LEC (10) CHEM 30A Jan 31st

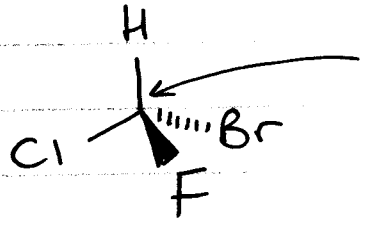
(1) CHIRAL CENTERS
(2) R/S DESIGNATION
(3) FISCHER PROJECTIONS
(4) CIS/TRANS DIASTEREOISOMERS

HMK Read Ch3
Problems 3.1 – 3.5, 3.10 – 3.23
+ Stereochem PROBLEM SET

MIDTERM => WEDNESDAY

---

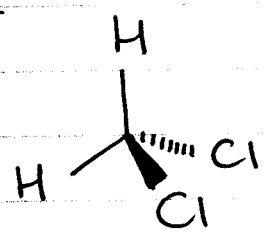
(1) CHIRAL CENTERS



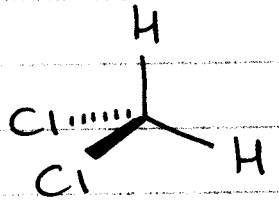
CHIRAL or STEREOGENIC center

IF AN OBJECT (molecule) is not CHIRAL, it is ACHIRAL

e.g.



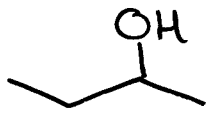
m



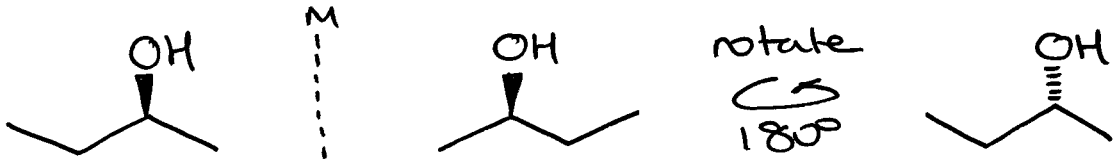
THESE MOLECULES ARE THE SAME

One of the most common causes of chirality in organic molecules is a TETRAHEDRAL atom (usually C) bonded to FOUR DIFFERENT GROUPS.

* This does not define "CHIRAL"

e.g. 

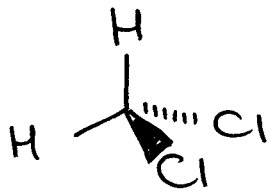
ENANTIOMERS come in PAIRS



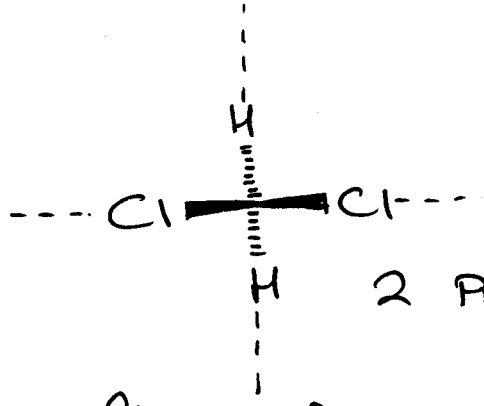
IDENTIFYING CHIRAL OBJECTS

If a molecule can be drawn with
(i) a PLANE of SYMMETRY or
(ii) an INVERSION CENTER

$\Longrightarrow$ IT IS ACHIRAL

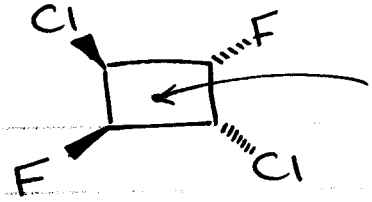
e.g. (i) 

ACHIRAL



2 PLANES

You will see this more often than:

(ii) 

center of INVERSION (no plane)

ACHIRAL

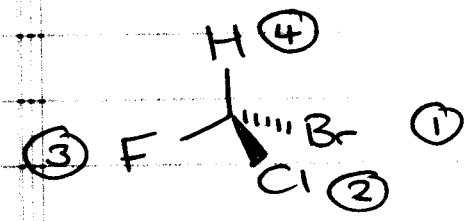
centre of inversion ⇒ identical groups lie equidistant of a point on opposite sides of that point.

