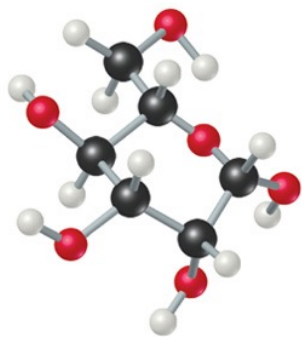


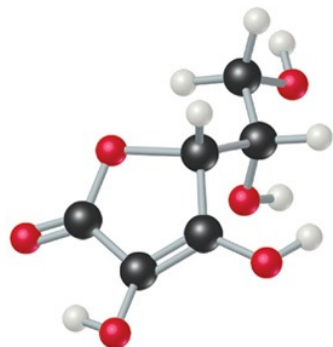
Chapter 24/25
Organic and
Biological Chemistry

Organic Chemistry

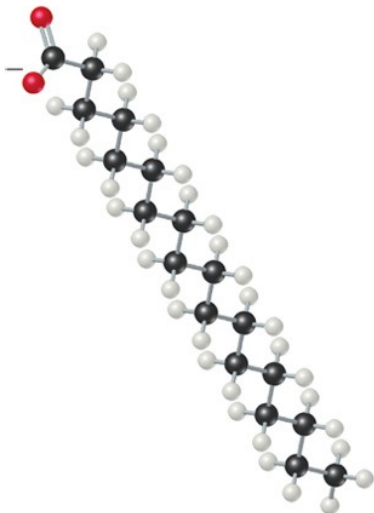


Glucose ($C_6H_{12}O_6$)

- The chemistry of carbon compounds.
- What's special about carbon?
 - tetravalent (sp^3 hybridization)
 - wide choice in oxidation states
 - CO_2 C, +4
 - CH_4 C, -4
 - bonds well to O, N, halides, itself, etc.
 - Covalent bonds are very strong



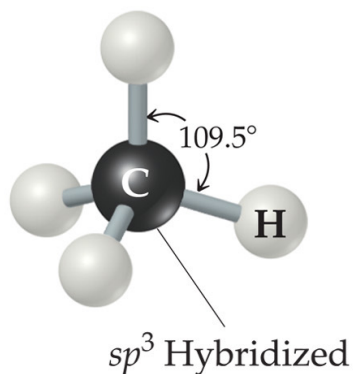
Ascorbic acid ($HC_6H_7O_6$)



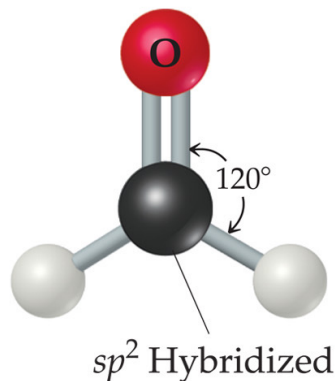
Surfactant ($C_{17}H_{35}COO^-$)

Structure of Carbon Compounds

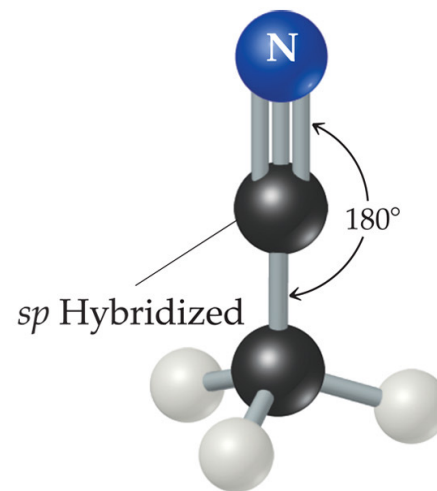
- There are three hybridization states and geometries found in organic compounds:
 - sp^3 Tetrahedral
 - sp^2 Trigonal planar
 - sp Linear



(a) Tetrahedral



(b) Trigonal planar



(c) Linear

Hydrocarbons

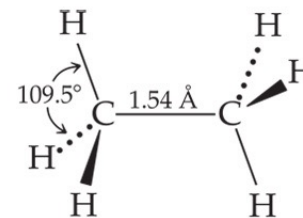
- Four types:

- Alkanes

ALKANE
Ethane CH_3CH_3



(a)

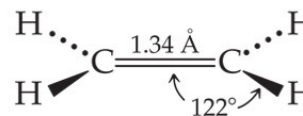


- Alkenes

ALKENE
Ethylene $\text{CH}_2=\text{CH}_2$

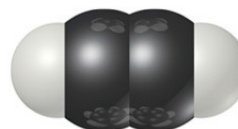


(b)

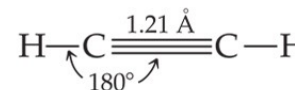


- Alkynes

ALKYNE
Acetylene $\text{CH}\equiv\text{CH}$

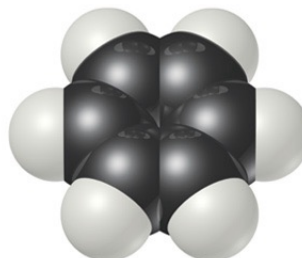


(c)

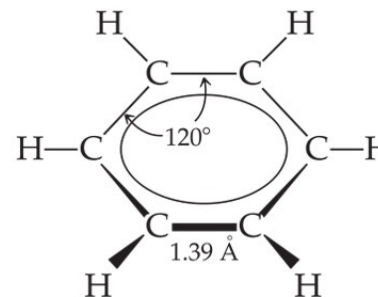


- Aromatic hydrocarbons

AROMATIC
Benzene C_6H_6

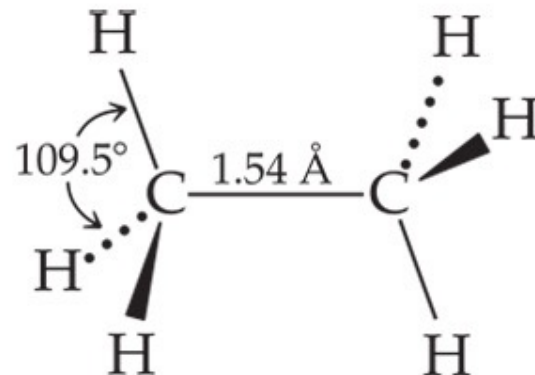


(d)



Alkanes

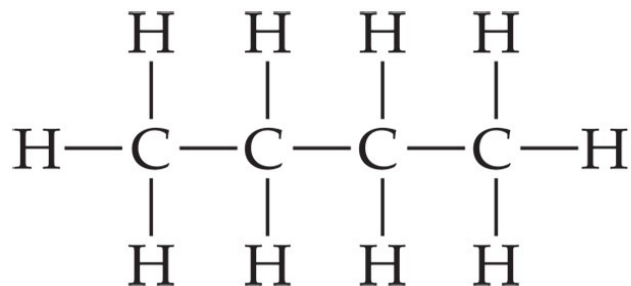
ALKANE
Ethane



- Only single bonds.
- Saturated hydrocarbons.
 - “Saturated” with hydrogens.

Formulas

- Lewis structures of alkanes look like this.
- Also called structural formulas.
- Often not convenient, though...

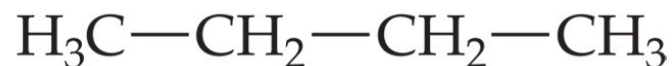
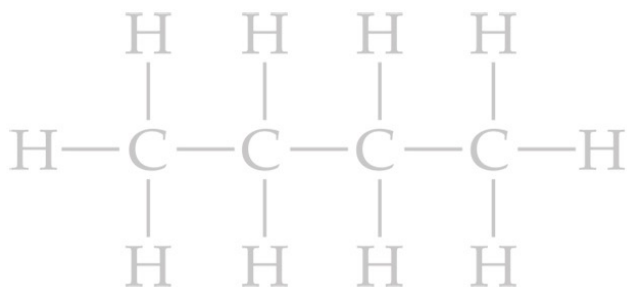


or



Formulas

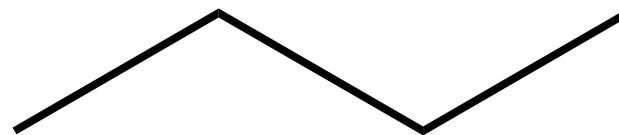
...so more often condensed formulas are used.



or



or



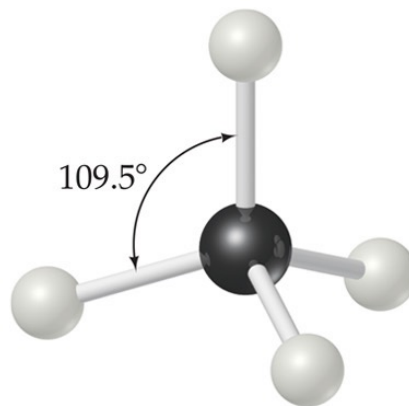
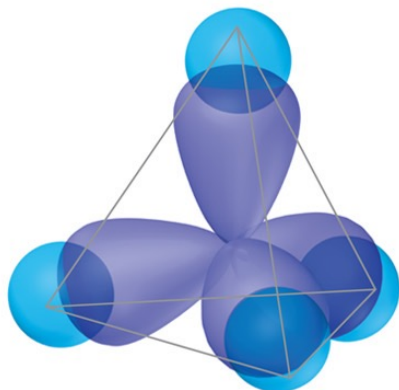
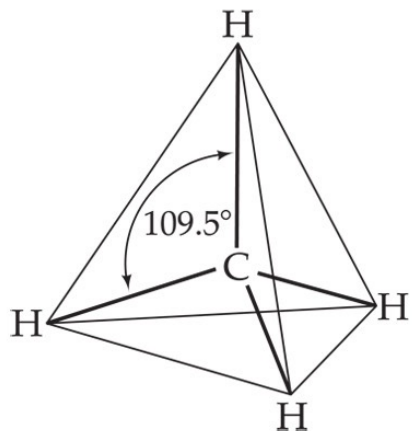
Note: always **4 bonds** to Carbon.

Properties of Alkanes

Molecular Formula	Condensed Structural Formula	Name	Boiling Point (°C)
CH ₄	CH ₄	Methane	-161
C ₂ H ₆	CH ₃ CH ₃	Ethane	-89
C ₃ H ₈	CH ₃ CH ₂ CH ₃	Propane	-44
C ₄ H ₁₀	CH ₃ CH ₂ CH ₂ CH ₃	Butane	-0.5
C ₅ H ₁₂	CH ₃ CH ₂ CH ₂ CH ₂ CH ₃	Pentane	36
C ₆ H ₁₄	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃	Hexane	68
C ₇ H ₁₆	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃	Heptane	98
C ₈ H ₁₈	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃	Octane	125
C ₉ H ₂₀	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃	Nonane	151
C ₁₀ H ₂₂	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃	Decane	174

- Only van der Waals force: London force.
- Boiling point increases with length of chain.

Structure of Alkanes

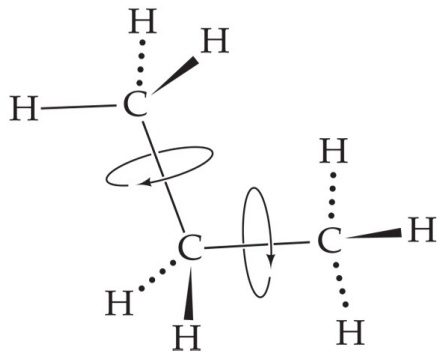


- Carbons in alkanes sp^3 hybrids.
- Tetrahedral geometry.
- 109.5° bond angles.

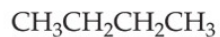
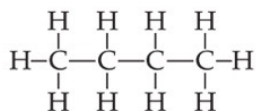
Structure of Alkanes



- Only σ -bonds in alkanes
- Free rotation about C—C bonds.



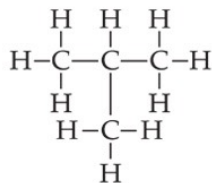
Isomers



Butane

mp -135°C

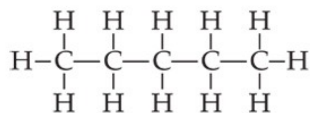
bp -0.5°C



Isobutane
(2-methylpropane)

mp -145°C

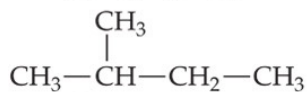
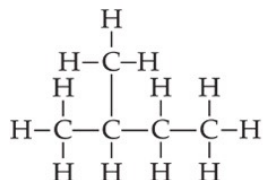
bp -10°C



Pentane

mp -130°C

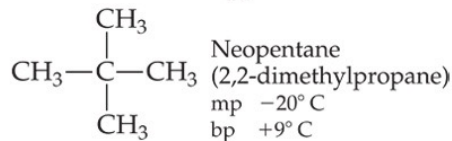
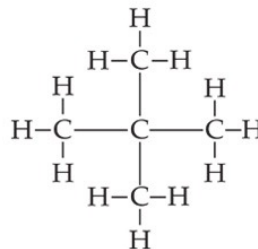
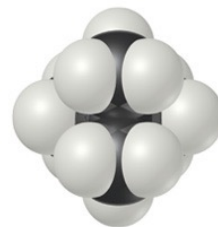
bp $+36^\circ\text{C}$



Isopentane
(2-methylbutane)

mp -160°C

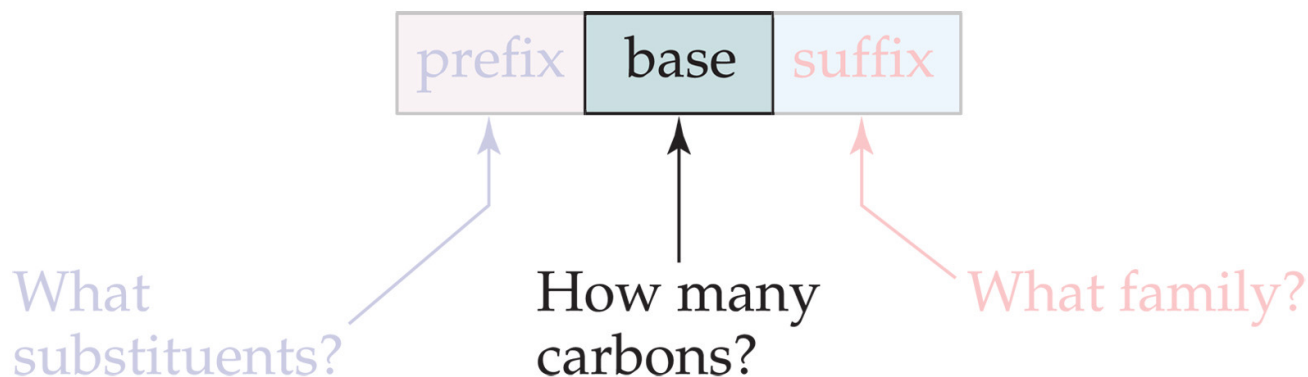
bp $+28^\circ\text{C}$



Have same molecular formulas, but atoms are bonded in different order.

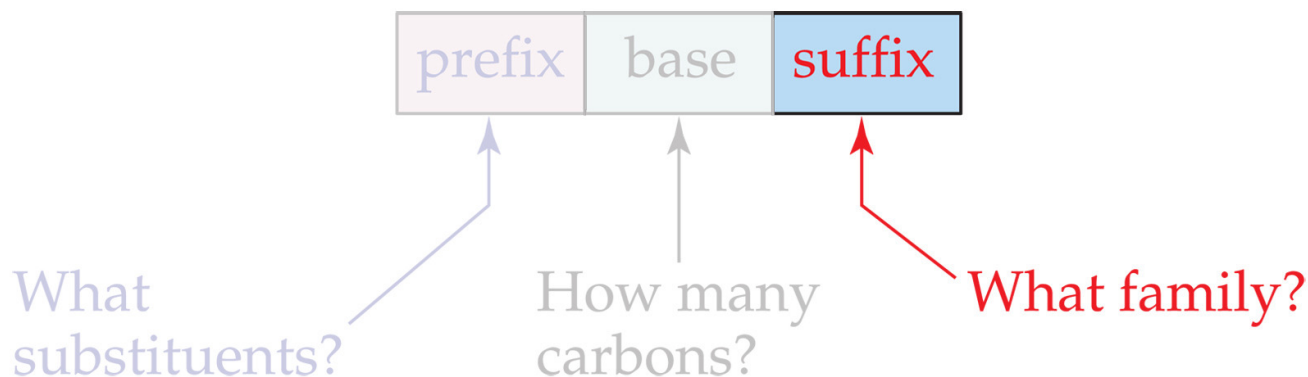
Organic Nomenclature

- Three parts to a compound name:
 - *Base*: Tells how many carbons are in the longest continuous chain.



