Today

Sections 4.9-4.14
Compounds with more than one center of chirality

Sections 5.4
Functional Groups

Sections 5.1 - 5.3, 5.5
Degrees of unsaturation, alkene nomenclature and structure, and how alkenes react

Next Class

Sections 4.9-4.14
Optical activity and compounds with more than one center of chirality

Remember to rework Test 1 by Friday. On a separate piece of paper, provide answers for any questions for which you did not receive full credit. Please do not do the corrections on the actual test.

Maximum possible number of stereoisomers

$$2^n$$

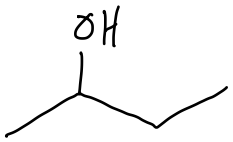
where n is the number of stereogenic centers

Stereogenic centers are locations that cause the molecule to exist as different stereoisomoers: R vs S, Z vs E

n=2 four possible combinations R R R S S R S S

n=3 eight possible combinations

Definitions



$CH_3-CH=CH-CH_3$

stereoisomers are molecules that have the same connectivity but efferent 3-D relationships between parts of the molecules

e.g. (*R*)-2-butanol vs (*S*)-2-butanol

same BP cannot be separated by distillation

(*Z*)-2-butene vs (*E*)-2-butene

different BP's can be separated by distillation.

The words **enantiomer** and **diastereomer** describe the relationship between two stereoisomers.

enantiomers are stereoisomers that are nonsuperposable mirror images
an object must be chiral to have an enantiomer

e.g. (*R*)-2-butanol and (*S*)-2-butanol

diastereomers are stereoisomers that are not mirror images of each other

(*Z*)-2-butene and (*E*)-2-butene

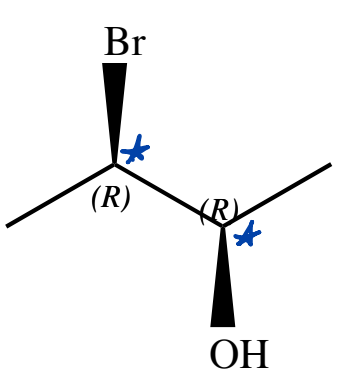
Why do we care? enantiomers = same physical properties
diastereomers have dif physical properties

Enantiomers	and	Diastereomers
molecules that are **nonsuperposable** and **mirror images** of each other		molecules that have the same connectivity and are **nonsuperposable** but **NOT mirror images** of each other
The relationship can be identified using *R*,*S* system of nomenclature		
If all chirality centers have opposite configurations and Z,E alkenes, if present, remain the same		If at least one pair but not all pairs of chirality centers have opposite configurations or if Z,E alkenes, if present, have opposite configurations

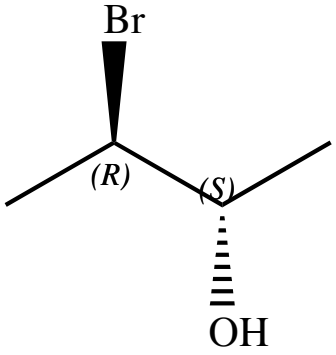
if all stereogenic centers are the same then the two drawings are the same molecule

3-bromo-2-butanol

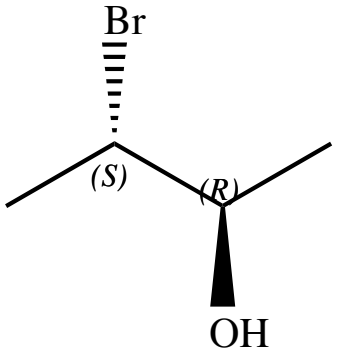
Maximum number of stereoisomers is 2^n where n is the number of stereogenic centers.