– DISTINGUISHING ENANTIOMERS

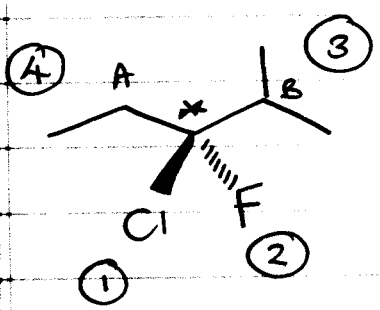
R,S designation

– assigning priority

(i) ATOMIC WEIGHT of atoms on stereocenter



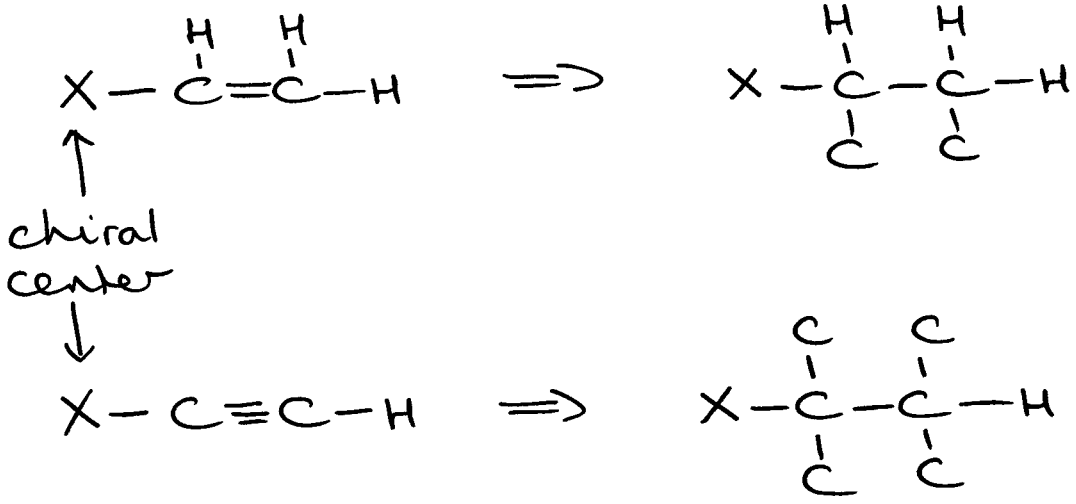
(ii) FIRST POINT of DIFFERENCE



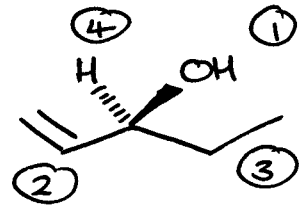
C_A attached to C, H, H (4)

C_B attached to C, C, H (3)

(iii) MULTIPLE BONDED ATOMS – count as the equivalent number of singly bonded atoms



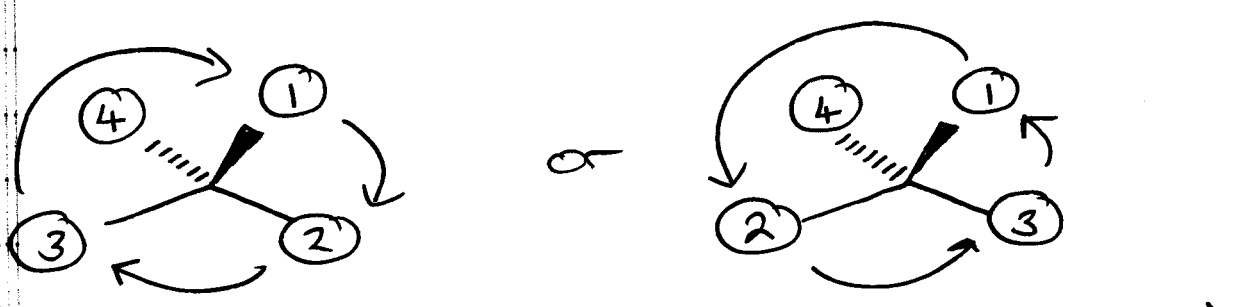
So consider:



use 1, 2, 3, 4 to set R or S

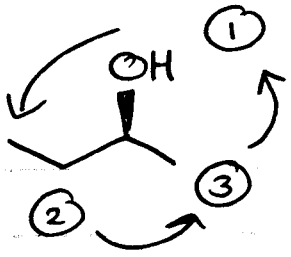
Rotate molecule to put lowest priority group in the back ⇒

TWO POSSIBLE ORIENTATIONS

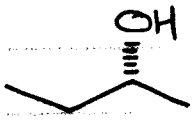


CLOCKWISE (R) COUNTERCLOCKWISE (S)

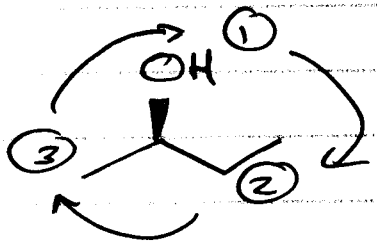
So/



(S)-2-BUTANOL



rotate ↻ 180°



Small group is not in the back

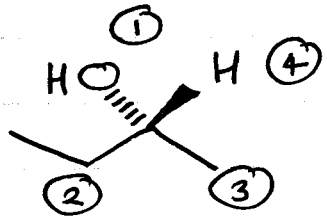
(R)-2-BUTANOL

or if you have trouble rotating molecules

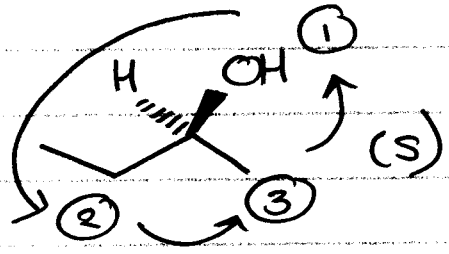
TRICK...

- SWITCH LOWEST PRIORITY GROUP (4) WITH THE GROUP THAT IS IN THE BACK
- ASSIGN R/S, REALISING THAT THE STEREOCHEMISTRY OF THE ORIGINAL MOLECULE IS THE OPPOSITE

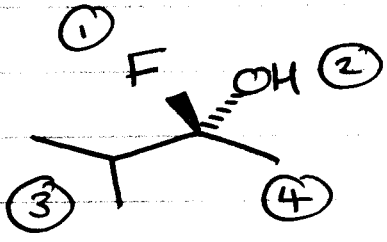
e.g



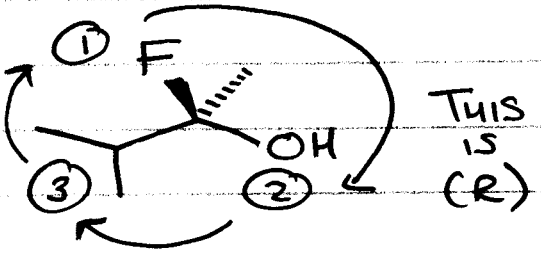
switch ① / ④



↑ SO THIS MUST BE (R)