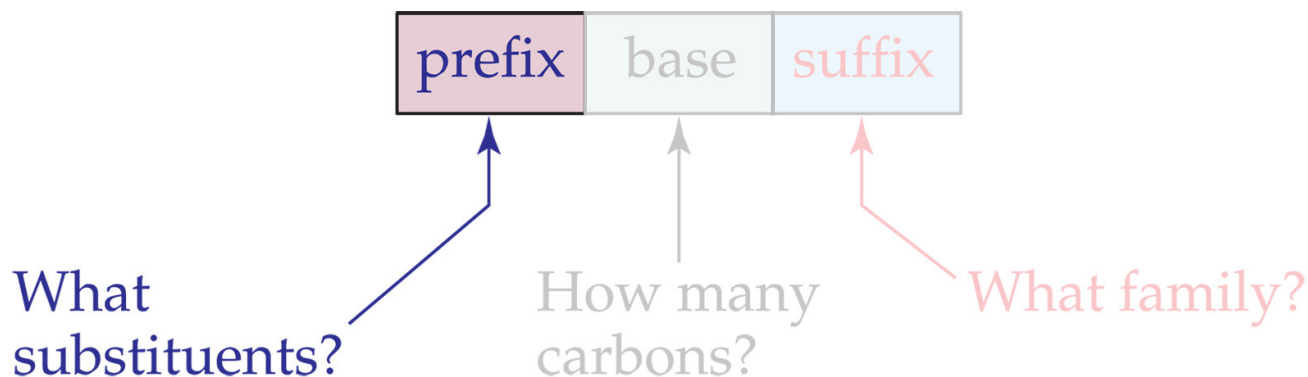
Organic Nomenclature

- Three parts to a compound name:
 - Base: Tells how many carbons are in the longest continuous chain.
 - Suffix: Tells what type of compound it is.

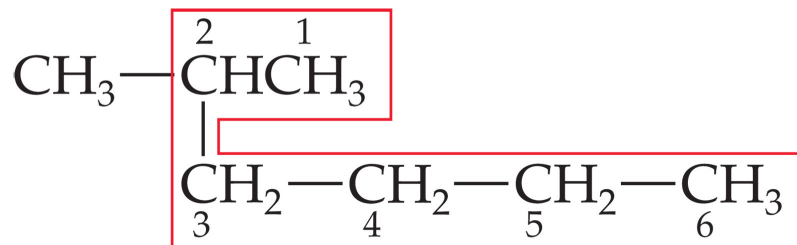


Organic Nomenclature

- Three parts to a compound name:
 - Base: Tells how many carbons are in the longest continuous chain.
 - Suffix: Tells what type of compound it is.
 - Prefix: Tells what groups are attached to chain.



To Name a Compound...

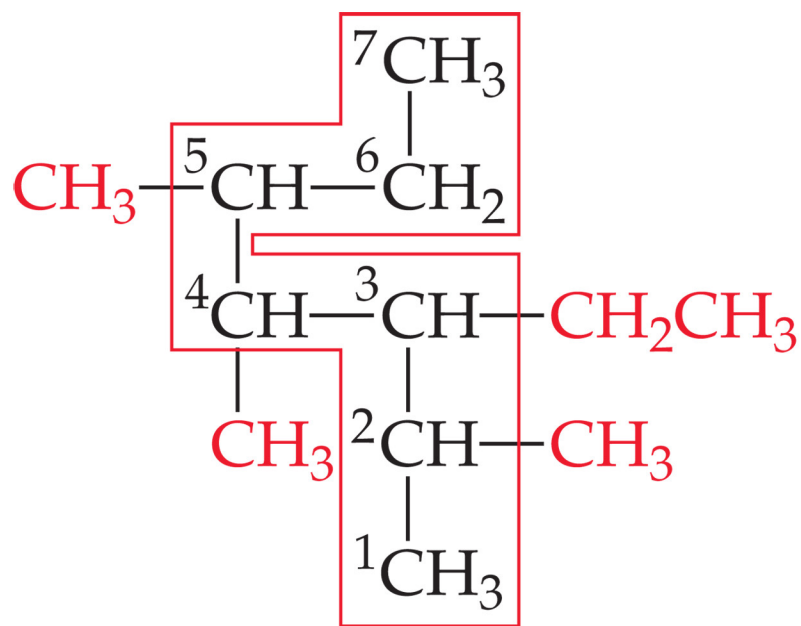


2-Methylhexane

1. Find the longest chain in the molecule.
2. Number the chain from the end nearest the first substituent encountered.
3. List the substituents as a prefix along with the number(s) of the carbon(s) to which they are attached.

Group	Name
CH ₃ —	Methyl
CH ₃ CH ₂ —	Ethyl
CH ₃ CH ₂ CH ₂ —	Propyl
CH ₃ CH ₂ CH ₂ CH ₂ —	Butyl
$ \begin{array}{c} \text{CH}_3 \\ \\ \text{HC} - \\ \\ \text{CH}_3 \end{array} $	Isopropyl
$ \begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3 - \text{C} - \\ \\ \text{CH}_3 \end{array} $	<i>tert</i> -Butyl

To Name a Compound...



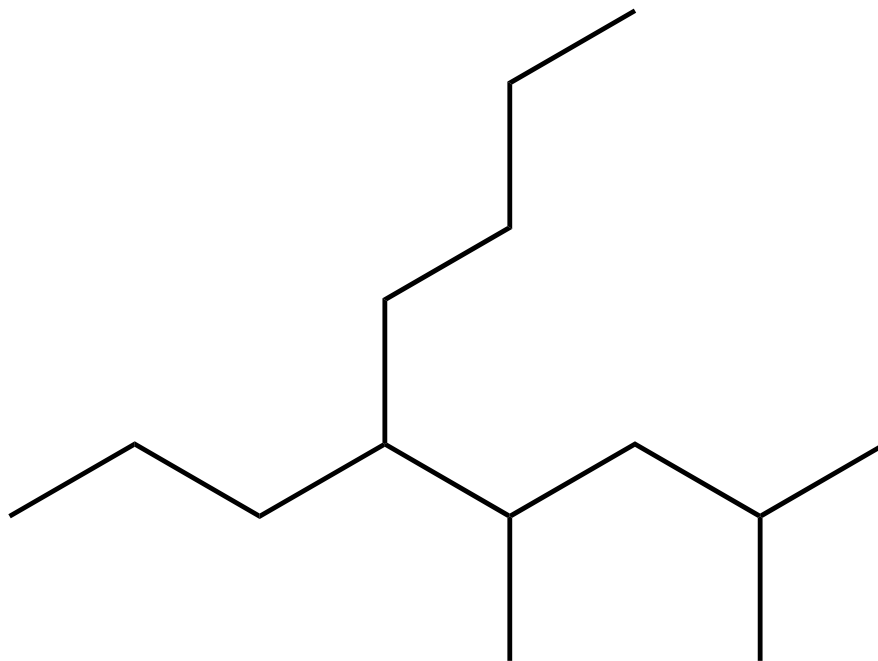
3-Ethyl-2,4,5-trimethylheptane

list substituents
alphabetically.

More than one longest
chain:

pick the one with the
most substituents.

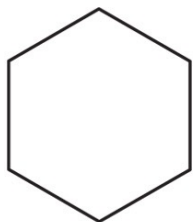
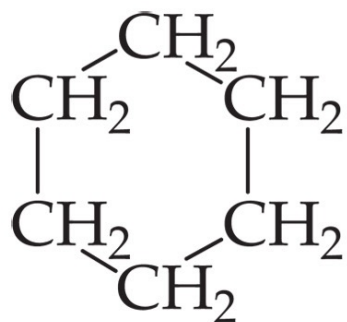
The most substituents:



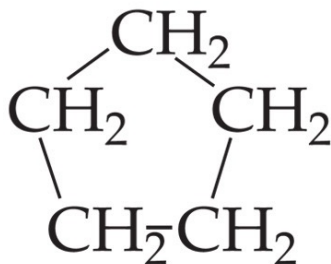
2,4-dimethyl-5-propylnonane

Cycloalkanes

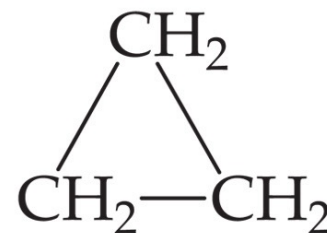
- Carbon can also form ringed structures.
- Five- and six-membered rings are most stable.
 - Can take on conformation in which angles are very close to tetrahedral angle.
 - Smaller rings are quite strained.



Cyclohexane



Cyclopentane



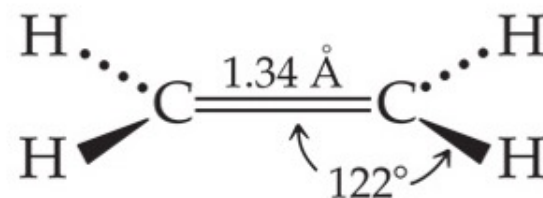
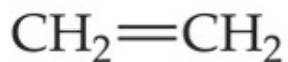
Cyclopropane

Reactions of Alkanes

- Rather unreactive due to presence of only C—C and C—H σ -bonds.
- Therefore, great nonpolar solvents.
- General rule of organic chemistry;
 - reactivity comes from the **functional groups**, ie. the part of the molecule that is not just an alkane.
 - different functional groups give rise to different kinds of activity.

Alkenes

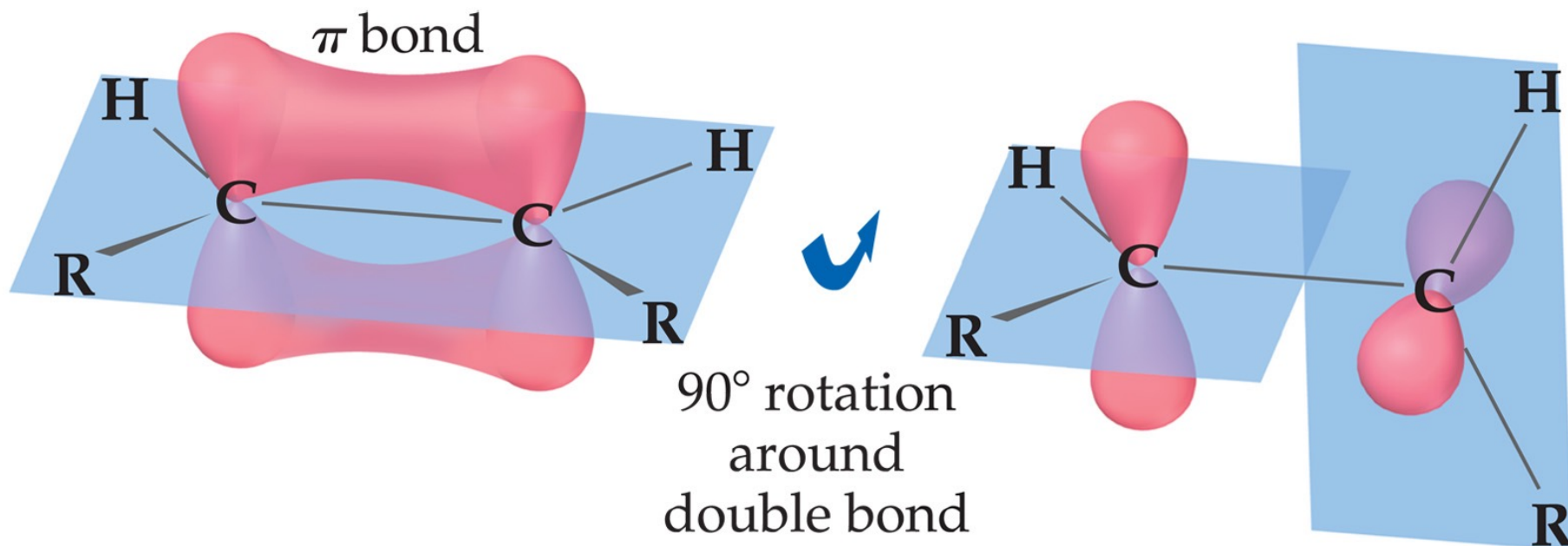
ALKENE
Ethylene



- Contain at least **one** carbon–carbon double bond.
- Unsaturated.
 - Have fewer than maximum number of hydrogens.

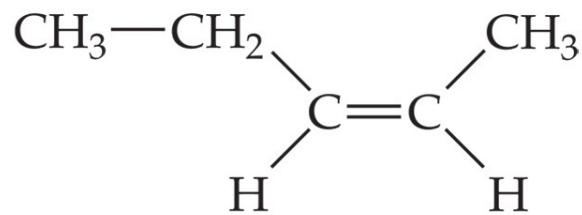
Structure of Alkenes

- Unlike alkanes, alkenes cannot rotate freely about the double bond.
 - **Side-to-side overlap makes this impossible without breaking π -bond.**

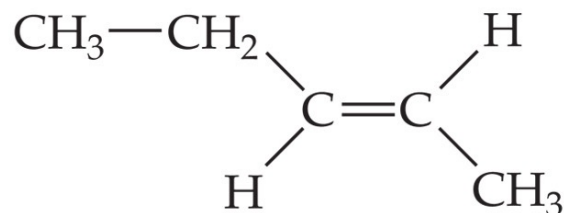


Structure of Alkenes

This creates geometric isomers, which differ from each other in the spatial arrangement of groups about the double bond.

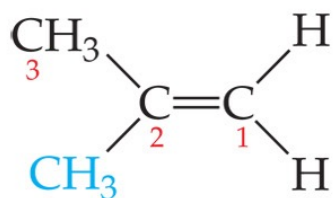


cis-2-Pentene

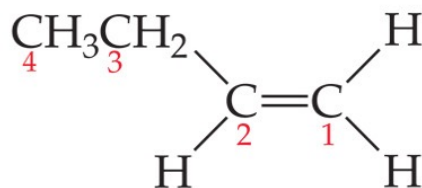


trans-2-Pentene

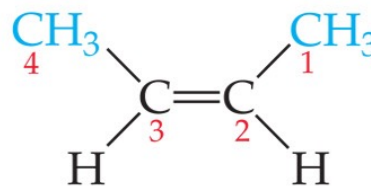
Properties of Alkenes



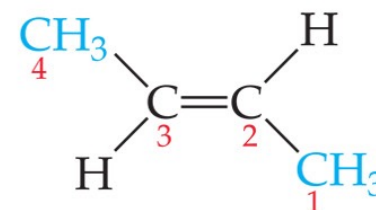
Methylpropene
bp -7°C



1-Butene
bp -6°C



cis-2-Butene
bp $+4^{\circ}\text{C}$



trans-2-Butene
bp $+1^{\circ}\text{C}$

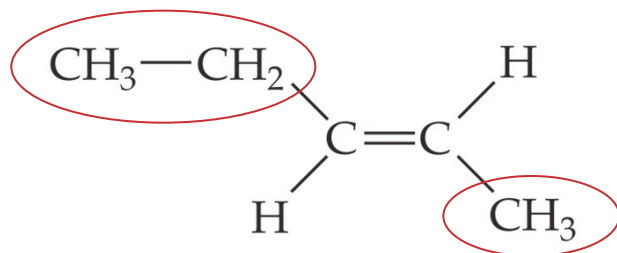
Structure also affects physical properties of alkenes.

