Isomerism

Isomers are molecules that have the same molecular formula but different structural formula

2 types:

1. Structural Isomers – atoms bonded in different orders

Isomerism – molecules with the same formula and different structures

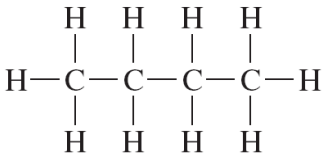
2 Types

1) Structural Isomers
   - → atoms bonded in different orders.
   - → we will focus on alkanes (saturated hydrocarbons)

Structural Isomerism

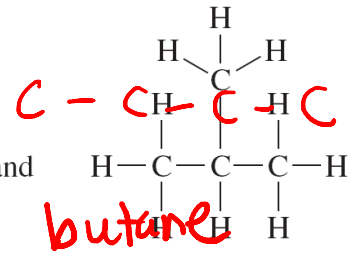
Ex. C_4H_{10}

C_4H_{10}



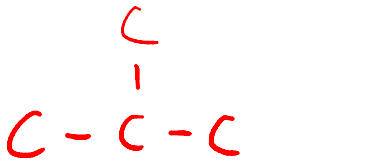
butane

and



isobutane

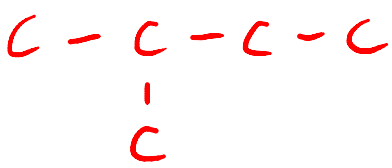
butane



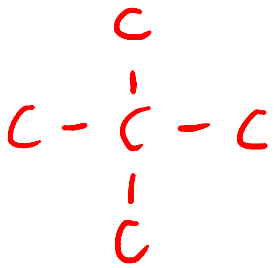
methylpropane

How many structural isomers for C_5H_{12}

pentane

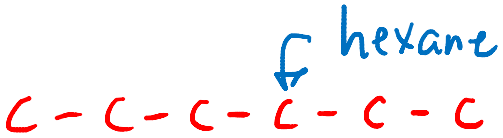


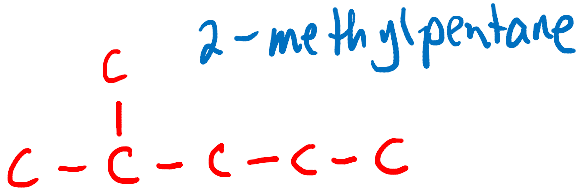
2-methylbutane

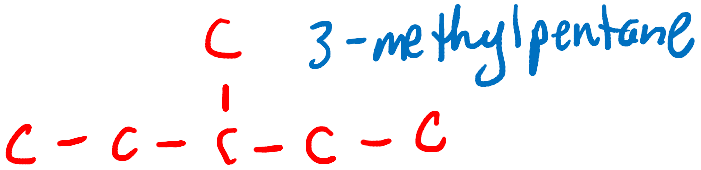


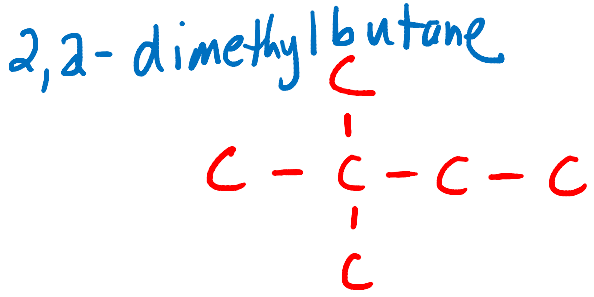
2,2-dimethylpropane

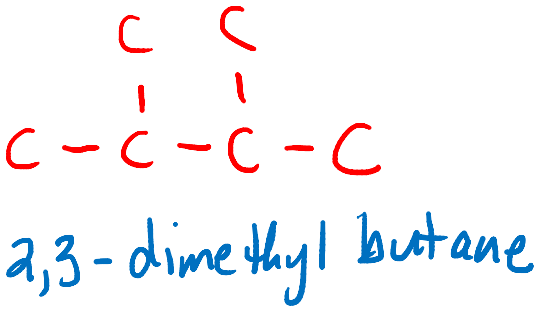
How many structural isomers for C_5H_{12}