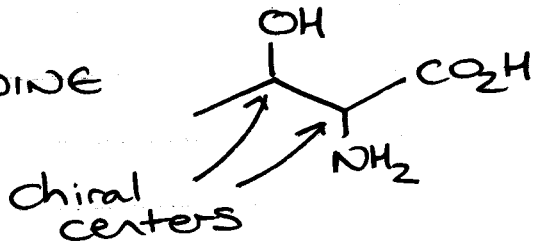
switch ② / ④

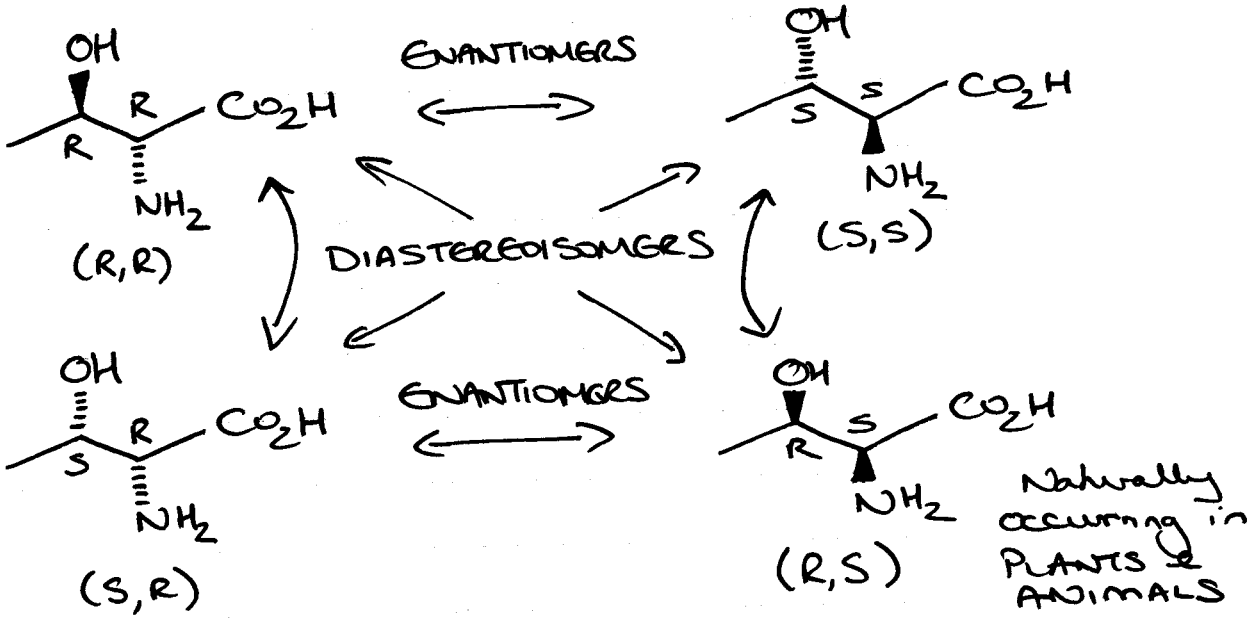


SO, THIS ONE IS (S)