Nomenclature of Alkenes

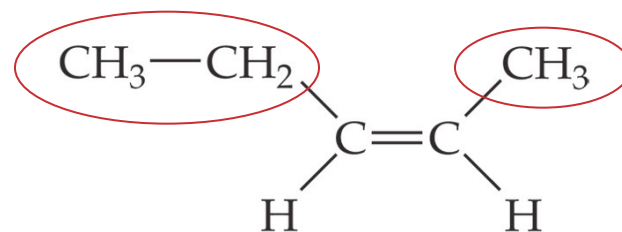
- Chain numbered so double bond gets **smallest** possible number.
- *cis*- alkenes have **carbons** in chain on same side of molecule.
- *trans*- alkenes have carbons in chain on opposite side of molecule.



1-Pentene

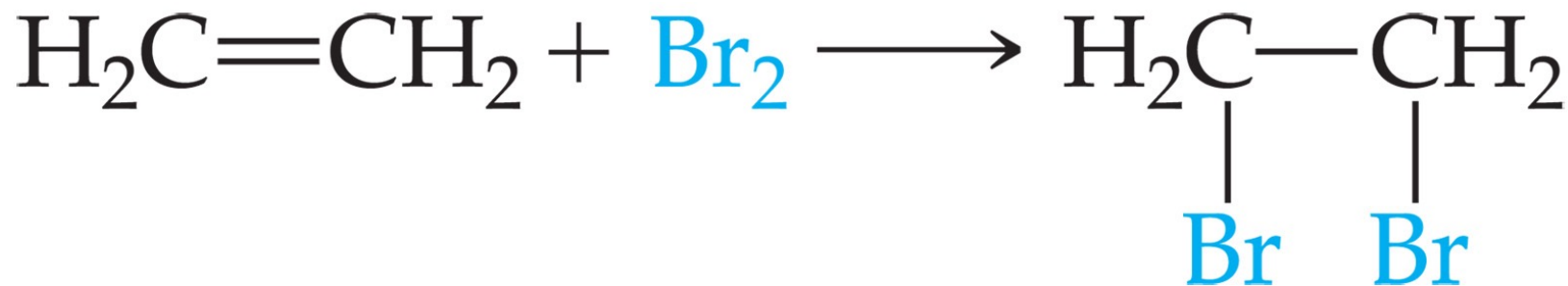


trans-2-Pentene



cis-2-Pentene

Reactions of Alkenes



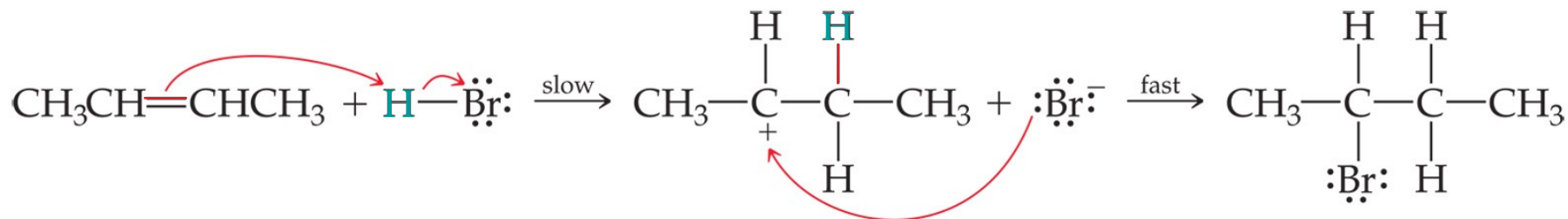
- Addition Reactions

- Two atoms (e.g., bromine) add across the double bond.
- One π -bond and one σ -bond are replaced by two σ -bonds; therefore, ΔH is negative.

“Arrow pushing

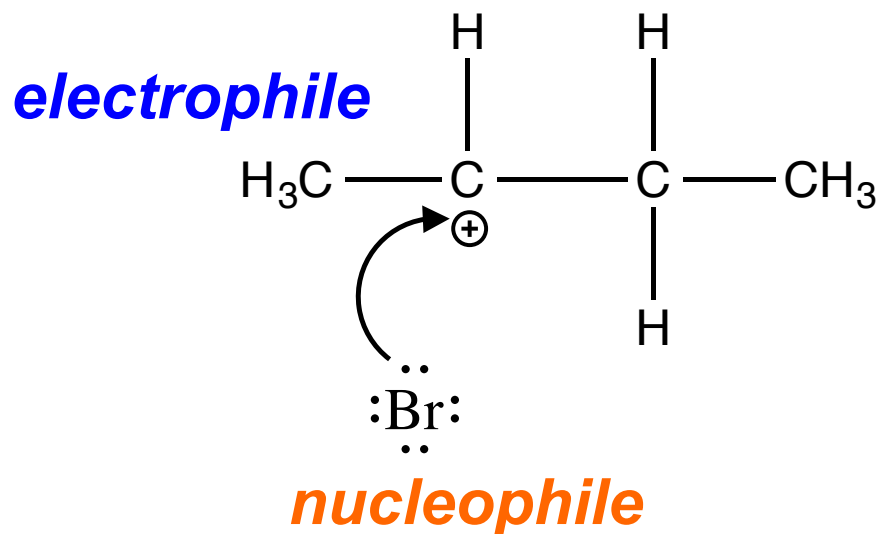
- The organic chemist's language of reaction mechanism

Mechanism of Addition Reactions



- **The basics of arrow pushing:**
 - Arrow goes from where electrons come from to where they are going.
 - Double headed arrow indicates 2 electrons
 - Single headed arrow indicates 1 electron
- **Alkene addition two-step mechanism:**
 - First step is slow, rate-determining step.
 - Second step is fast.

Mechanism of Addition Reactions

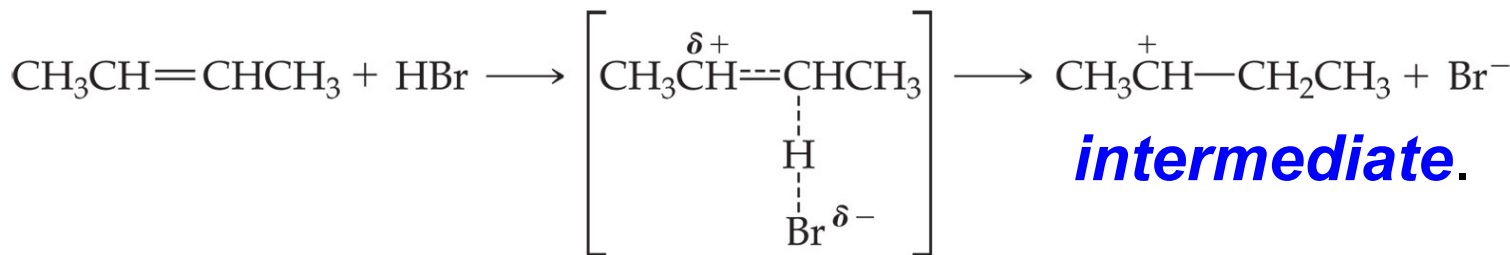
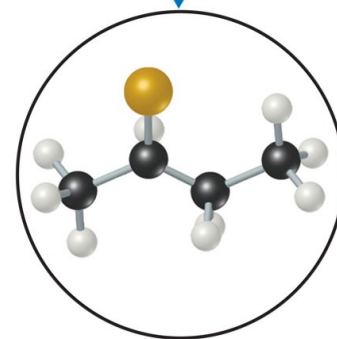
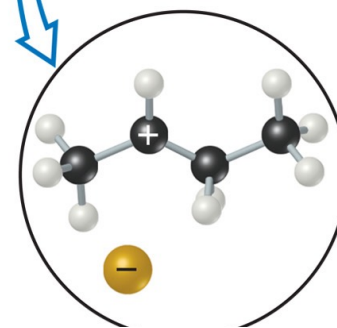
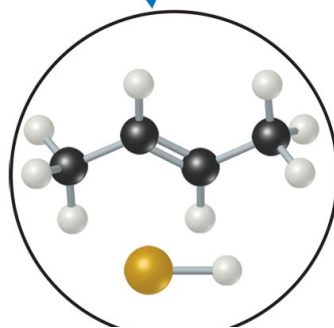
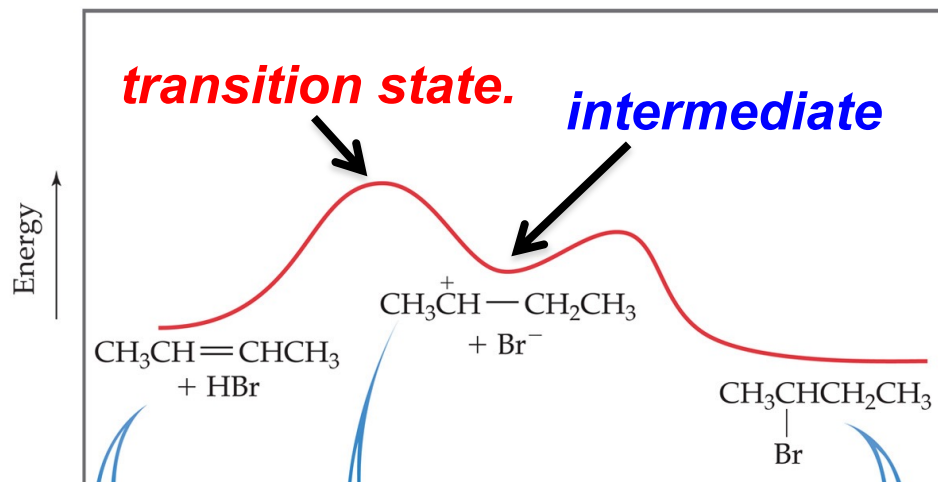


- **The basics of arrow pushing:**
 - Arrow goes from where electrons come from to where they are going.
 - Double headed arrow indicates 2 electrons
 - Single headed arrow indicates 1 electron
 - Arrow goes from *nucleophile* to *electrophile*

Mechanism of Addition Reactions

In first step, π -bond breaks and new C—H bond and cation form. An *intermediate*.

The top of the hill: a *transition state*.



transition state.

intermediate.

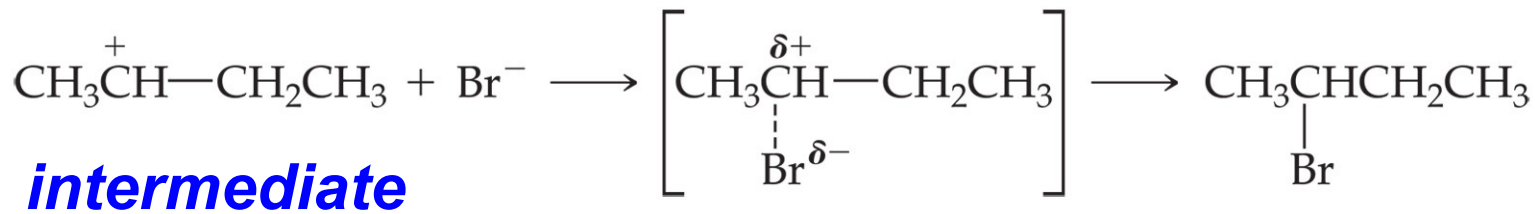
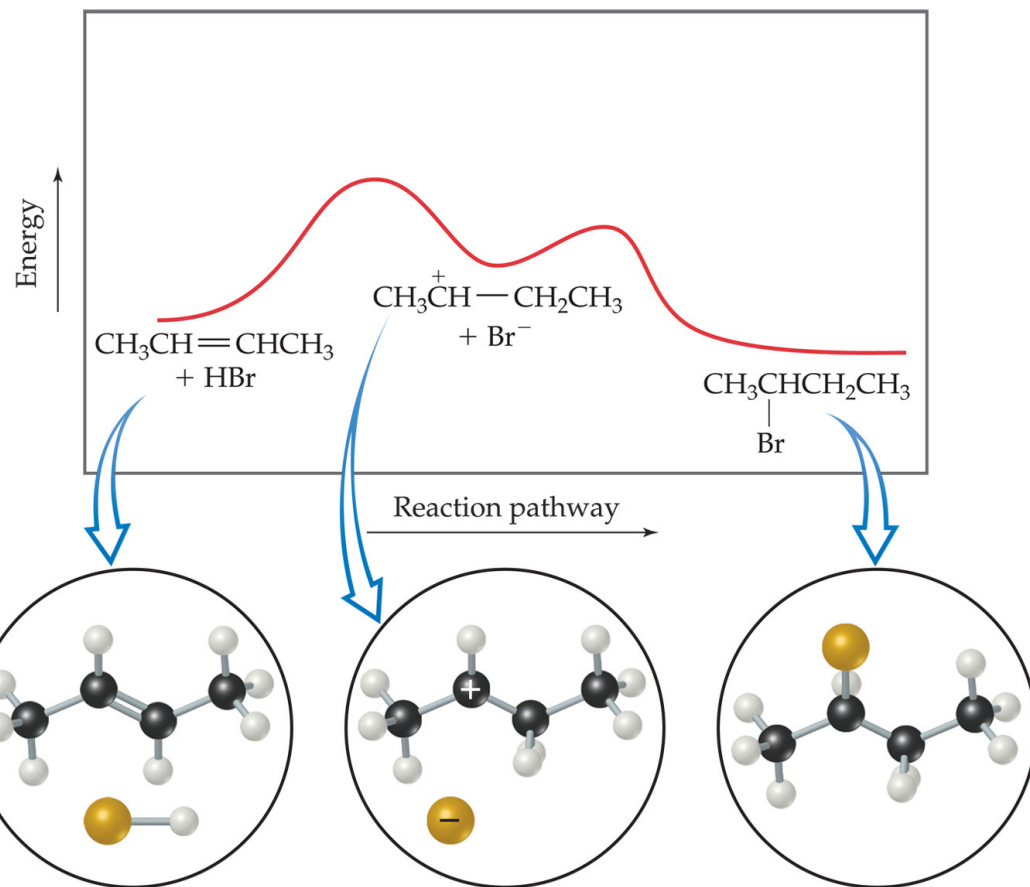
Mechanism of Addition Reactions

Valley in E diagram:

must be an intermediate!

Peak in E diagram:

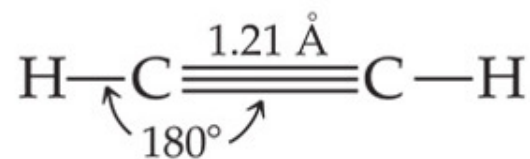
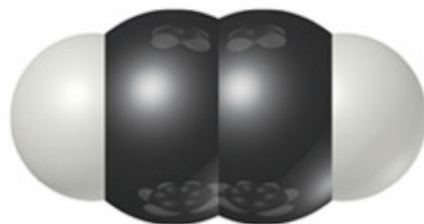
Must be a transition state!



Transition state

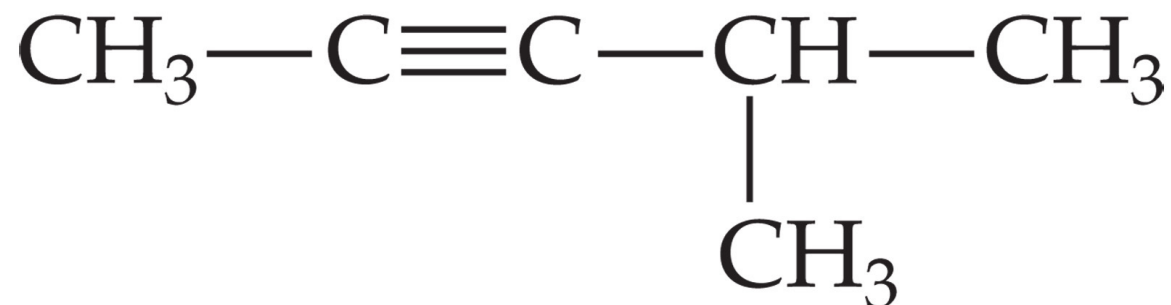
Alkynes

ALKYNE
Acetylene $\text{CH}\equiv\text{CH}$



- Contain at least one carbon–carbon triple bond.
- Carbons in triple bond *sp*-hybridized and have linear geometry.
- Also unsaturated.