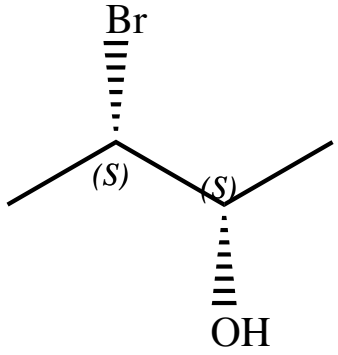
A



B



C



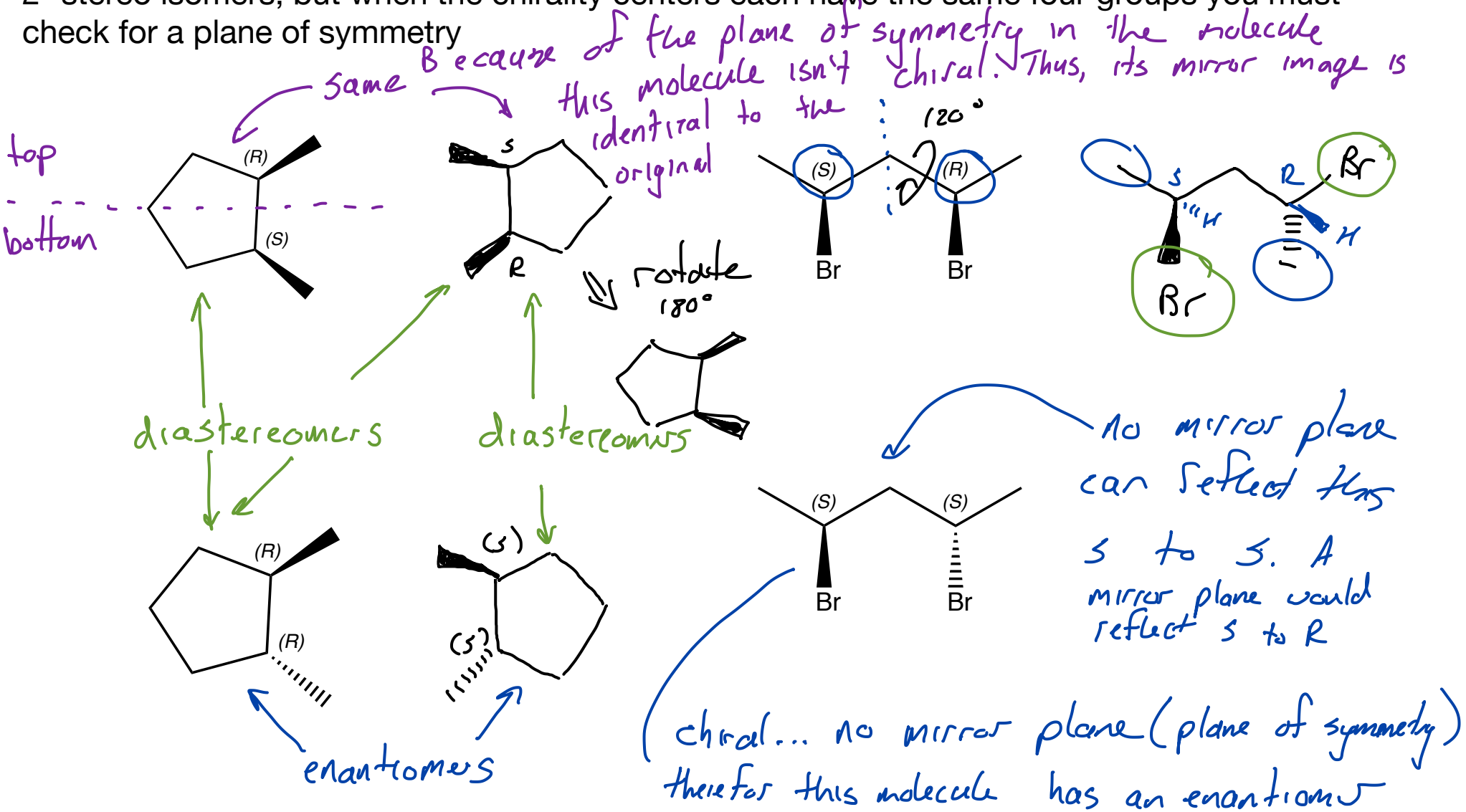
D

enantiomers? A + D, B + C

diastereomers? A + B, A + C, B + D, C + D

Achiral molecules that contain chirality centers possess a mirror plane: meso complex

2^n stereo isomers, but when the chirality centers each have the same four groups you must check for a plane of symmetry