COMPOUNDS W/ MORE THAN ONE STEREOCENTER

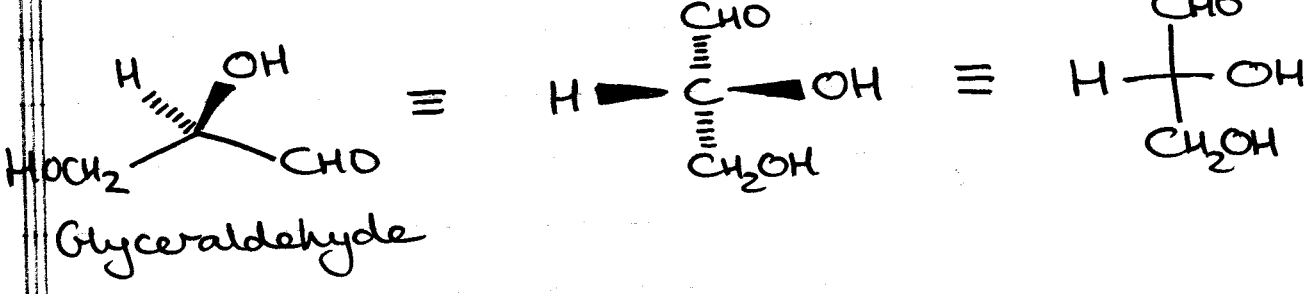
Amino acid THREONINE





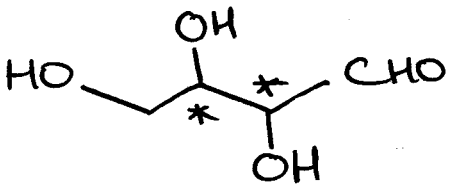
DIASTEREOISOMERS — NON MIRROR IMAGE STEREOISOMERS

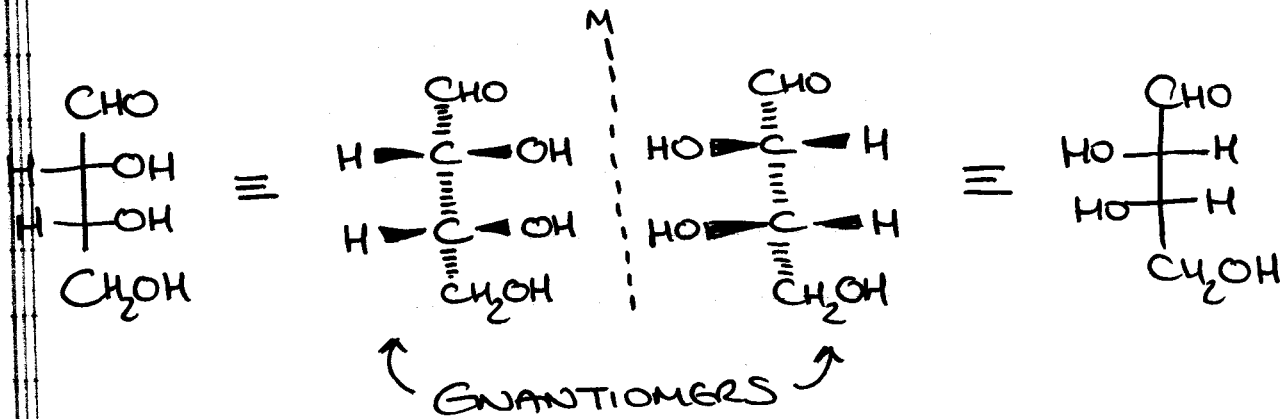
FISCHER PROJECTIONS



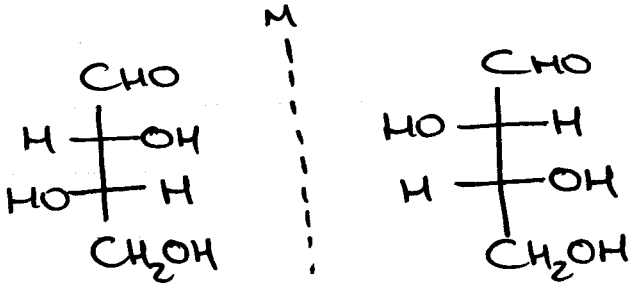
Useful for compounds with many continuous stereocenters

2,3,4-trihydroxybutanal

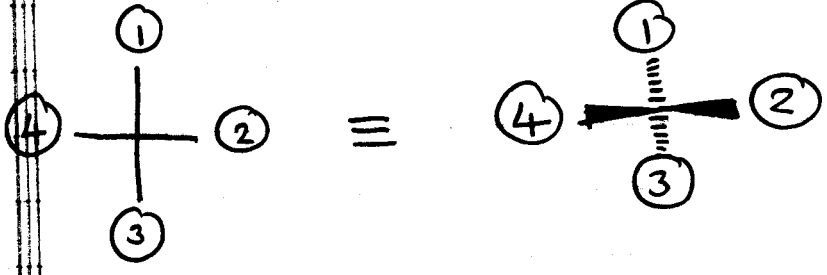




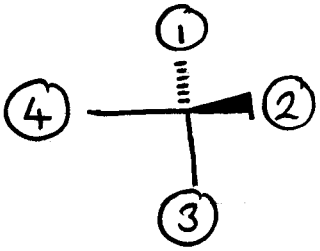
ANOTHER PAIR OF ENANTIOMERS



Determining R/S in Fischer Projections



Switch one wedge & one dash for STRAIGHT LINES



⇐ assign R/S

(THIS ONE IS (S))