Nomenclature of Alkynes

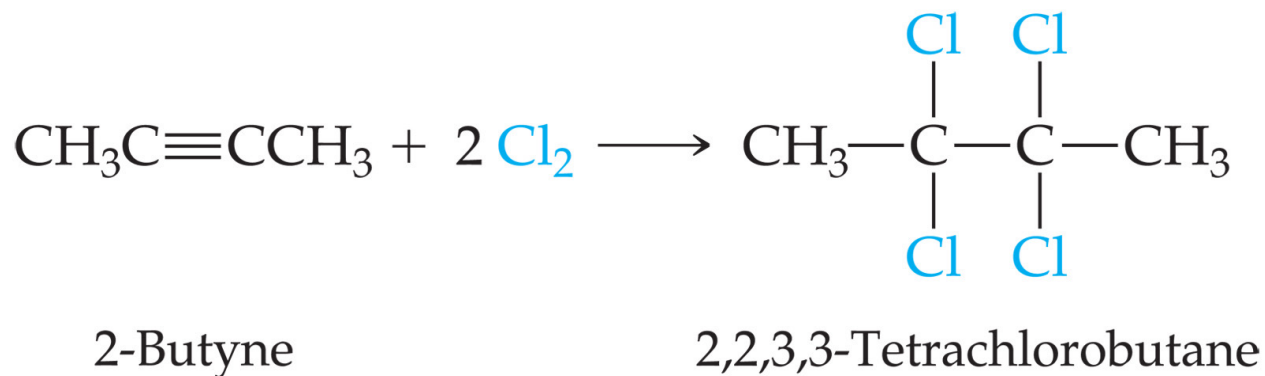


4-methyl-2-pentyne

- Analogous to naming of alkenes.
- Suffix is *-yne* rather than *-ene*.

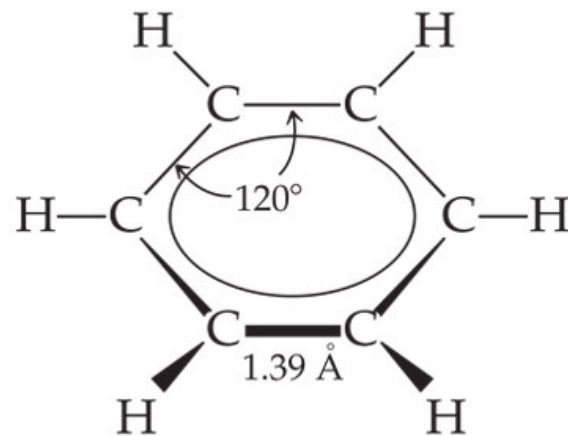
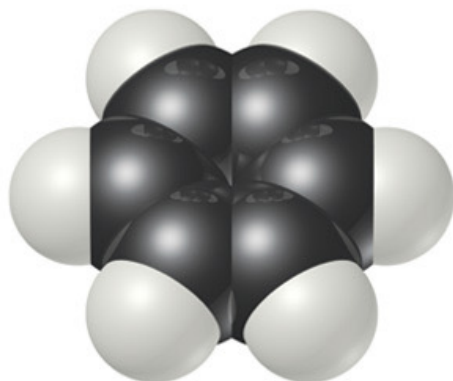
Reactions of Alkynes

- Undergo many of the same reactions alkenes do.
- As with alkenes, impetus for reaction is replacement of π -bonds with σ -bonds.



Aromatic Hydrocarbons

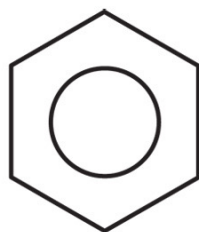
AROMATIC
Benzene C_6H_6



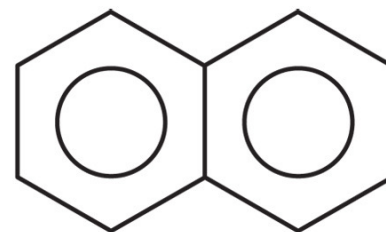
- Cyclic hydrocarbons.
- *p*-Orbital on each atom.
 - Molecule is planar.
- Odd number of electron pairs in π -system.
- $4n+2$ pi electrons in a cycle.

Aromatic Nomenclature

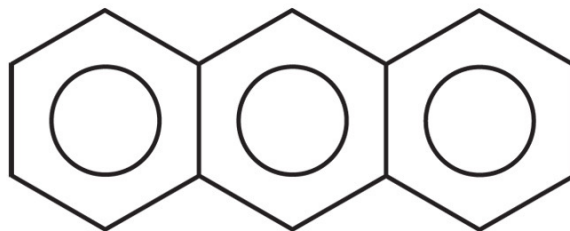
Many aromatic hydrocarbons are known by their common names.



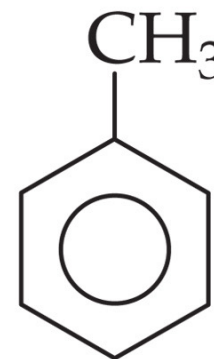
Benzene



Naphthalene

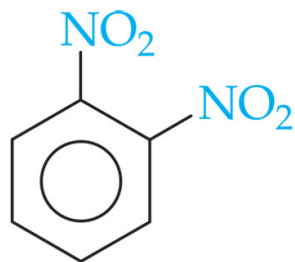


Anthracene

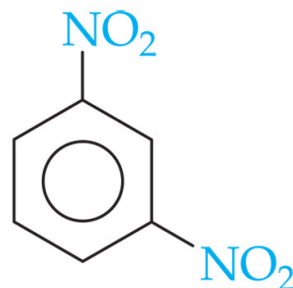


Toluene
Methylbenzene

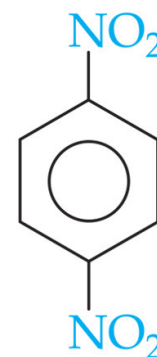
Structure of Aromatic Compounds



ortho-Dinitrobenzene
mp 118°C



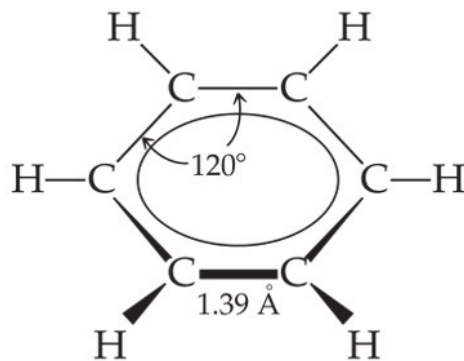
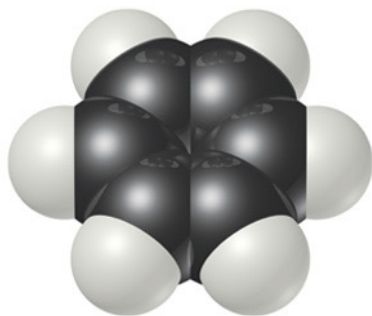
meta-Dinitrobenzene
mp 90°C



para-Dinitrobenzene
mp 174°C

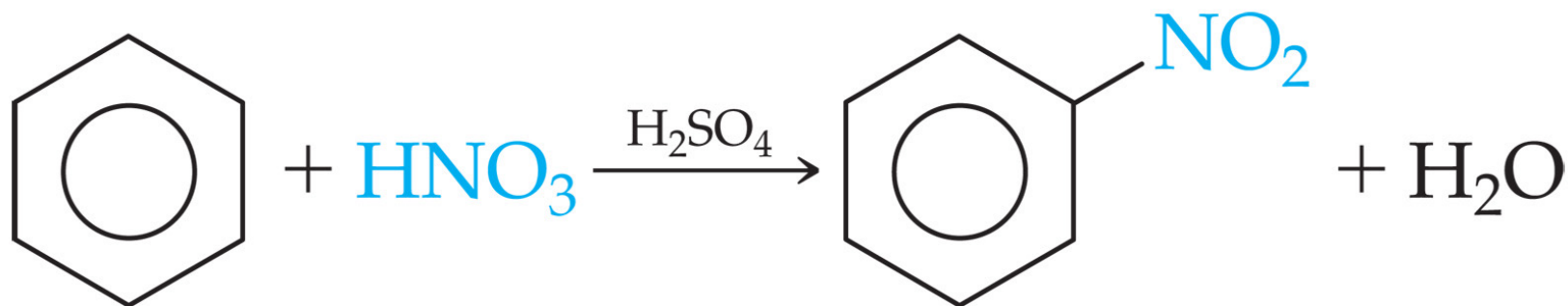
- Two substituents on a benzene ring could have three possible relationships
 - *ortho*-: On adjacent carbons.
 - *meta*-: One carbon between them.
 - *para*-: On opposite sides of ring.

Reactions of Aromatic Compounds



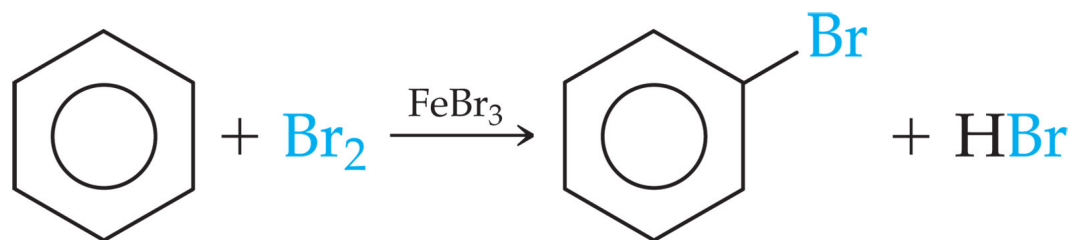
- Unlike in alkenes and alkynes, π -electrons do not sit between two atoms.
- Electrons are delocalized; this stabilizes aromatic compounds.

Reactions of Aromatic Compounds

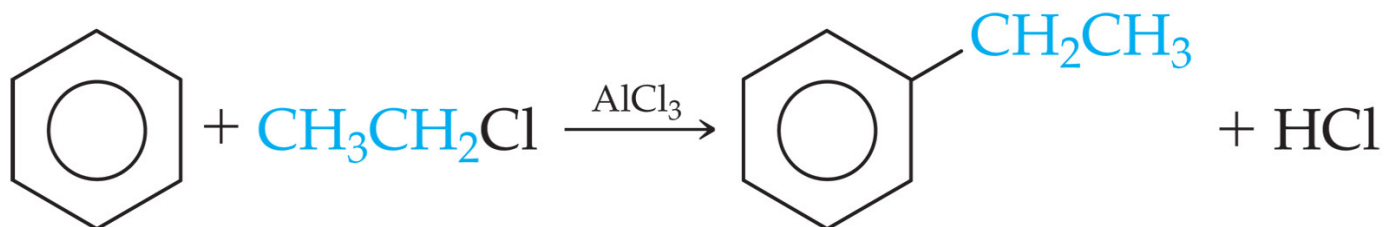


- Due to stabilization, aromatic compounds do not undergo addition reactions; they undergo substitution.
- Hydrogen is replaced by substituent.

Reactions of Aromatic Compounds



Halogenation



Friedel-Crafts Reaction

Reactions of aromatic compounds often require a catalyst.

Functional Group	Type of Compound	Suffix or Prefix	Example	Systematic Name (common name)
	Alkene	-ene		Ethene (Ethylene)
	Alkyne	-yne		Ethyne (Acetylene)
	Alcohol	-ol		Methanol (Methyl alcohol)
	Ether	ether		Dimethyl ether
	Haloalkane (X = halogen)	halo-		Chloromethane (Methyl chloride)
	Amine	-amine		Ethylamine
	Aldehyde	-al		Ethanal (Acetaldehyde)
	Ketone	-one		Propanone (Acetone)
	Carboxylic acid	-oic acid		Ethanoic acid (Acetic acid)
	Ester	-oate		Methyl ethanoate (Methyl acetate)
	Amide	-amide		Ethanamide (Acetamide)

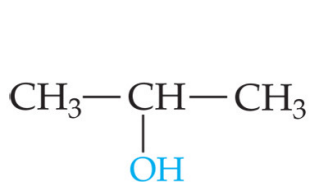
Functional Groups

The non alkane part of an organic molecule.

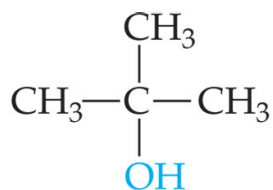
The more reactive part.

Alcohols

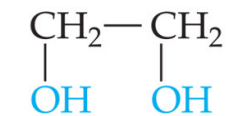
- Contain one or more hydroxyl groups, —OH
 - Named from parent hydrocarbon; suffix changed to *-ol* and number designates carbon to which hydroxyl is attached.



2-Propanol
Isopropyl alcohol;
rubbing alcohol



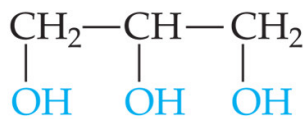
2-Methyl-2-propanol
t-Butyl alcohol



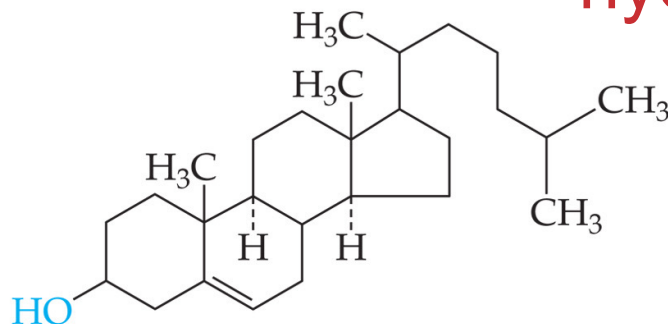
1,2-Ethanediol
Ethylene glycol



Phenol

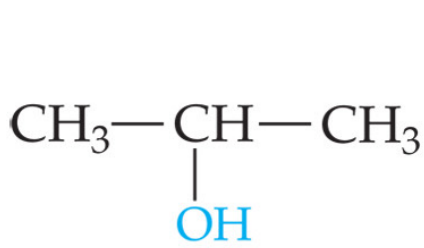


1,2,3-Propanetriol
Glycerol; glycerin

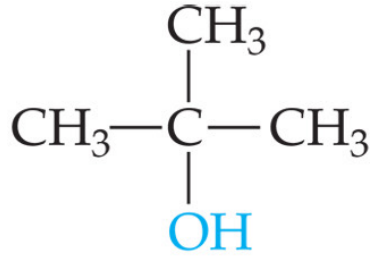


Cholesterol

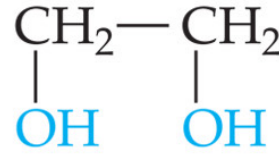
Alcohols



2-Propanol
Isopropyl alcohol;
rubbing alcohol



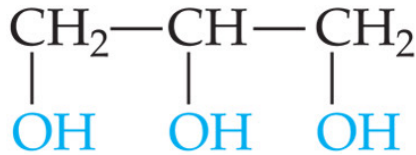
2-Methyl-2-propanol
t-Butyl alcohol



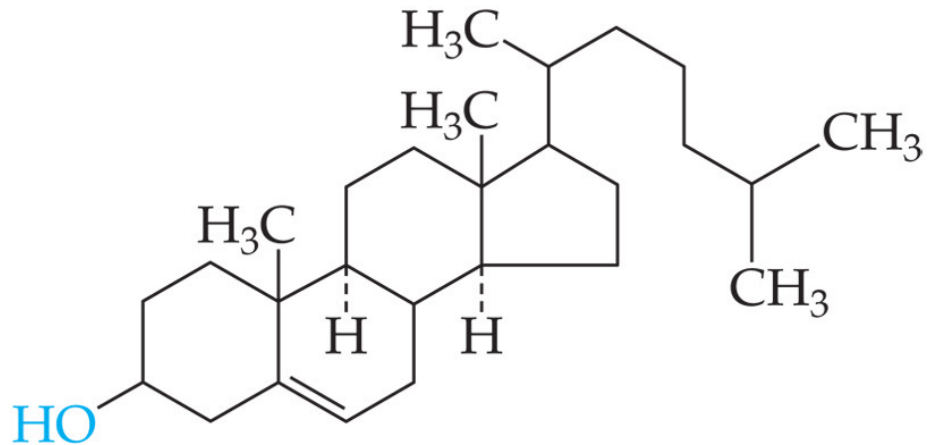
1,2-Ethandiol
Ethylene glycol



Phenol

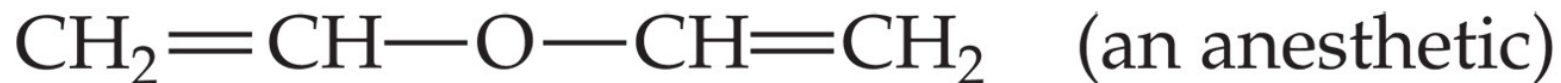


1,2,3-Propanetriol
Glycerol; glycerin



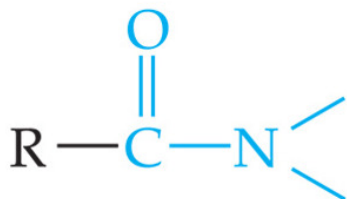
Cholesterol
a steroid

Ethers



- Tend to be quite unreactive.
- Therefore, they are good polar solvents.