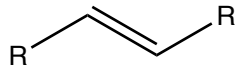


first semester

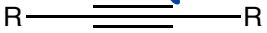
second semester

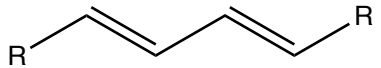
Group I	Group II	Group III	Group IV
alkenes and alkynes	polar group alkyl halides, alcohols, ethers, epoxides, alkylsulfonates, tertiary ammonium ions, sulfonium ions, amines		aromatics special C–C π bonds

alkene

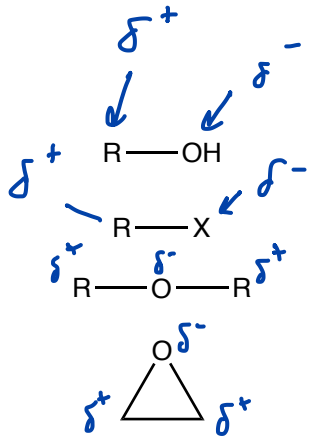


alkyne



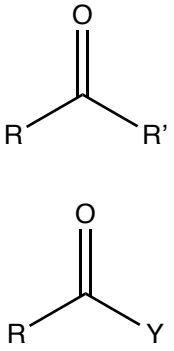


C–C π bonds



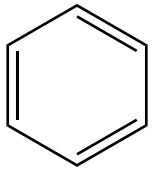
R ≠ H

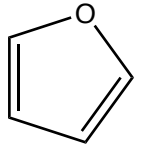
X = F, Cl, Br, I

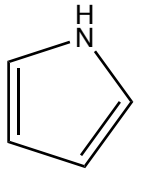


Y = Cl, OR, NRR', SR

R or R' = C or H





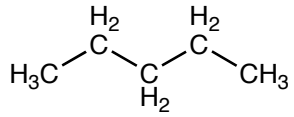
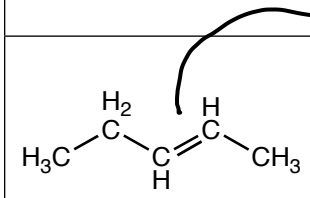
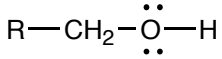
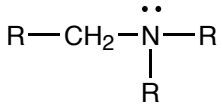
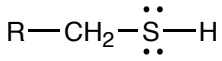
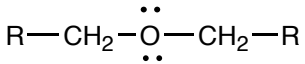


Organic "variables"

R for C's or H

X for halogen

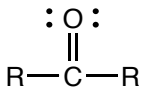
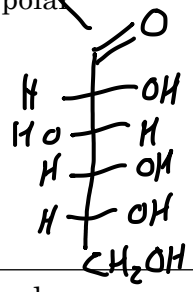
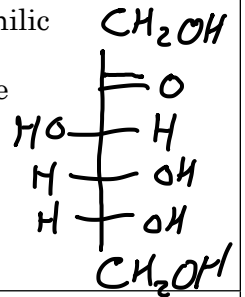
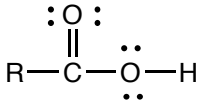
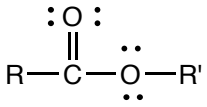
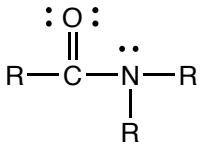
Y for any org atom

Lewis Structure	functional group name	polar/nonpolar	reactivity/notable trait
	alkane	nonpolar	not particularly reactive in an organic chemistry sense
	alkene and alkyne	nonpolar	π electrons are nucleophilic no free rotation around C=C bonds π electrons can be involved in resonance
	alcohol/hydroxyl group	polar	O atom is nucleophilic
 R = C or H	amine/amino group	polar	N atom is nucleophilic N atom is basic
	thiol/sulfhydryl	nonpolar	S atom is nucleophilic
 R = C or H	ether	slightly polar	O atom is electron rich, but only weakly nucleophilic

acetone is a ketone

glucose has an aldehyde C=O

Fructose has a ketone C=O

Lewis Structure	functional group name	polar/nonpolar	reactivity/notable trait
 R = C or H	carbonyl R = C ketone R = H aldehyde	polar 	O atom is electron rich but not nucleophilic C atom is electrophilic π electrons can be involved in resonance 
 R = C or H	carboxylic acid/carboxyl group	polar	O atoms are electron rich but not nucleophilic C atom is electrophilic acidic π electrons are in resonance with lone-pair electrons
 R = C or H R' = C, R' ≠ H	ester	polar	O atoms are electron rich but not nucleophilic C atom is electrophilic π electrons are in resonance with lone-pair electrons
 R = C or H	amide/amido group	polar	O atom and N atom are electron rich but not nucleophilic C atom is electrophilic π electrons are in resonance with lone-pair electrons N atom is less basic than amine N