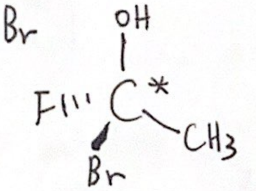
MTW 10.3/24 ①

stereoisomers: same constitutional isomer, same bond connectivity, but different arrangement of groups in 3D space.

C_2H_4OFBr



chiral center: 4 different groups around a tetrahedral atom

Chirality: phenomenon for object that are not superimposable on their mirror image.

Enatiomers = non - superimposable mirror images

Diastereomers = stereoisomers that aren't enantiomers

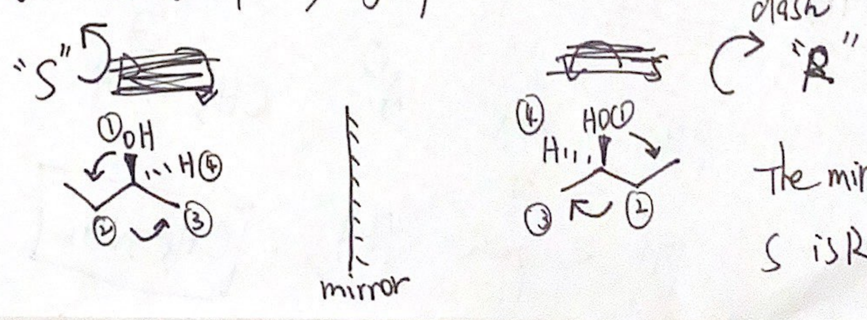
↳ need at least 2 chiral centers

Meso Compound = 2 chiral centers, but itself is not a chiral object.

. Each chiral center has the same 4 groups

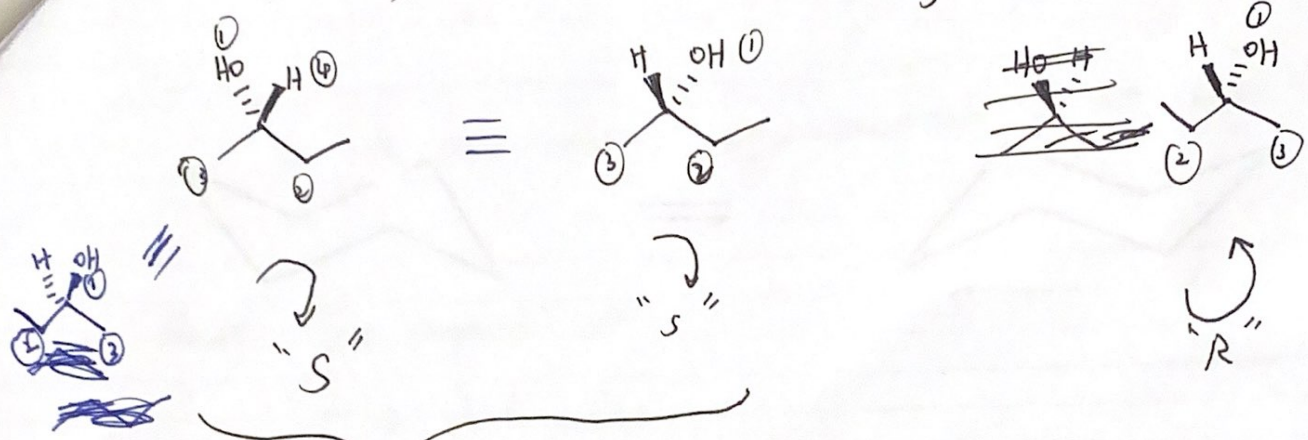
Assigning chirality → assigning R/S

① when lowest priority group is in back (⋮) dash



The mirror image of S is R.

② lowest priority group is in front (▼) wedge.



Wedge on right vs left

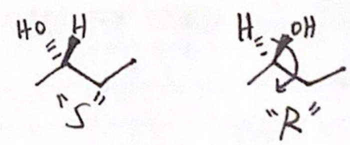
⇓

No difference in R/S assignment

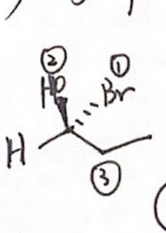
⇓

same molecule.

However, if you switch any 2 groups from wedge to dash, you get the enantiomer!



③ lowest priority group is in the plane ("|" solid line)

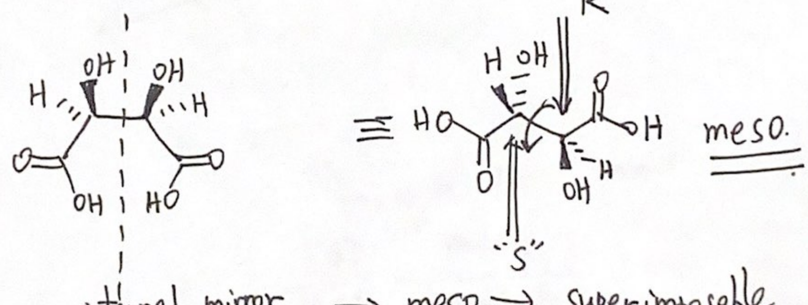


⇒ Try to "see" this molecule from the way that putting the lowest priority group back.

All the same molecule. flips/rotations/turns do not change chirality

Meso: One compound with:

- 2 chiral centers
- same 4 groups on both chiral centers
- R,S or S,R

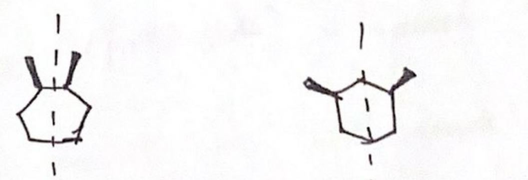


internal mirror plane → meso → superimposable on mirror image.