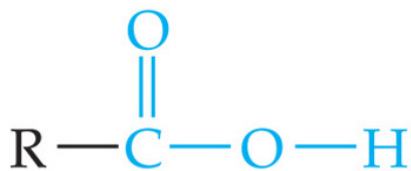
Carbonyl Compounds



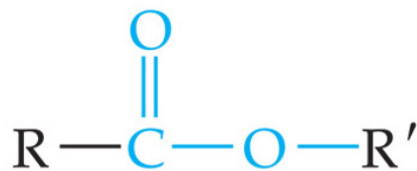
Amide



Aldehyde



Carboxylic
acid



Ester

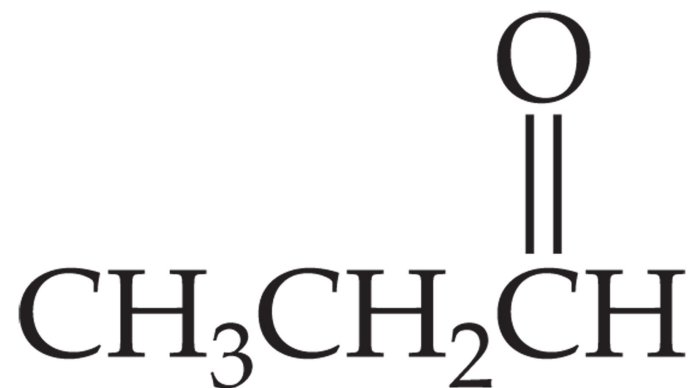


Ketone

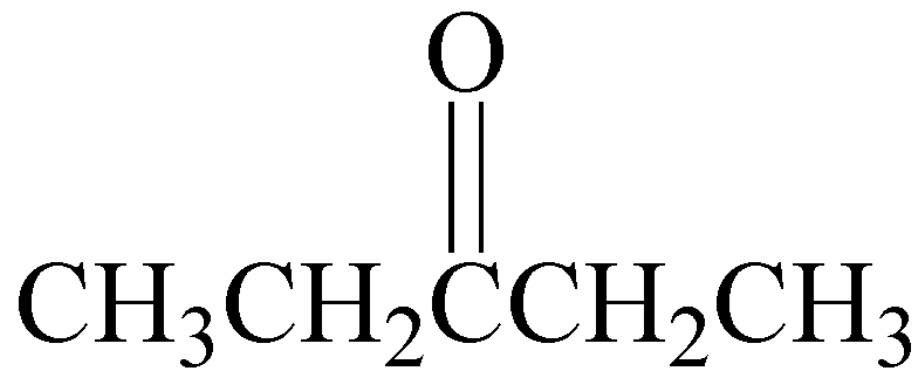
- Contain C—O double bond.
- Include many classes of compounds.

Aldehydes

At least one
hydrogen attached
to carbonyl carbon.



Ketones



Two carbons
bonded to
carbonyl carbon.

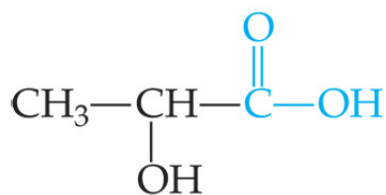
Carboxylic Acids

- Have hydroxyl group bonded to carbonyl group.
- Tart tasting.
- Carboxylic acids are weak acids .

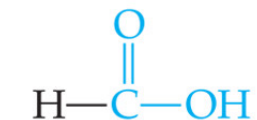


Acetic acid

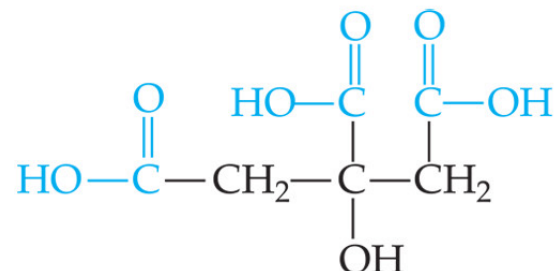
Carboxylic Acids



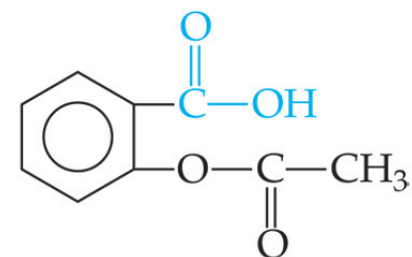
Lactic acid



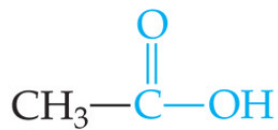
Methanoic acid
Formic acid



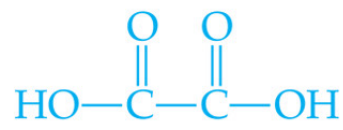
Citric acid



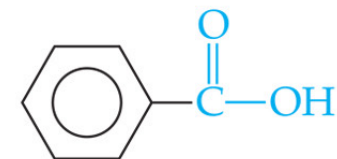
Acetylsalicylic acid
Aspirin



Ethanoic acid
Acetic acid

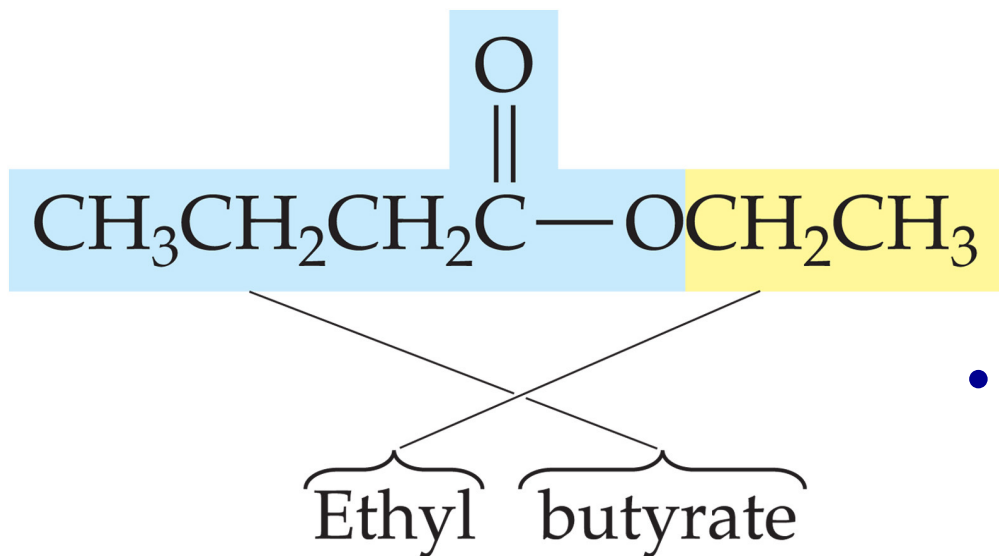


Oxalic acid



Phenyl methanoic acid
Benzoic acid

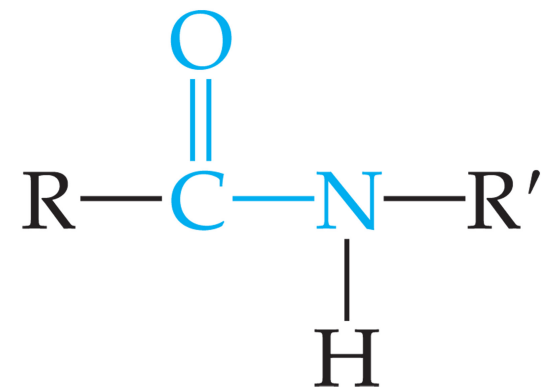
Esters



- Products of reaction between carboxylic acids and alcohols.
- Found in many fruits and perfumes.

Amides

Formed by reaction of carboxylic acids with amines.



Amines

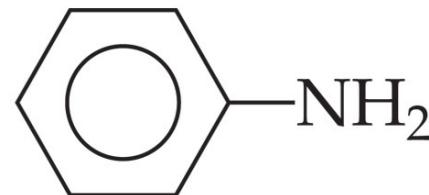
- Organic bases.
- Generally have strong, unpleasant odors.



Ethylamine



Trimethylamine



Phenylamine
Aniline

Exam 4 Topics

1. Valence bond theory
2. Molecular orbital theory
3. Coordination chemistry
4. Organic

Valence bond theory:

1. Hybridization (mostly covered in last exam)
2. Double bonds due to overlap of atomic p orbitals (pi bonds)
3. Concept of delocalization what orbitals are overlapping in a delocalized system?

Exam 4, MO theory and coordination compounds

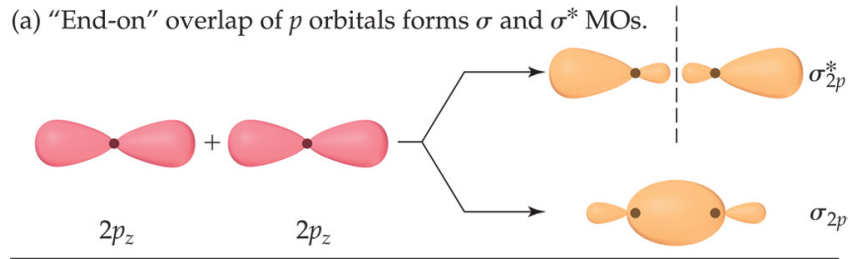
Chapter 9, end and Chapter 24.

MO theory: Rules:

- 1. The number of MO's equals the # of Atomic orbitals
- 2. The overlap of two atomic orbitals gives two molecular orbitals, 1 bonding, one antibonding
- 3. Atomic orbitals combine with other atomic orbitals of *similar energy*.
- 4. Degree of overlap matters. More overlap means bonding orbital goes *lower* in E, antibonding orbital goes *higher* in E.
- 5. Each MO gets two electrons
- 6. Orbitals of the *same energy* get filled 1 electron at a time until they are filled.

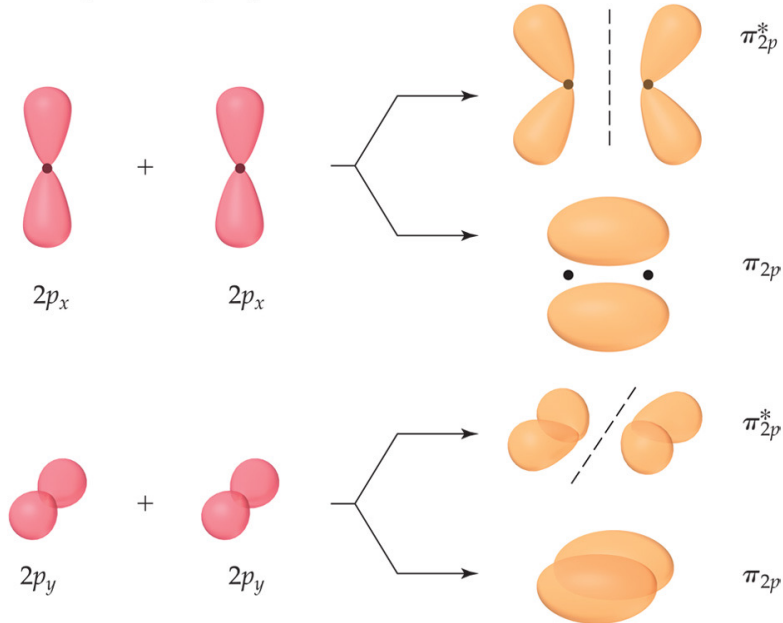
Difference between pi and sigma orbitals

(a) "End-on" overlap of p orbitals forms σ and σ^* MOs.



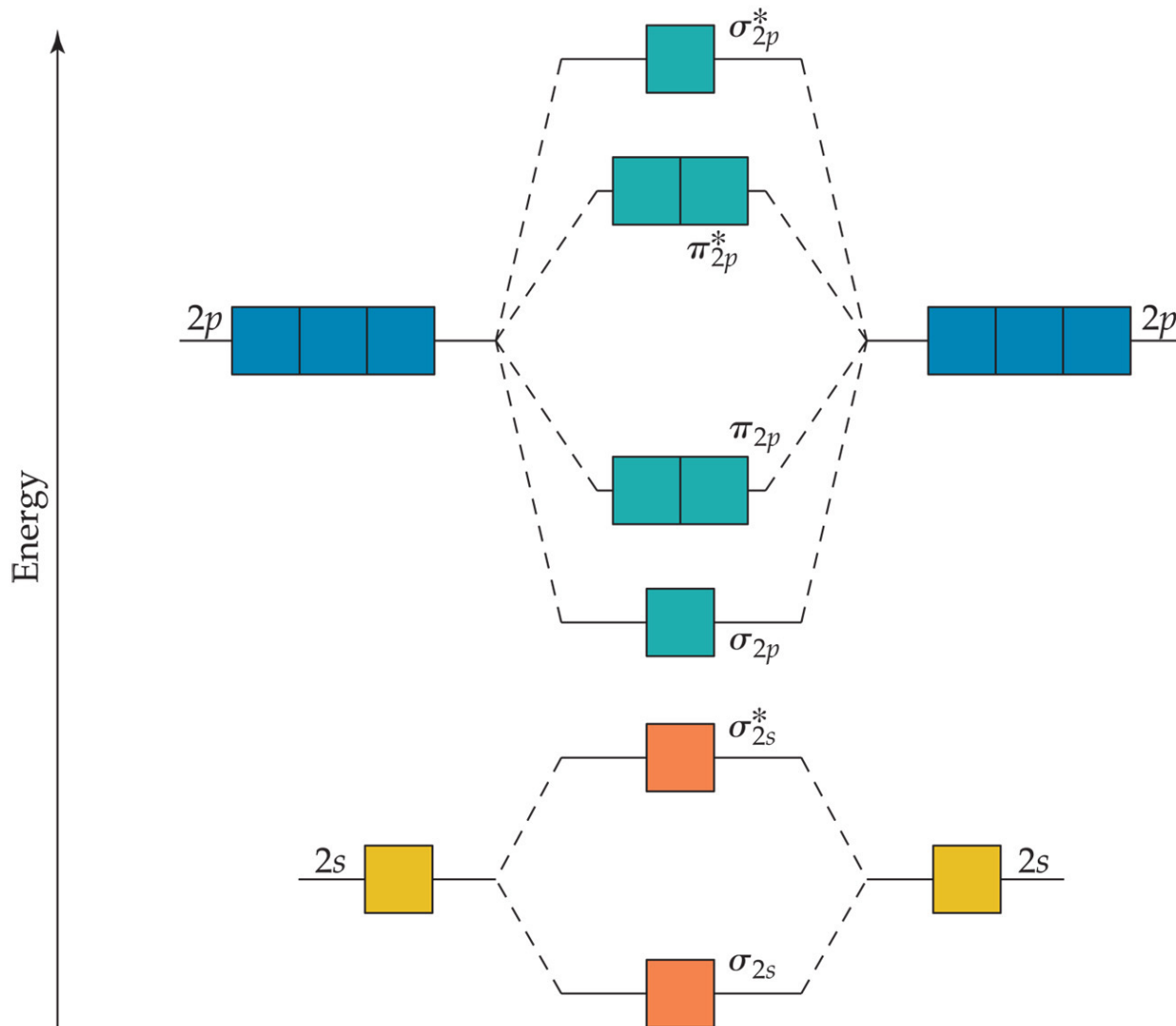
End on

(b) "Sideways" overlap of p orbitals forms two sets of π and π^* MOs.



