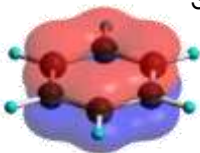


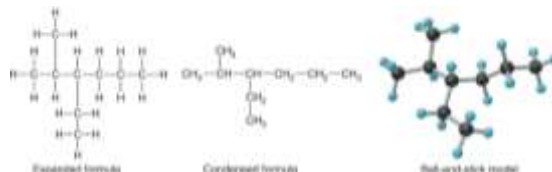
## Organic Chemistry

SCH 3U Review

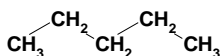


## Alkanes: Saturated Hydrocarbons

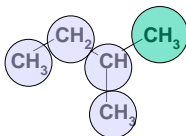
- Hydrocarbons are molecules composed of carbon & hydrogen
  - Each carbon atom forms 4 chemical bonds
  - A **saturated hydrocarbon** is one where all C - C bonds are "single" bonds & the molecule contains the **maximum** number of H-atoms
  - Saturated hydrocarbons are called **ALKANES**



## Normal vs Branched Alkanes

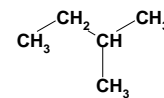
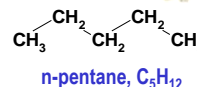


- NORMAL** alkanes consist of continuous chains of carbon atoms
- Alkanes that are NOT continuous chains of carbon atoms contain **branches**
- The longest continuous chain of carbons is called the **parent chain**



## Structural Isomerism

- Structural isomers** are molecules with the same chemical formulas but different molecular structures - different "**connectivity**".
- They arise because of the many ways to create branched hydrocarbons.
- a.k.a. "**Constitutional Isomers**"



## The First 10 "Normal" Alkanes

Name	Formula	M.P.	B.P.	# Structural Isomers
Methane	CH <sub>4</sub>	-183	-162	1
Ethane	C <sub>2</sub> H <sub>6</sub>	-89	-89	1
Propane	C <sub>3</sub> H <sub>8</sub>	-187	-42	1
Butane	C <sub>4</sub> H <sub>10</sub>	-138	0	2
Pentane	C <sub>5</sub> H <sub>12</sub>	-130	36	3
Hexane	C <sub>6</sub> H <sub>14</sub>	-95	68	5
Heptane	C <sub>7</sub> H <sub>16</sub>	-91	98	9
Octane	C <sub>8</sub> H <sub>18</sub>	-57	126	18
Nonane	C <sub>9</sub> H <sub>20</sub>	-54	151	35
Decane	C <sub>10</sub> H <sub>22</sub>	-30	174	75

**C1 - C4 are Gases at Room Temperature**

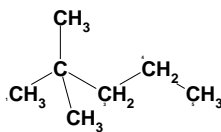
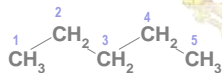
**C5 - C16 are Liquids at Room Temperature**

## IUPAC Rules for Naming Branched Alkanes

- Find and name the **parent chain** in the hydrocarbon - this forms the root of the hydrocarbon name
- Number the **carbon atoms in the parent chain** starting at the end closest to the branching
- Name **alkane branches** by dropping the "ane" from the names and adding "yl". A one-carbon branch is called "methyl", a two-carbon branch is "ethyl", etc...
- When there are more than one type of branch (ethyl and methyl, for example), they are named **alphabetically**
- Finally, use **prefixes** to indicate multiple branches

### Example 1: 2,2-dimethylpentane

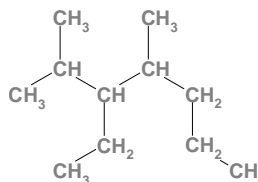
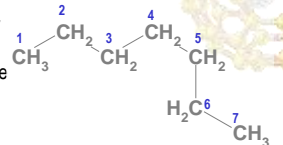
- The parent chain is indicated by the ROOT of the name - "pentane". This means there are 5 carbons in the parent chain.



- "dimethyl" tells us that there are TWO methyl branches on the parent chain. A methyl branch is made of a single carbon atom.
- "2,2-" tell us that BOTH methyl branches are on the second carbon atom in the parent chain.

