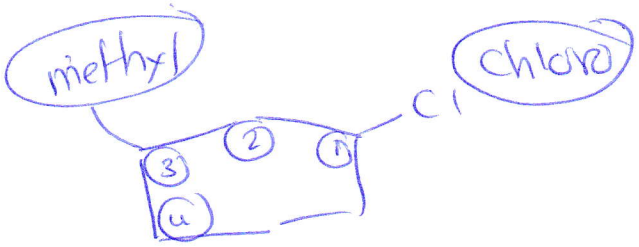


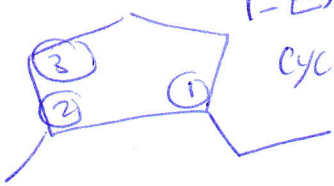
isopropyl Cyclohexane.

② Presence of 2 substituents:

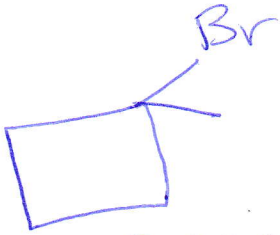
a) Give no. (1) for carbon (in the cyclic) that has a substituent based on alphabetical order.

b) Give the second substituent a lower number.





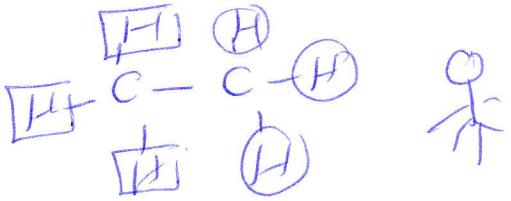
1-Ethyl-2-methyl cyclopentane



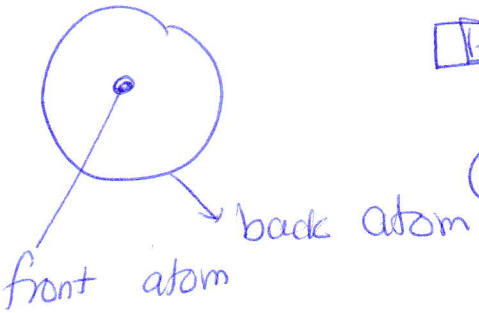
1-Bromo-1-methylcyclobutane

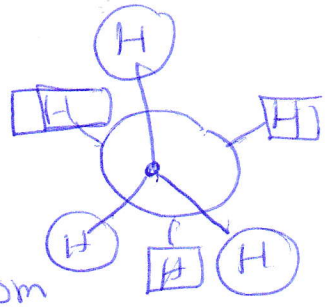
* Conformation of alkenes and cycloalkanes

First: Alkane.

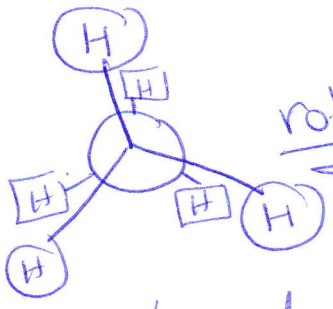


Ethane



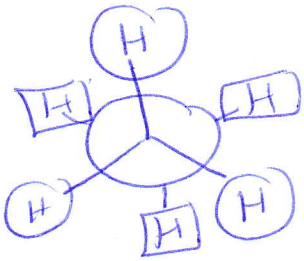


Newman projection.



eclipsed Conformer (less stable)

rotation around σ-bond



staggered Conformer (More stable)