Side to side.

A typical MO diagram, like the one below.



Filling MO diagrams. Bond order etc.

	Large 2s-2p interaction			Small 2s-2p interaction		
	B ₂	C ₂	N ₂	O ₂	F ₂	Ne ₂
σ_{2p}^*	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox" value="1↓"/>
π_{2p}^*	<input type="checkbox" value="1"/> <input type="checkbox"/>	<input type="checkbox" value="1"/> <input type="checkbox" value="1"/>	<input type="checkbox" value="1"/> <input type="checkbox" value="1"/>	<input type="checkbox" value="1"/> <input type="checkbox" value="1"/>	<input type="checkbox" value="1"/> <input type="checkbox" value="1"/>	<input type="checkbox" value="1"/> <input type="checkbox" value="1"/>
σ_{2p}	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox" value="1↓"/>	<input type="checkbox" value="1↓"/> <input type="checkbox" value="1↓"/>	<input type="checkbox" value="1↓"/> <input type="checkbox" value="1↓"/>	<input type="checkbox" value="1↓"/> <input type="checkbox" value="1↓"/>
π_{2p}	<input type="checkbox" value="1"/> <input type="checkbox" value="1"/>	<input type="checkbox" value="1"/> <input type="checkbox" value="1"/>	<input type="checkbox" value="1"/> <input type="checkbox" value="1"/>	<input type="checkbox" value="1↓"/>	<input type="checkbox" value="1↓"/>	<input type="checkbox" value="1↓"/>
σ_{2s}^*	<input type="checkbox" value="1↓"/>	<input type="checkbox" value="1↓"/>	<input type="checkbox" value="1↓"/>	<input type="checkbox" value="1↓"/>	<input type="checkbox" value="1↓"/>	<input type="checkbox" value="1↓"/>
σ_{2s}	<input type="checkbox" value="1↓"/>	<input type="checkbox" value="1↓"/>	<input type="checkbox" value="1↓"/>	<input type="checkbox" value="1↓"/>	<input type="checkbox" value="1↓"/>	<input type="checkbox" value="1↓"/>
Bond order	1	2	3	2	1	0
Bond enthalpy (kJ/mol)	290	620	941	495	155	—
Bond length (Å)	1.59	1.31	1.10	1.21	1.43	—
Magnetic behavior	Paramagnetic	Diamagnetic	Diamagnetic	Paramagnetic	Diamagnetic	—

Exam 4 Coordination compounds.

Terms and concepts:

1. Coordination sphere
2. Ligand
3. Coordination compound
4. Metal complex
5. Complex ion
6. Coordination
7. Coordination number

Same ligands different properties?

Figuring oxidation number on metal

Polydentate ligands (what are they)?

Isomers.

structural isomers (formula same, bonds differ)

geometric isomers (formula AND bonds same,
structure differs)

Stereoisomers:

Chirality, handedness,

Isomers
(same formula, different properties)

Structural isomers
(different bonds)

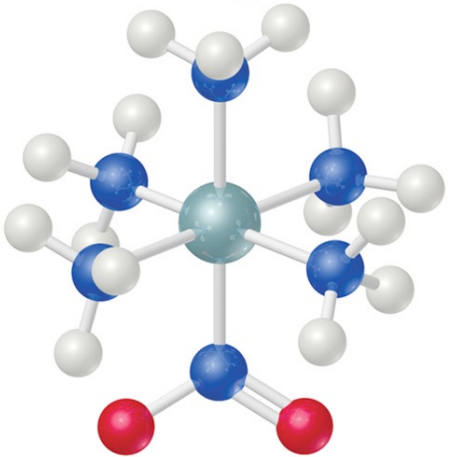
Stereoisomers
(same bonds, different arrangements)

**Coordination-
sphere isomers**

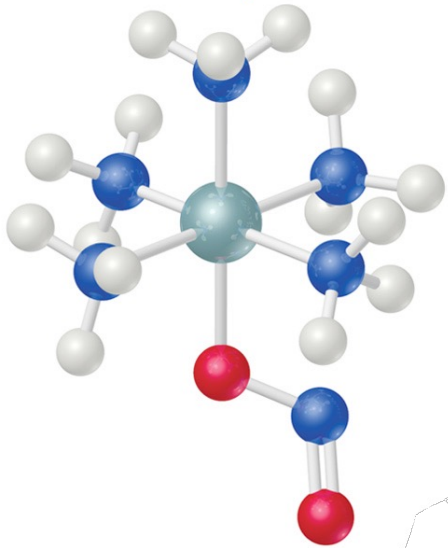
**Linkage
isomers**

**Geometric
isomers**

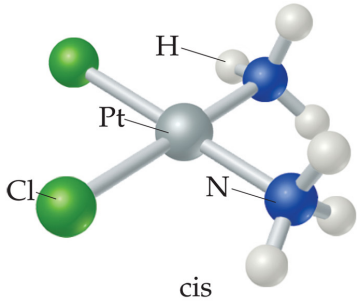
**Optical
isomers**



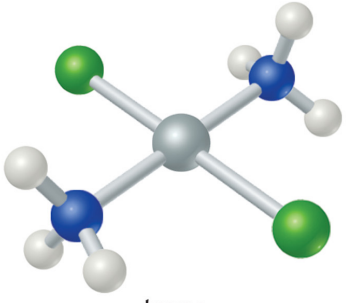
Nitro isomer



Nitrito isomer

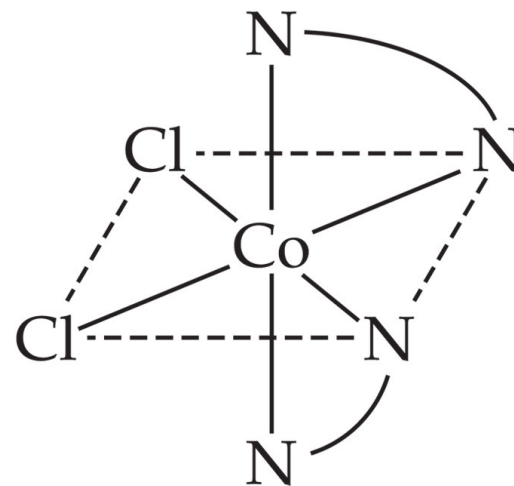
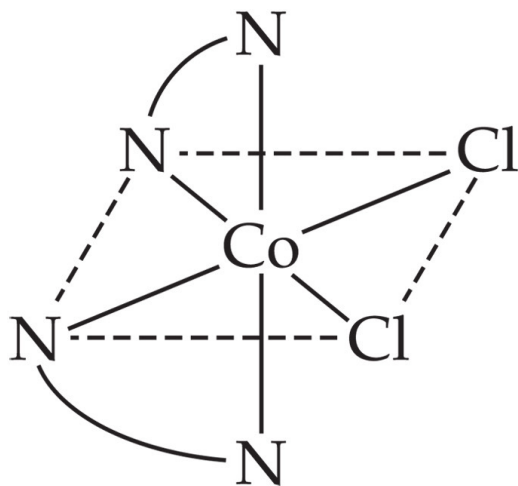
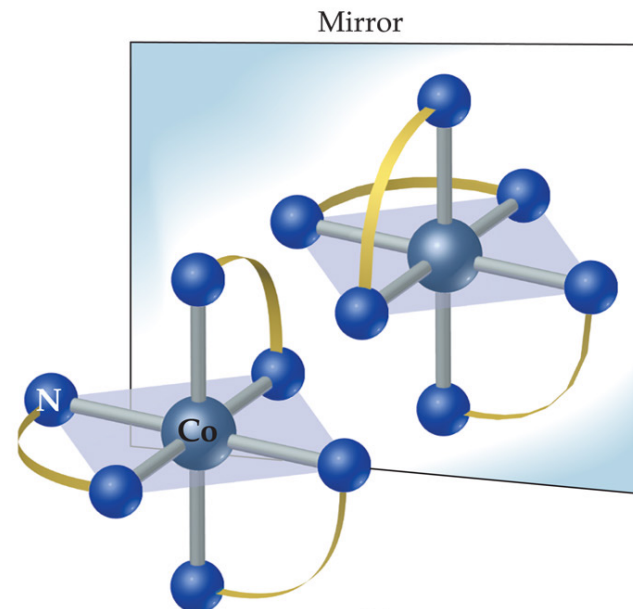
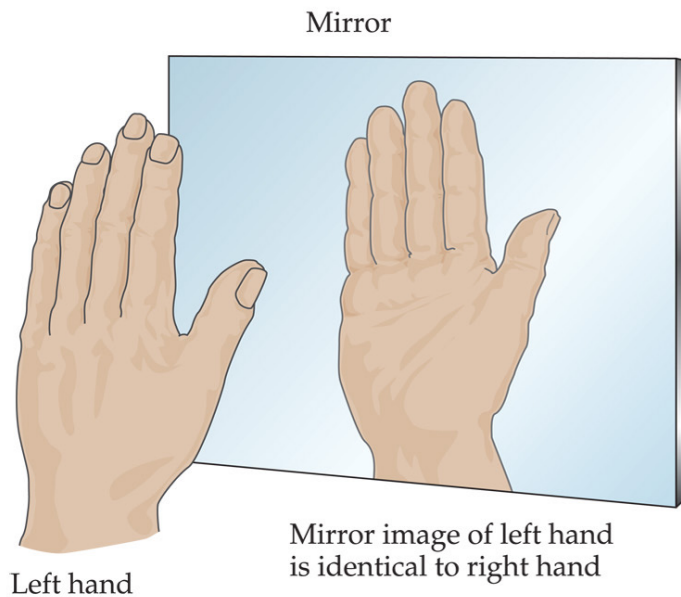


cis



trans

Stereoisomers



Explaining the properties of metal complexes

Magnetism and color

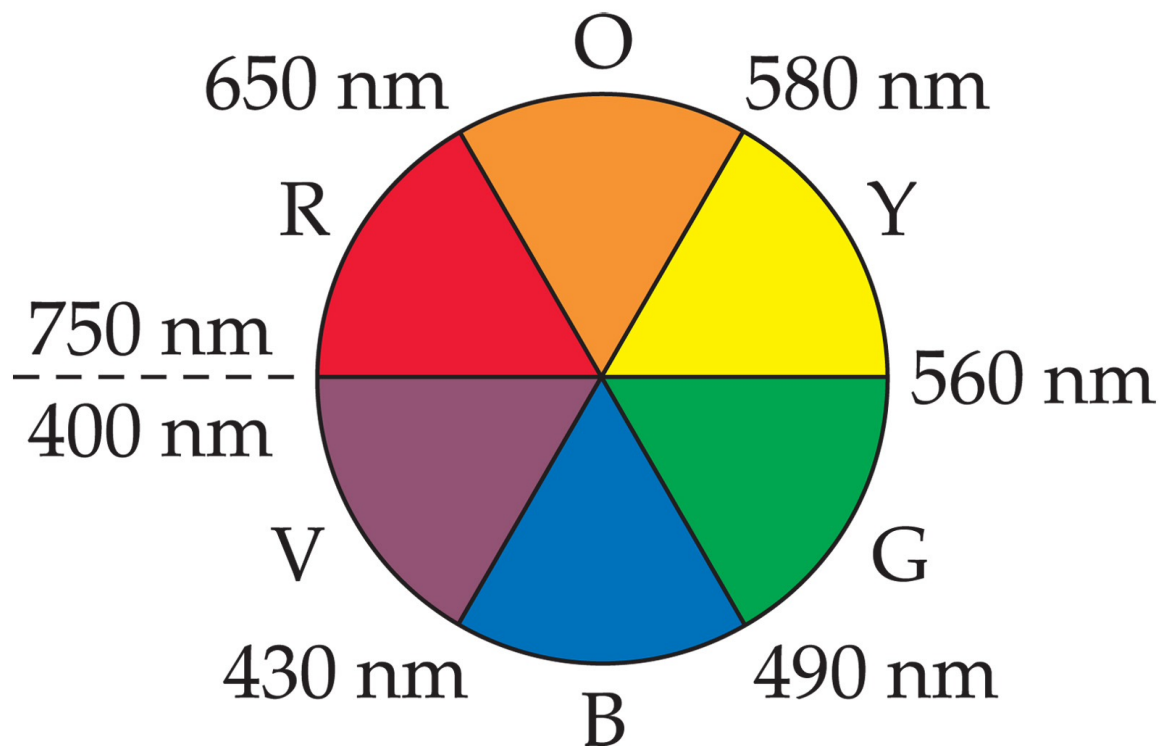
How does seeing color work?

Absorb **Orange**

See **Blue**

Absorb **Red**

See **Green**



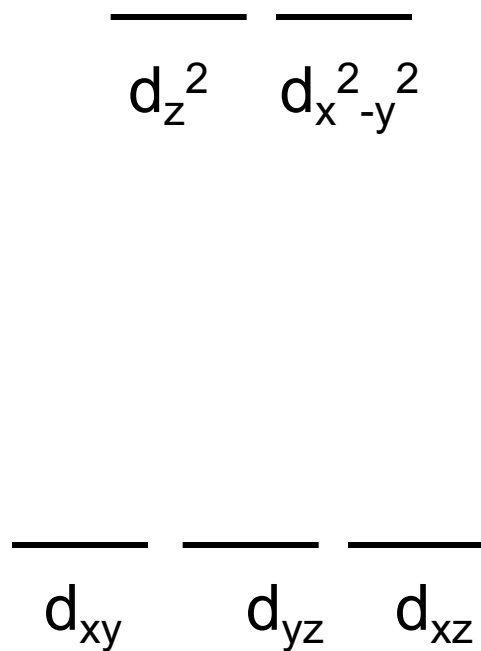
Different ligands on same metal give different colors



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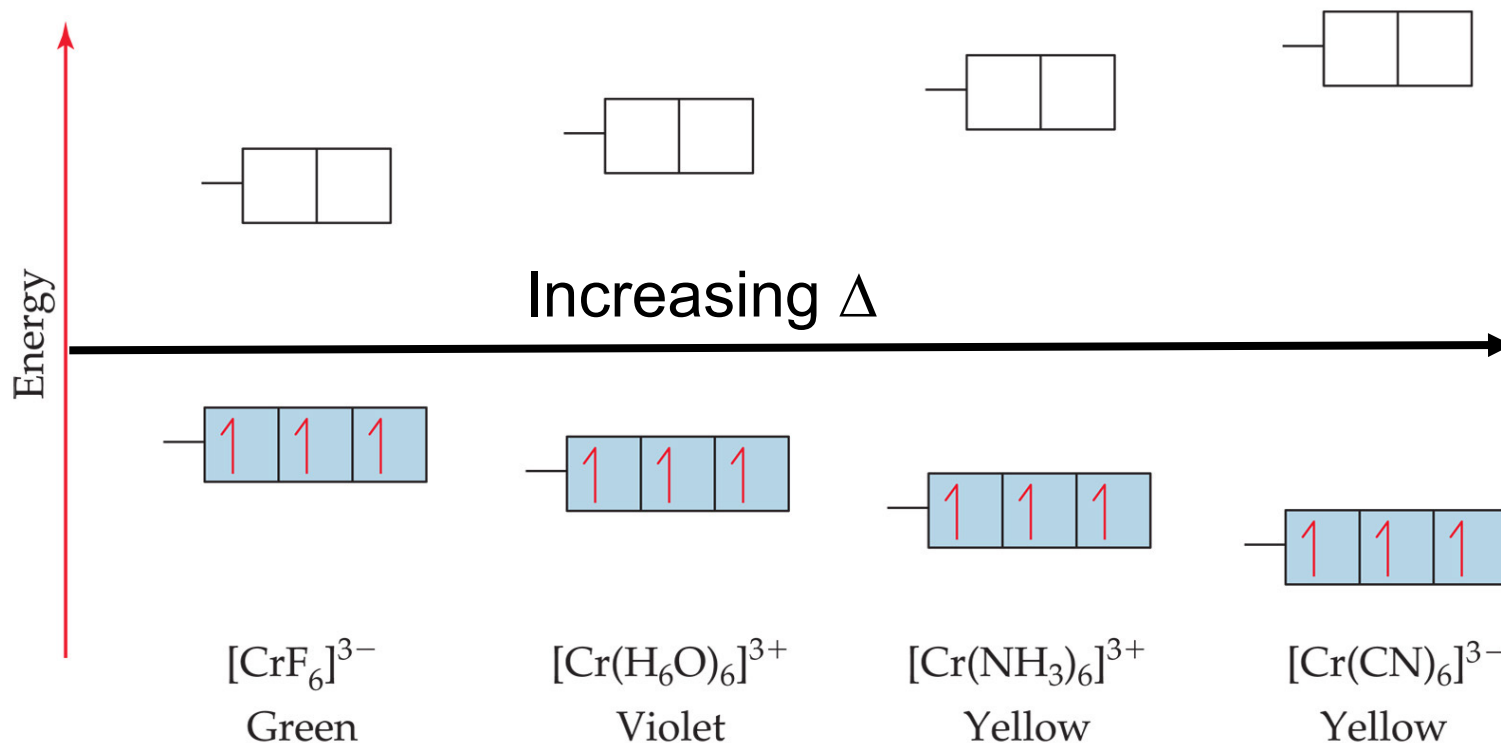
Addition of NH_3 ligand to $\text{Cu}(\text{H}_2\text{O})_4$ changes its color