⇓

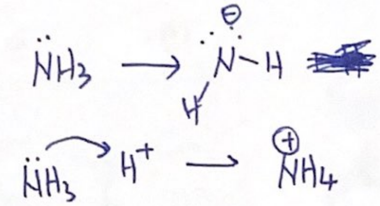
Not a chiral molecule,

Not optically active.



Acid - Base

- Acid = proton donor (H^+)
- Base = proton acceptor



$$H{-}Cl + Na^{\oplus}\,OH^{\ominus} \rightleftharpoons H{-}OH + Cl^{\ominus} + Na^{\oplus}$$

H-Cl: Acid; NaOH: Base; H-OH: Conjugate acid; $Cl^{\ominus}$: Conjugate base.

We can describe methmatically "how far" a reaction proceeds by defining an <u>equallibrium</u> constant

$$A \rightleftharpoons B \quad K_{eq}$$

⟹ equalibrium arrows: say A and B interconvert

$$K_{eq} = \frac{[B]}{[A]} = \frac{\text{products}}{\text{reactants}}$$

Keq tells us which side (starting matterial / left side / reactents) Vs (products / right side) is favored at equallibrium.

If $K_{eq} = 1$ → equal amount of A and B

$K_{eq} = \infty$ → lots of B, little A

$K_{eq} = 0.0000001$ → lots of A, little B stability matters

For acids and bases:

$$H-A \quad B: \rightleftharpoons A^{\ominus}: \quad \overset{\oplus}{B}-H$$

Acid Base Conj. Base Conj. acid

$$K_A = \frac{[A^{\ominus}][\overset{\oplus}{B}-H]}{[HA][B:]} \uparrow \qquad K_a \in (\sim 10^{-20}, 10^{55})$$

We use log scale to make the #s small.

$$\downarrow pK_A = -\log_{10} K_A \uparrow$$

K_A and pK_A tell us how much an acid will be protonated vs deprotonated at a specific pH.

↳ reflect a given acid's intrinsic ability to protonate base

Smaller pK_A values → stronger acid

⇓

stable conjugate Base (weak)

→ $$H-Cl \rightleftharpoons Cl^{\ominus} + H^{\oplus}$$

H–Cl: super strong acid.

$Cl^{\ominus}$: Conj. Base of HCl

Equilibrium favors formation of the weaker acid

↳ for a given pair of "acids", the smaller the pka, the stronger the acid.

↳ A stronger acid will react to form a more stable anion

⇓

[more stable] conj. base.

$H-A \quad H-O-H \rightleftharpoons A^{\ominus} \quad H-\overset{\oplus}{O}(H)-H$

acid — conj. Base

If $pH = pK_A$ — $\# HA = \# A{:}^{\ominus}$

$[Acid] = [Conj.\ Base]$

$pH > pK_A$ — $\# HA < \# A^{\ominus}$

$[Acid] < [Conj.\ Base]$

$pH < pK_A$ — $[Acid] > [Conj.\ Base]$

⇓

Acid is mostly protonated.

A given acid will be <u>protonated</u> if the pH of the solution is <u>less</u> than the pKA of the acid.

$H_3C-\ddot{N}(H)-H$ Acid or Base?

⇓

It depends.

The <u>molecular enviroment</u> (pH) determines whether a molecule functions as an acid or a base.

The number of protons an sp^3-hybrid N-atom is bound to changes w/ pH. (recall low pH means acidic solution, lots of H^+'s around)

More stable anion has ⊖ (negative charge)

① On a more E.N atom $HO^{\ominus} > {}^{\ominus}CH_3$

② On an atom with more s-character ($sp > sp^2 > sp^3$)
50% s 33 s% 25% s

③ on a larger atom $I^{\ominus} > F^{\ominus}$

④ stablized by resonance delocalization ${}^{\ominus}OH < \overset{O}{\overset{\|}{C}}-O^{\ominus}$

⑤ stablized by induction from nearby E.w. elements

Ex. Rank the following acids: 1 = most acidic 4 = least acidic

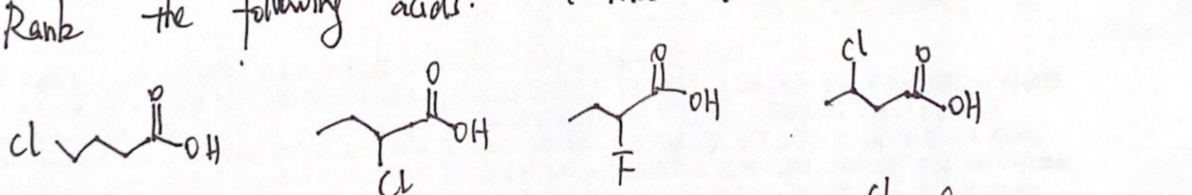
	H_2O	CH_4	NH_3	H_2S
1. Draw Conj. Base	$HO^{\ominus}$	${}^{\ominus}CH_3$	${}^{\ominus}NH_2$	${}^{\ominus}SH$
	2	4	3	1

C N O F
S Cl
Br
I

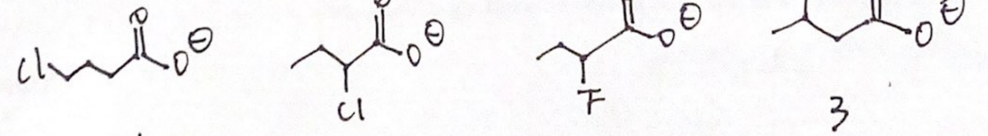
· ${}^{\ominus}SH$ is more stable than ${}^{\ominus}OH$ b/c S is bigger.

· from C, N, O, EN ↗, anion stability ↗, more acidic.

Rank the following acids: 1 = most acidic 4 = least acidic



Conj. Base



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