### Example 2: 3-ethyl-2,4-dimethylheptane

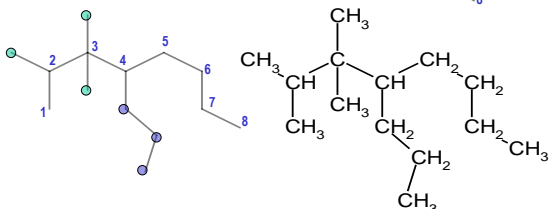
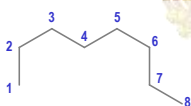
- The parent chain is indicated by the ROOT of the name - "heptane". This means there are 7 carbons in the parent chain.



- "2,4-dimethyl" tells us there are TWO methyl branches on the parent chain, at carbons #2 and #4.
- "3-ethyl-" tell us there is an ethyl branch (2-carbon branch) on carbon #3 of the parent chain.

### Example 3: 2,3,3-trimethyl-4-propyloctane

- The parent chain is indicated by the ROOT of the name - "octane". This means there are 8 carbons in the parent chain.

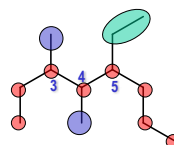
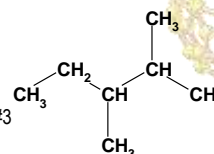


### Example 4: Name the molecules shown!

- parent chain has 5 carbons - "pentane"

- two methyl branches - start counting from the right - #2 and #3

- 2,3-dimethylpentane**

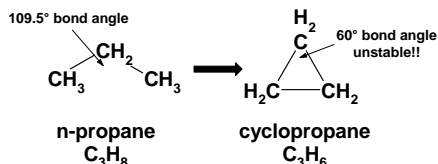


- parent chain has 8 carbons - "octane"
- two methyl branches - start counting from the left - #3 and #4
- one ethyl branch - #5
- name branches alphabetically

**5-ethyl-3,4-dimethyloctane**

## Alkanes Review - Cycloalkanes

- A cycloalkane is made of a hydrocarbon chain that has been joined to make a "ring".



- Note that two hydrogen atoms were lost in forming the ring!
- What is the general formula for a cycloalkane?

## Cycloalkanes: Cis-Trans Isomerism

- The Trans-isomer is the molecule with branches on OPPOSITE sides of the ring
- The Cis-isomer is the molecule with branches on the SAME SIDE of the ring.
- Cis-Trans isomerism is one type of geometric isomerism



Trans-1,2-dimethylcyclopentane



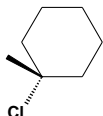
Cis-1,2-dimethylcyclopentane

## Cis-Trans Isomers - Examples

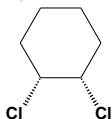
cis-1,3-dimethylcyclobutane



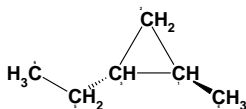
1-chloro-1-methylcyclohexane



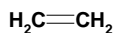
cis-1,2-dichlorocyclohexane



trans-1-ethyl-2-methylcyclopropane



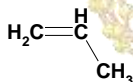
## Alkenes & Alkynes: Examples



ethene



ethyne

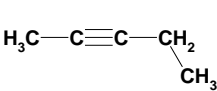
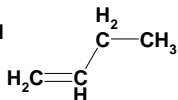
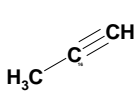


propene

propyne

1-butene

2-pentyne



## Name those alkenes...

cis-4-methyl-2-pentene

2-methyl-2-hexene

trans-2-bromo-3-methyl-2-pentene

cyclopentene

cis-3-heptene

## Alkenes & Alkynes

- Alkenes are hydrocarbons that contain at least one carbon-carbon **double bond**
- Alkynes are hydrocarbons that contain at least one carbon-carbon **triple bond**
- The suffix for the parent chains are changed from "ane" to "ene" and "yne"
  - e.g. ethene, propyne
- Where it is ambiguous, the **BONDS** are numbered like branches so that the location of the multiple bond may be indicated

## Cis-Trans Isomerism...Again!

- Like rings, alkenes and alkynes show restricted rotation - this time about the multiple bonds
- Because of the  $120^\circ$  bond angles in **alkenes**, cis-trans isomerism is possible
  - If one of the carbons in the double bond have two of the same substituents, there is **NO** cis-trans isomerism!
  - Remember that "trans" means opposite sides of the double bond and "cis" means the same side of the bond!
  - Use molar mass to prioritize the substituents to decide cis-trans isomerism