Splitting of d orbitals in an octahedral ligand field



Spectrochemical series (strength of ligand interaction)

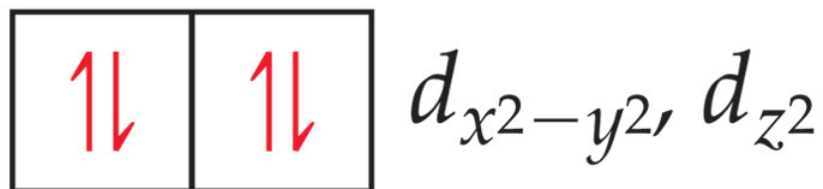
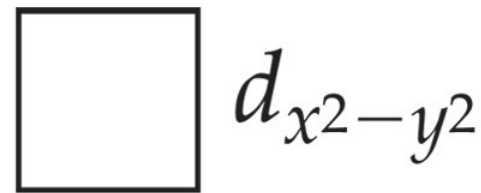
Increasing Δ



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Know low spin versus high spin

There is also splitting from tetrahedral
 And square planar. Know they are
 different, don't remember exactly what
 square planer looks like.



Tetrahedral

Square planar

- EXAM 4
- 3 Valence Bond Theory
- 3 Molecular Orbital Theory
- 2 color of complexes
- 5 electron config/charge/oxidation state/coordination number of metal complexes
- 1 isomers
- 1 naming
- 4 Crystal Field Theory
- 1 alkane/alkene
- 1 organic isomers
- 1 naming organic molecules
- 1 organic reactions
- 2 functional groups

Exam breakdown:

Valence bond/molecular orbital theory

Valence bond/hybridization

M.O. diagrams

Intermolecular forces

Transition metals

Color/absorption

Isomers

Electron config/magnetism/high/low spin

Ox#/coord#

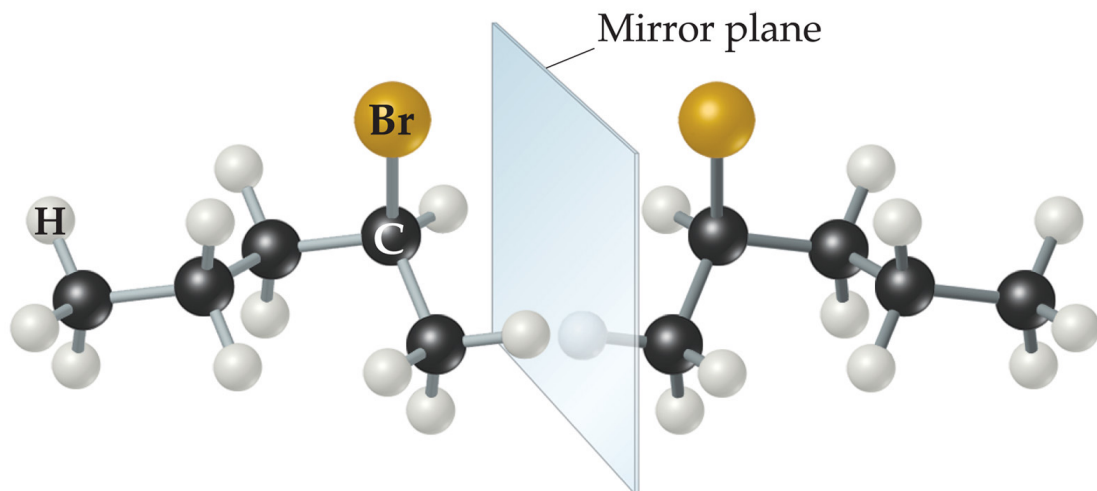
Organic

Naming org. compounds

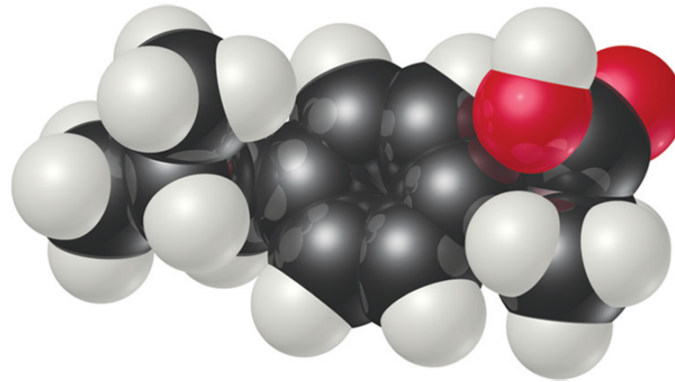
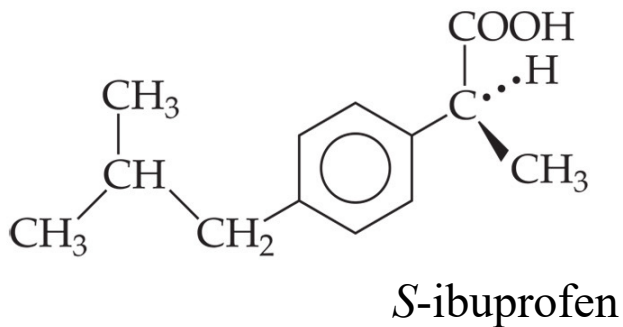
Molecular structure/isomers

Chirality

- Carbons with four different groups attached to them are handed, or chiral.
- Optical isomers or stereoisomers
- If one stereoisomer is “right-handed,” its enantiomer is “left-handed.”

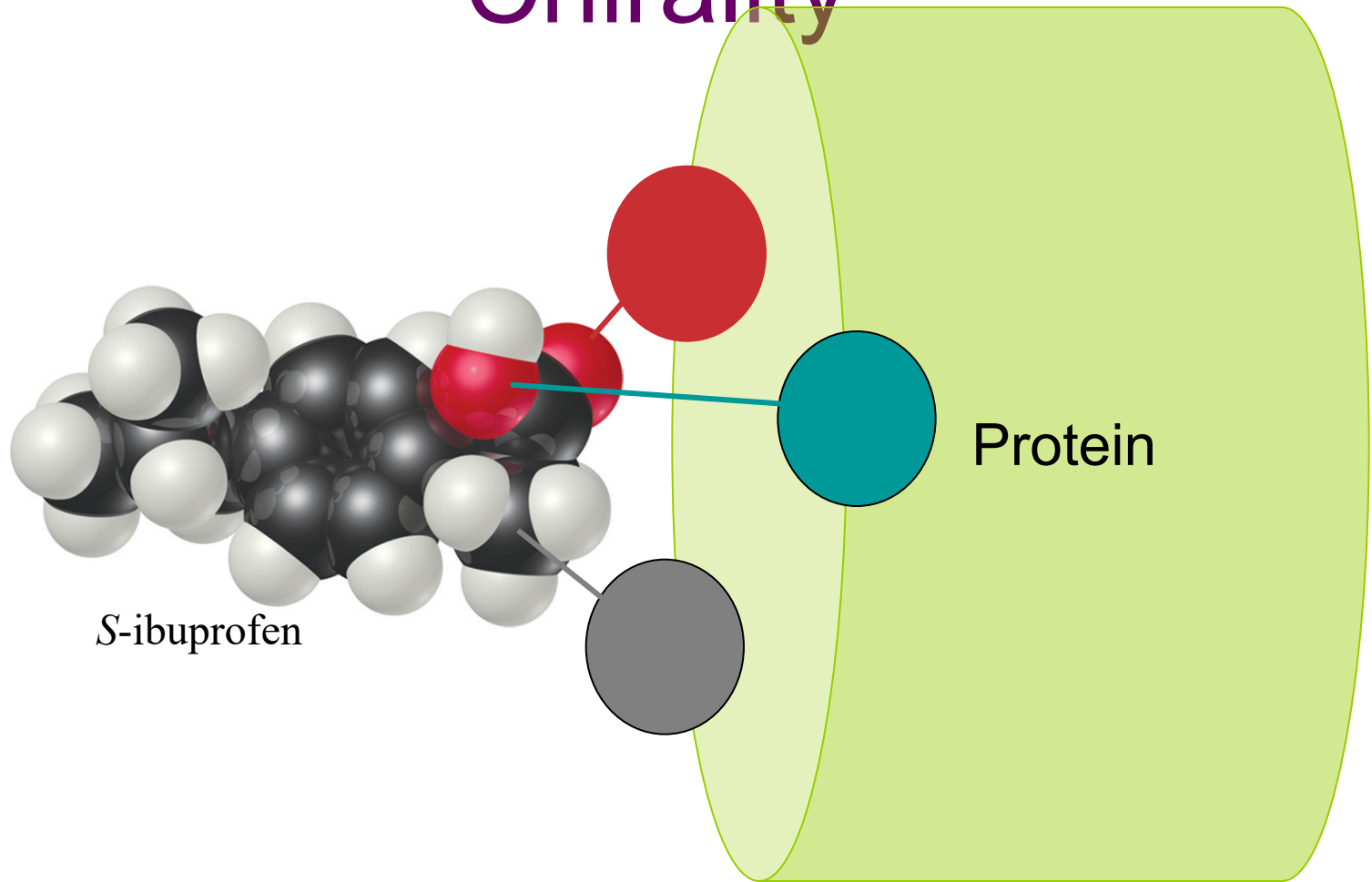


Chirality



- Many pharmaceuticals are chiral.
- Often only one enantiomer is clinically active.
- Why?

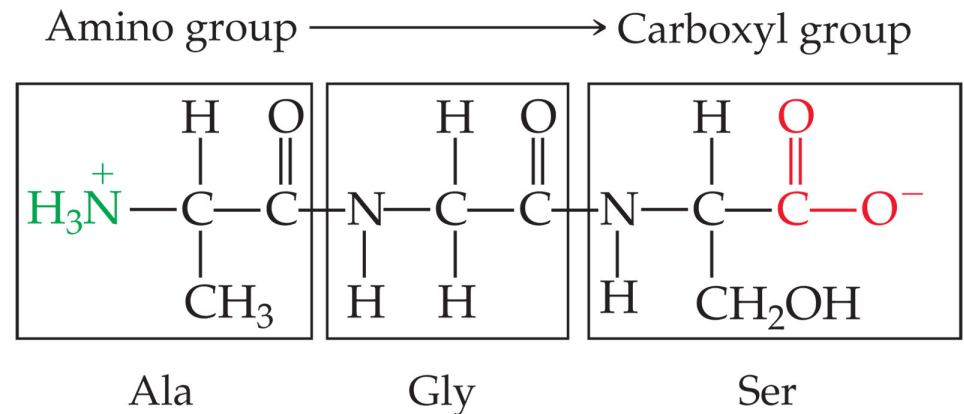
Chirality



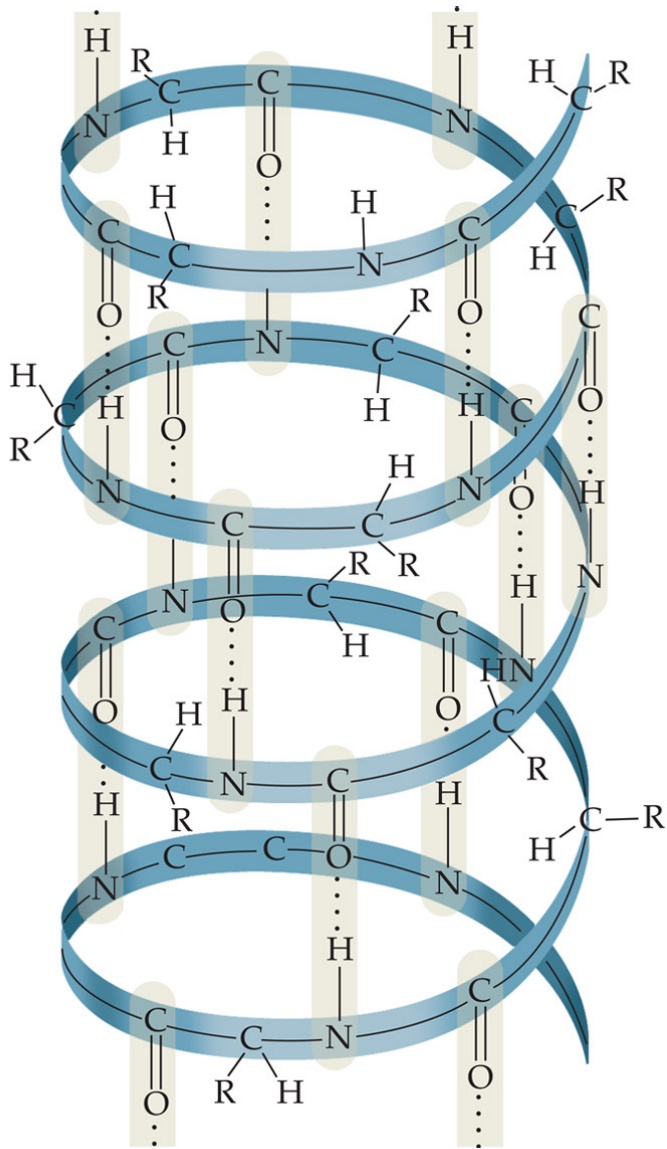
- Because they interact with a chiral protein binding site.

Amino Acids and Proteins

- Proteins are polymers of α -amino acids.
- A condensation reaction between the amine end of one amino acid and the acid end of another produces a peptide bond.