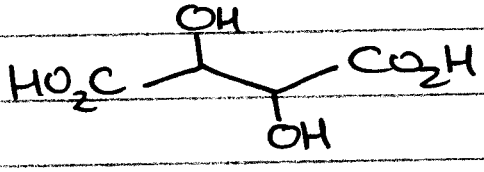
Go back and determine R/S for 2,3,4 trihydroxybutanal

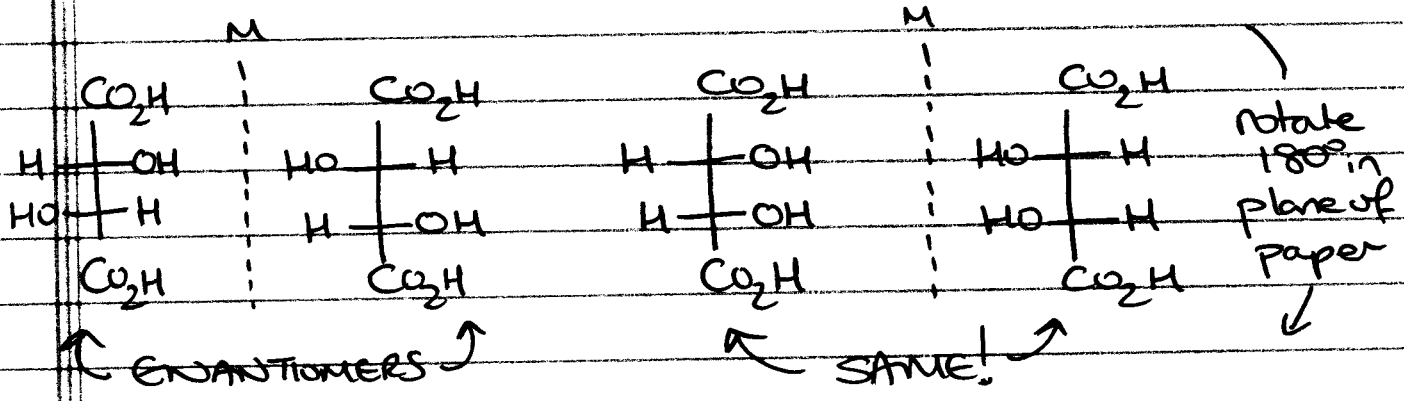
- A molecule with $\leq n$ chiral centers can have a maximum number of stereoisomers $= 2^n$

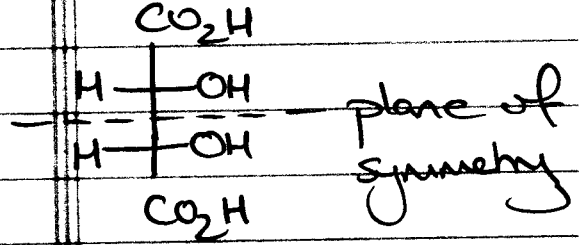
e.g. 2,3,4 trihydroxybutanal has 2 stereocenters

$2^2 = 4$ stereoisomers

CONSIDER TARTARIC ACID







COMPOUND w/ STEREOISOMERS but is ACHIRAL

$\Rightarrow$ MESO

- ENANTIOMERS ✓
- DIASTEREOISOMERS
  - CONFIGURATIONAL ✓
  - CIS/TRANS
    - RINGS e ALKENES