Geometric Isomerism

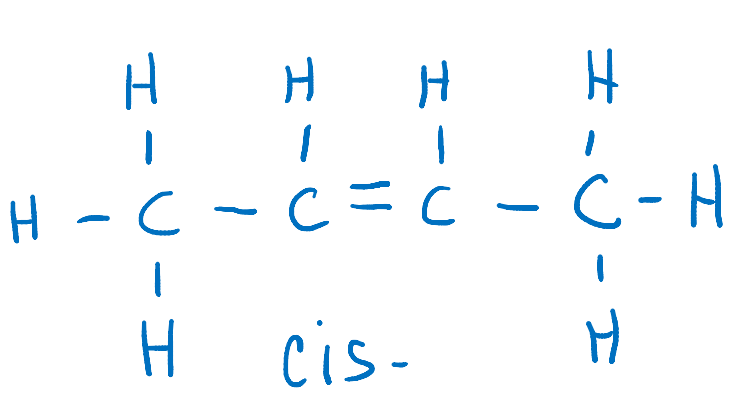
- 2. Geometric Isomers - atoms bonded in same order with different arrangement of atoms relative **to double bonded carbons**

2) Geometric Isomers

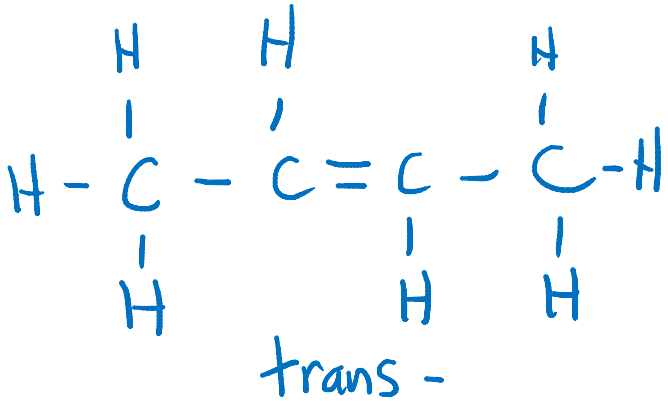
→ are found with alkenes

→ arrangement of atoms attached to double-bonded carbons.

inside (not on an end)

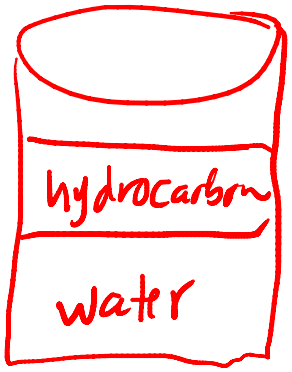


cis-



trans-

Properties of Hydrocarbons



1) Non-polar substances
2) Insoluble in water
3) Less dense than water
4) Very weak intermolecular forces
   → Van der Waals only (no polar bonds!)
5) Low melting points and low boiling points
6) Boiling points increase as carbons are added.
7) Undergo combustion reactions.

Combustion Reactions

hydrocarbon + O_2 $\longrightarrow$ CO_2 + H_2O

C_5H_{12} + O_2 $\longrightarrow$ CO_2 + H_2O

C_6H_{14} + O_2 $\longrightarrow$ CO_2 + H_2O

C_7H_{16} + O_2 $\longrightarrow$ CO_2 + H_2O

Balancing Tips -

balance C first

H second

O ALWAYS LAST.

$C_5H_{12} + 8O_2 \longrightarrow 5CO_2 + 6H_2O$

C - 5
H - 12
O - 2 ~~16~~

C - ~~1~~ 5
H - ~~2~~ 12
O - ~~3~~ ~~1~~ 16

$2C_6H_{14} + 19O_2 \longrightarrow 12CO_2 + 14H_2O$

C - 6
H - 14
O - 2 ~~38~~

C - ~~1~~ 6
H - 2 14
O - ~~3~~ 12 ~~19~~ 38

24
14
38

uneven - double ALL

$C_7H_{16} + 11O_2 \longrightarrow 7CO_2 + 8H_2O$

C - 7
H - 16
O - 2 ~~22~~

C - ~~1~~ 7
H - 2 16
O - ~~3~~ 15 22

14
8

Saturated Hydrocarbons: Alkanes

Alkanes: Saturated – no double or triple bonds

General formula C_nH_{2n+2}

TABLE 19.3 | Names, Formulas, and Physical Properties of Straight-Chain Alkanes

Name	Molecular formula C_nH_{2n+2}	Condensed structural formula	Boiling point (°C)	Melting point (°C)
Methane	CH_4	CH_4	−161	−183
Ethane	C_2H_6	CH_3CH_3	−89	−172
Propane	C_3H_8	$CH_3CH_2CH_3$	−42	−187
Butane	C_4H_{10}	$CH_3CH_2CH_2CH_3$	−0.6	−135
Pentane	C_5H_{12}	$CH_3CH_2CH_2CH_2CH_3$	36	−130
Hexane	C_6H_{14}	$CH_3CH_2CH_2CH_2CH_2CH_3$	69	−95
Heptane	C_7H_{16}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_3$	98	−90
Octane	C_8H_{18}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	125	−57
Nonane	C_9H_{20}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	151	−54
Decane	$C_{10}H_{22}$	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$	174	−30