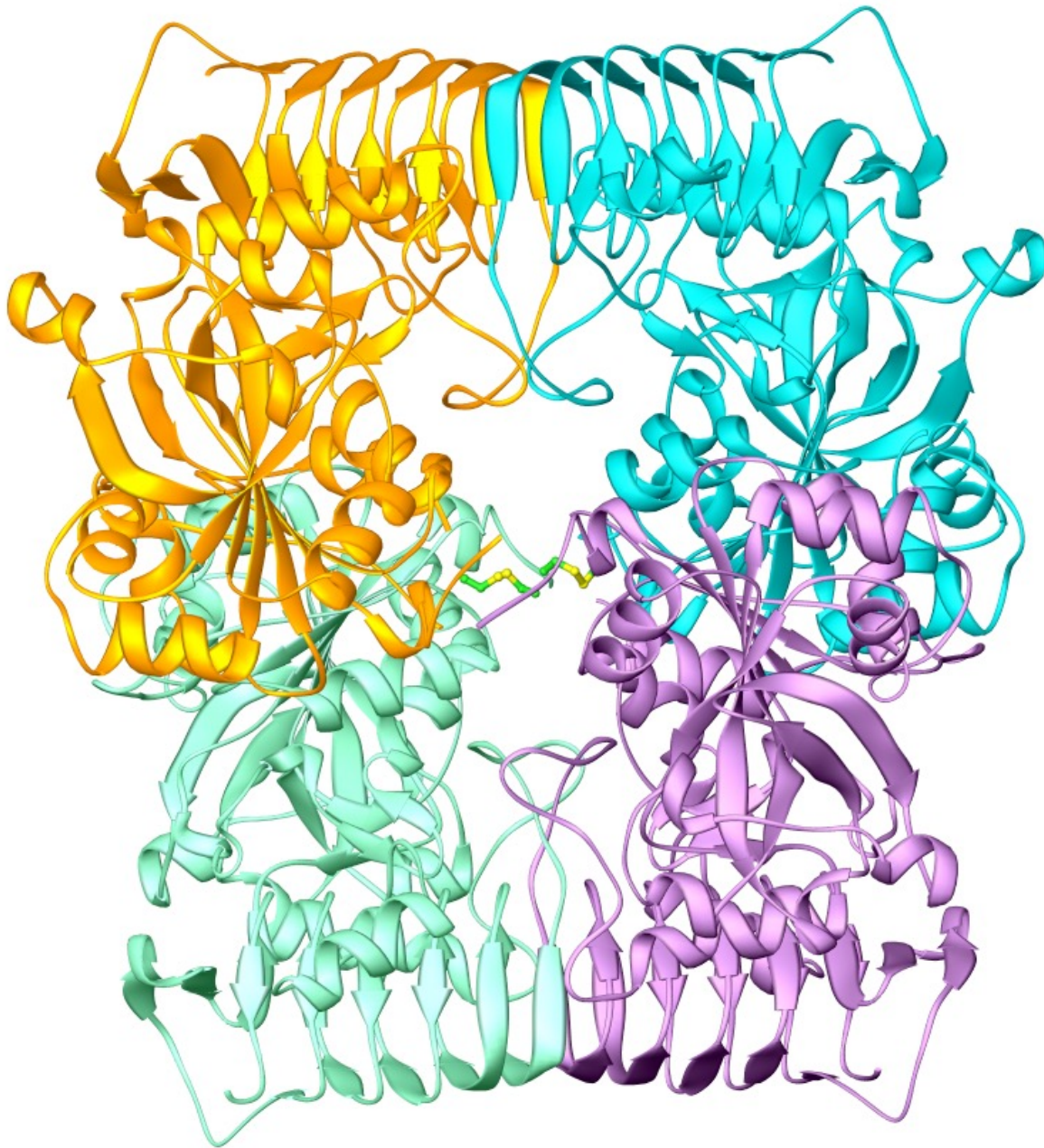


Amino Acids and Proteins



- Hydrogen bonding in peptide chains causes coils and helices in the chain.
- Kinking and folding of the coiled chain gives proteins a characteristic shape.

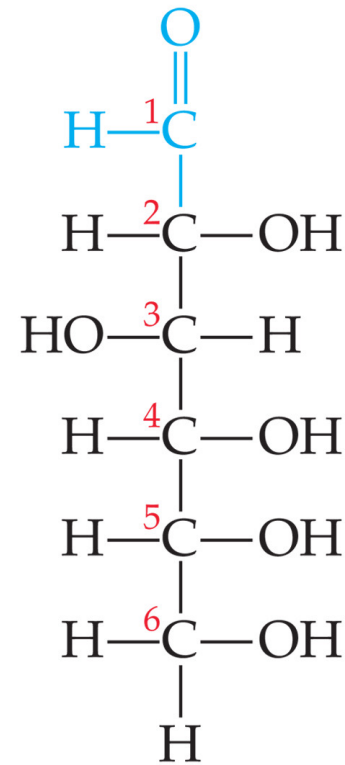
Amino Acids and Proteins



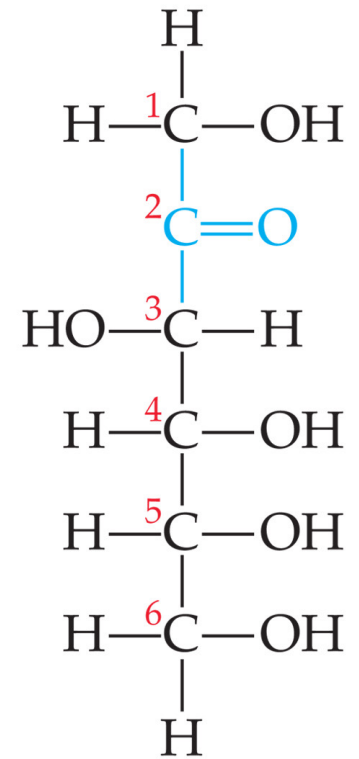
pyrophosphorylase
makes starch in
plants
The complete
molecule is a
tetramer. It's
mass is 240,000
amu.

Carbohydrates

Simple sugars are polyhydroxy aldehydes or ketones.

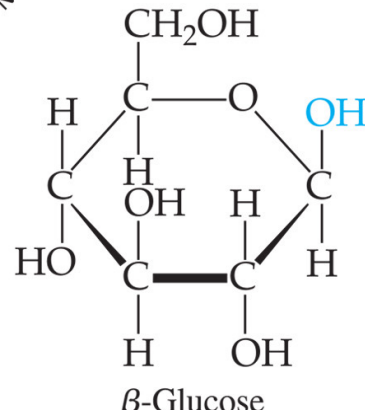
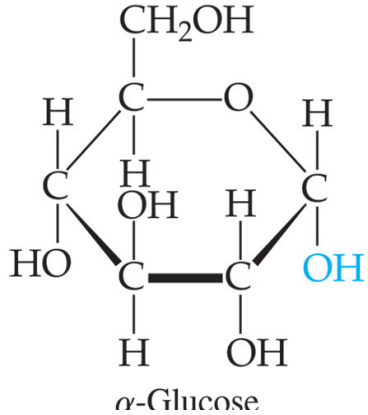
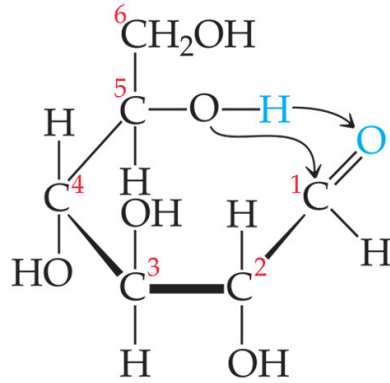


Glucose

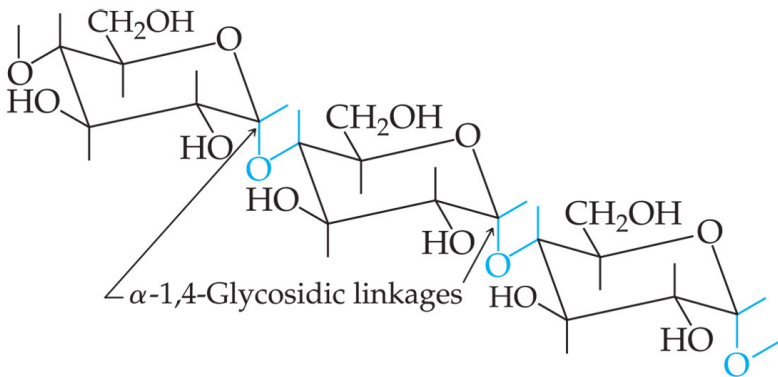


Fructose

Carbohydrates



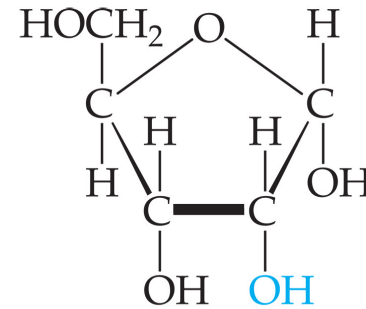
- In solution they form cyclic structures.



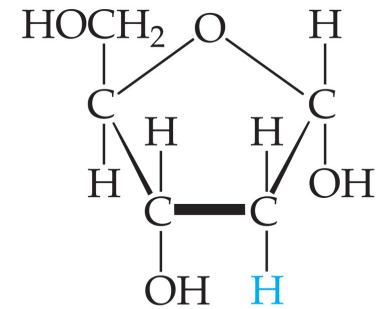
- These can form chains of sugars that form structural molecules such as starch and cellulose.

Nucleic Acids

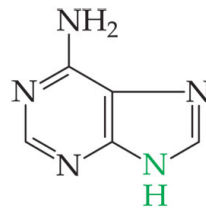
Two of the building blocks of RNA and DNA are sugars (ribose or deoxyribose)



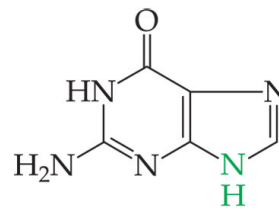
Ribose



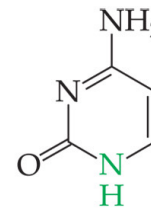
Deoxyribose



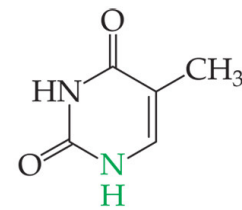
Adenine (A)
DNA
RNA



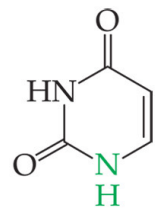
Guanine (G)
DNA
RNA



Cytosine (C)
DNA
RNA



Thymine (T)
DNA

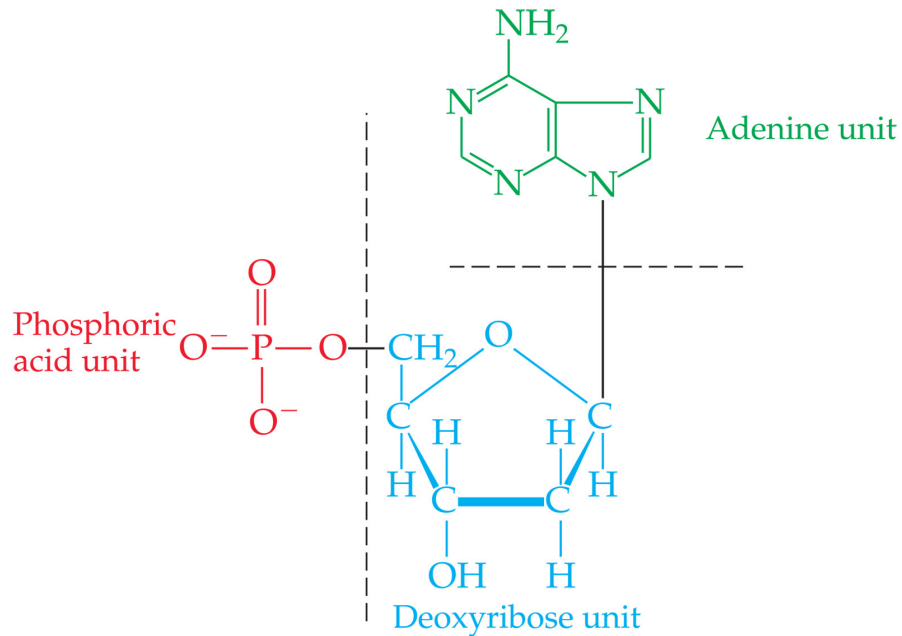


Uracil (U)
RNA

And cyclic bases
(adenine, guanine,
cytosine, and thymine
or uracil).

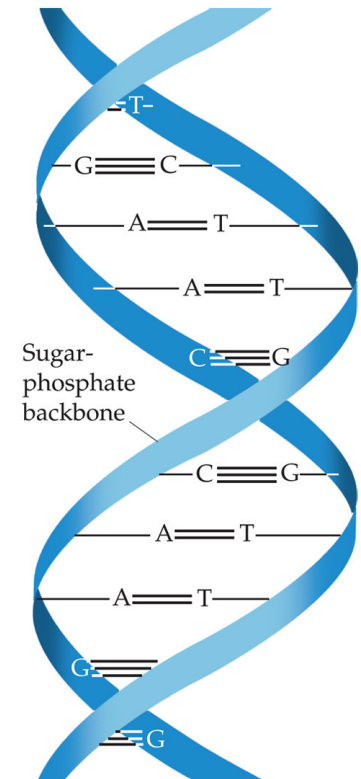
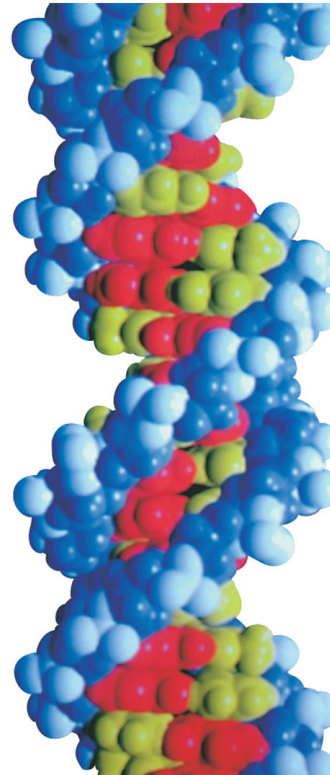
Nucleic Acids

These combine with a phosphate to form a nucleotide.



Nucleic Acids

Nucleotides combine to form the familiar double-helix form of the nucleic acids.



The FINAL

The best preparation:

1. The four exams.

1. The plan is about 40 questions...
 1. About 10 from each of the four exams.

Topics:

Chapter 1.

Dimensional analysis (at least 1 problem)
significant figures

The FINAL

Chapter 2.

History of atomic structure

dalton

cathode ray tubes

rutherford gold foil experiment

Miliken's oil drop experiment

atomic numbers, mass, isotopes

average at. weights

The periodic table

groups, periods, etc.

molecular and empirical formulas

ions, ionic compounds naming inorganic

compounds

naming binary molecular compounds

(nitrogen triiodide)

The FINAL

Chapter 2.

compounds

naming binary molecular compounds
(nitrogen triiodide)

atomic structure, protons, neutrons, electrons

Chapter 3.

stoichiometry calculations

dealing with chemical reactions

limiting reagent

calculate empirical formula

The FINAL

Chapter 4, aqueous reactions, solution stoichiometry

strong and weak electrolytes

the strong acids and the strong bases

Know your anions and cations.

precipitation reactions

acid/base reactions

Redox, oxidations numbers, redox reactions.

the activity series

solution stoichiometry

titrations

The FINAL

Chapter 5, thermochemistry

Kinetic and potential energy

what is work versus heat?

ΔH and ΔE

what is a state function

pV work

calorimetry

Hess' s law

enthalpies of formation

The FINAL

Chapter 6, electronic structure of atoms

wave and particle nature of light

black body radiation, quantization of energy

photons

The photoelectric effect

Line spectra & the bohr model

Quantum mechanics

atomic numbers

atomic orbitals

electron spin

electron configuration

The periodic table explained

The FINAL

Chapter 7, Periodic properties of the elements

effective nuclear charge

sizes of atoms

sizes of ions

ionization energies

electron affinities

group trends for:

alkali metals

alkaline earth metals

oxygen group, halogens, noble gases

The FINAL

Chapter 8, chemical bonding

ionic bonding

metal bonding

covalent bonding

bond polarity

electronegativity

Lewis structures

multiple bonds

resonance structures

octet rule and exceptions

bond enthalpy and bond length

The FINAL

Chapter 9, VSEPR, valence bond and molecular orbital theory
self explanatory.

Chapter 24. Coordination Chemistry
tell me oxidation state of metal
Tell me coordination number
Be able to recognize complexes by name
be able to name them.
Crystal Field Theory.

Chapter 25, organic and biochemistry
hydrocarbons
functional groups
naming organic compounds
isomers

The exam, the lowdown:

- questions from the previous 4 exams.
 - Exam 1:
 - Exam 2:
 - Exam 3:
 - Exam 4:

