

# Hard & Soft Bases + acids

HSAB

Soft - Soft  
Hard - hard

## ① Solubility in Water:

| Solub.<br>decreasing ↑ | <u>AgI</u> ✓ | $8.3 \times 10^{-17}$ |
|------------------------|--------------|-----------------------|
|                        | AgBr         | $5.2 \times 10^{-13}$ |
|                        | AgCl         | $1.8 \times 10^{-10}$ |
|                        | <u>AgF</u> ✗ | 205                   |
|                        |              |                       |

LiI

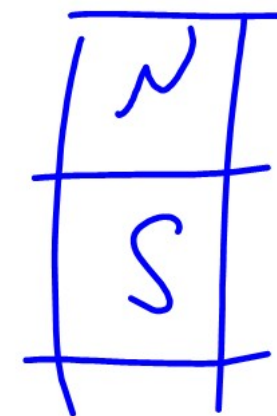
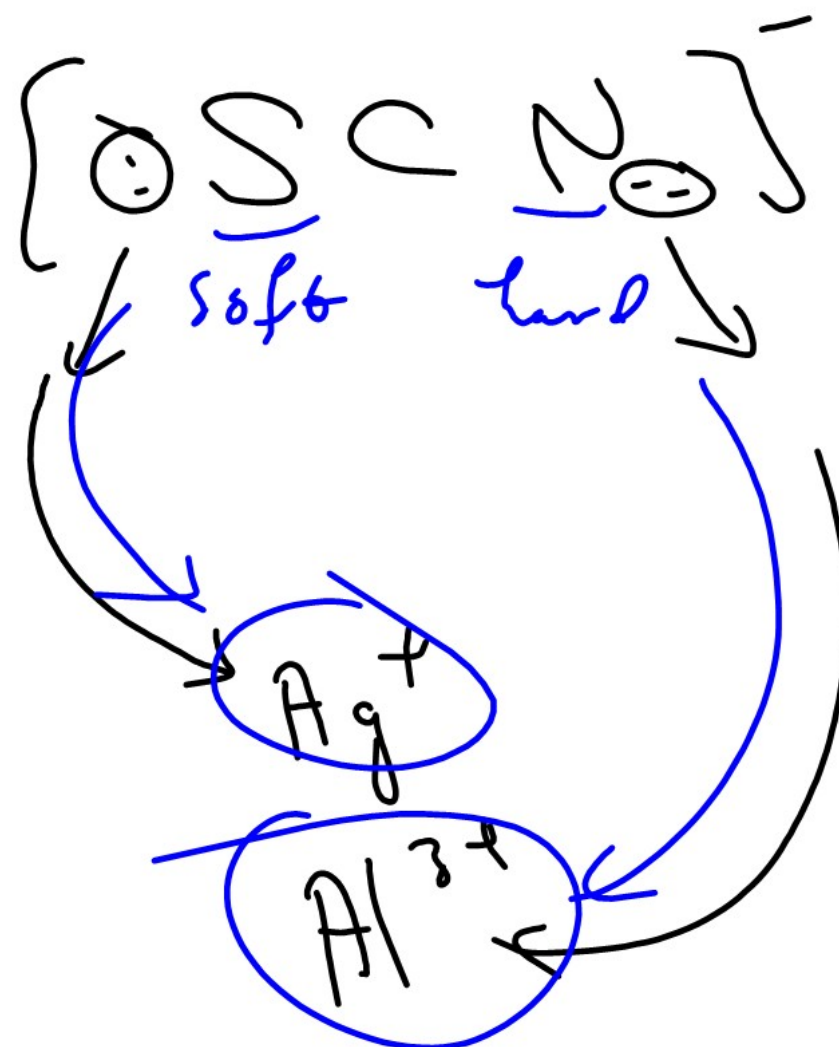
LiBr

LiCl

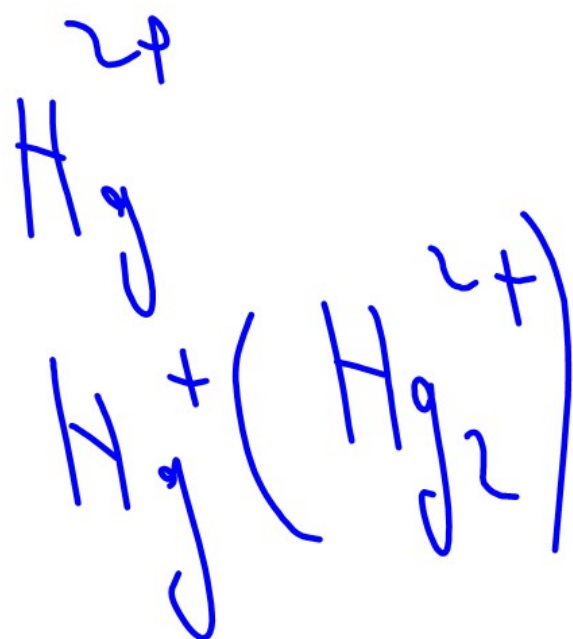
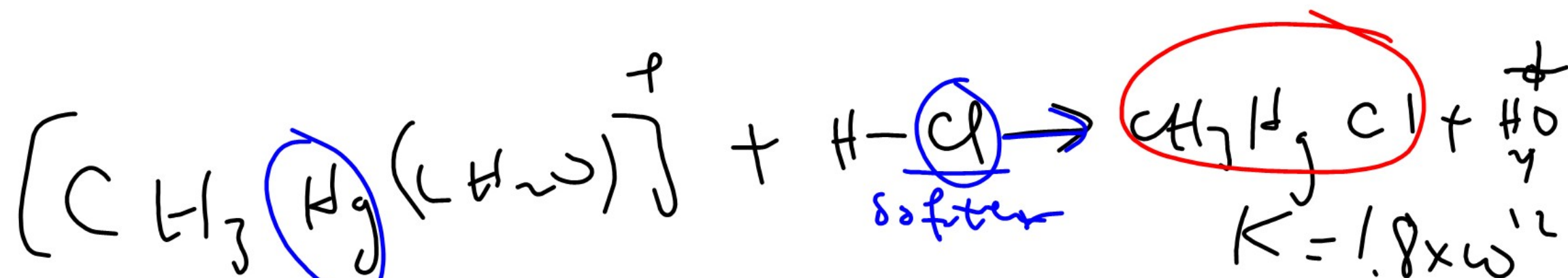
LiF

Solub.  
in  
Water ↑

② Rxn. with



③ Eg. Const Key.



# HSAB

acids

hard acid

$Al^{3+}$

high charge  $\oplus$

small size

soft

$Ag^+$

little charge  $\oplus$   
large size

base

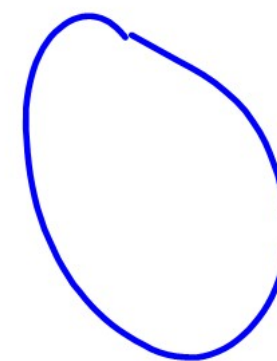
hard

$\checkmark$   $NH_3$   $O$

$F^-$

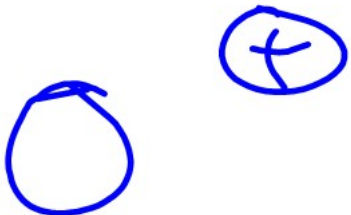
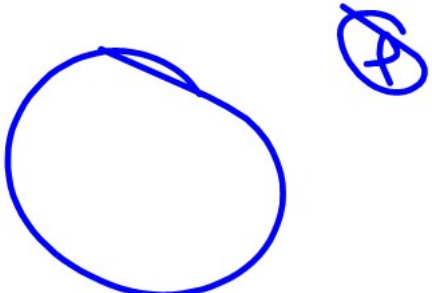
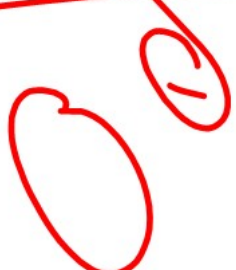
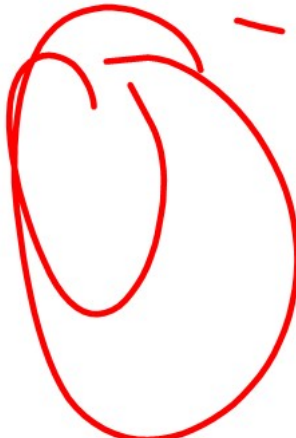
soft

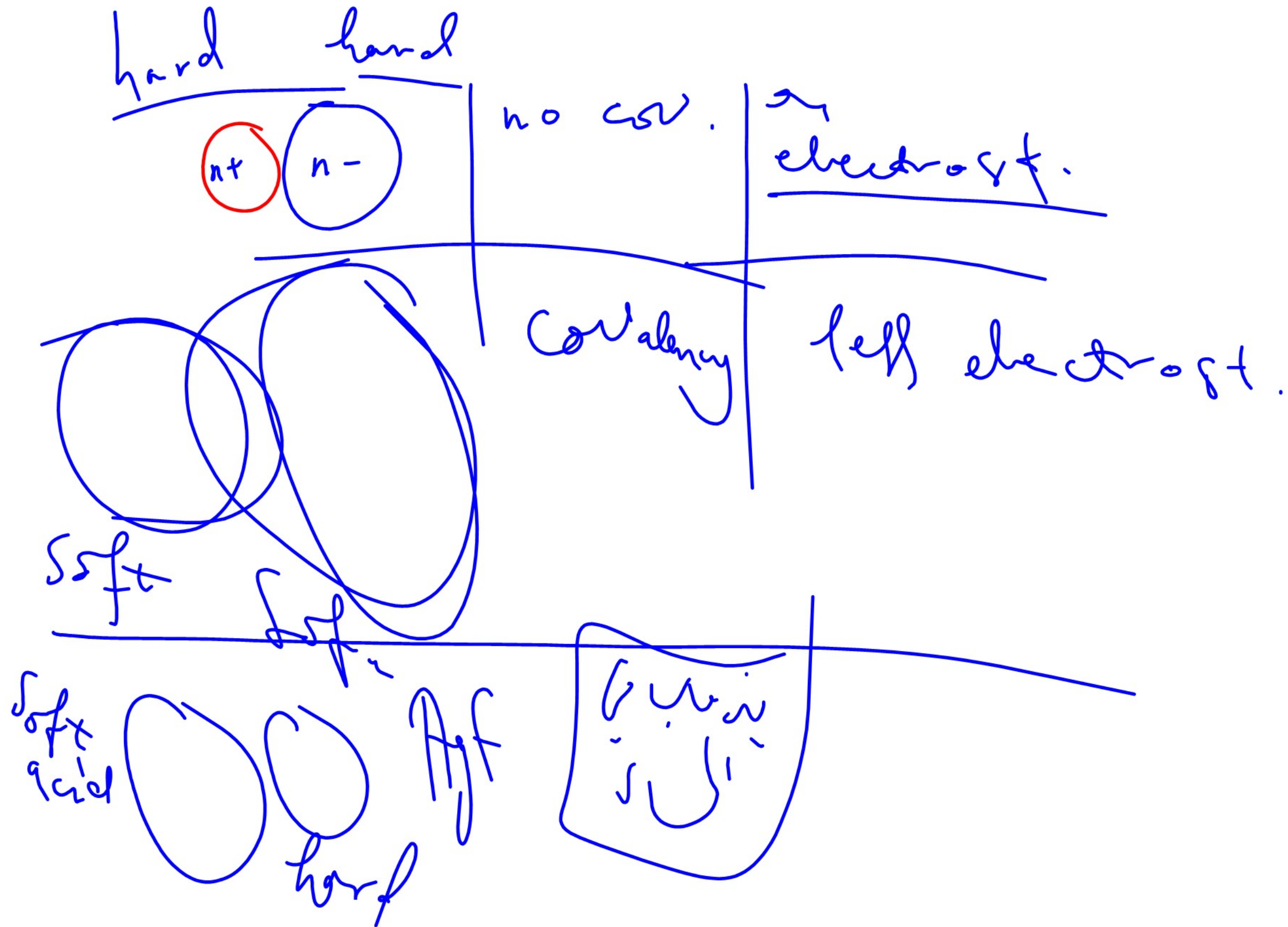
$\checkmark$   $AsH_3$

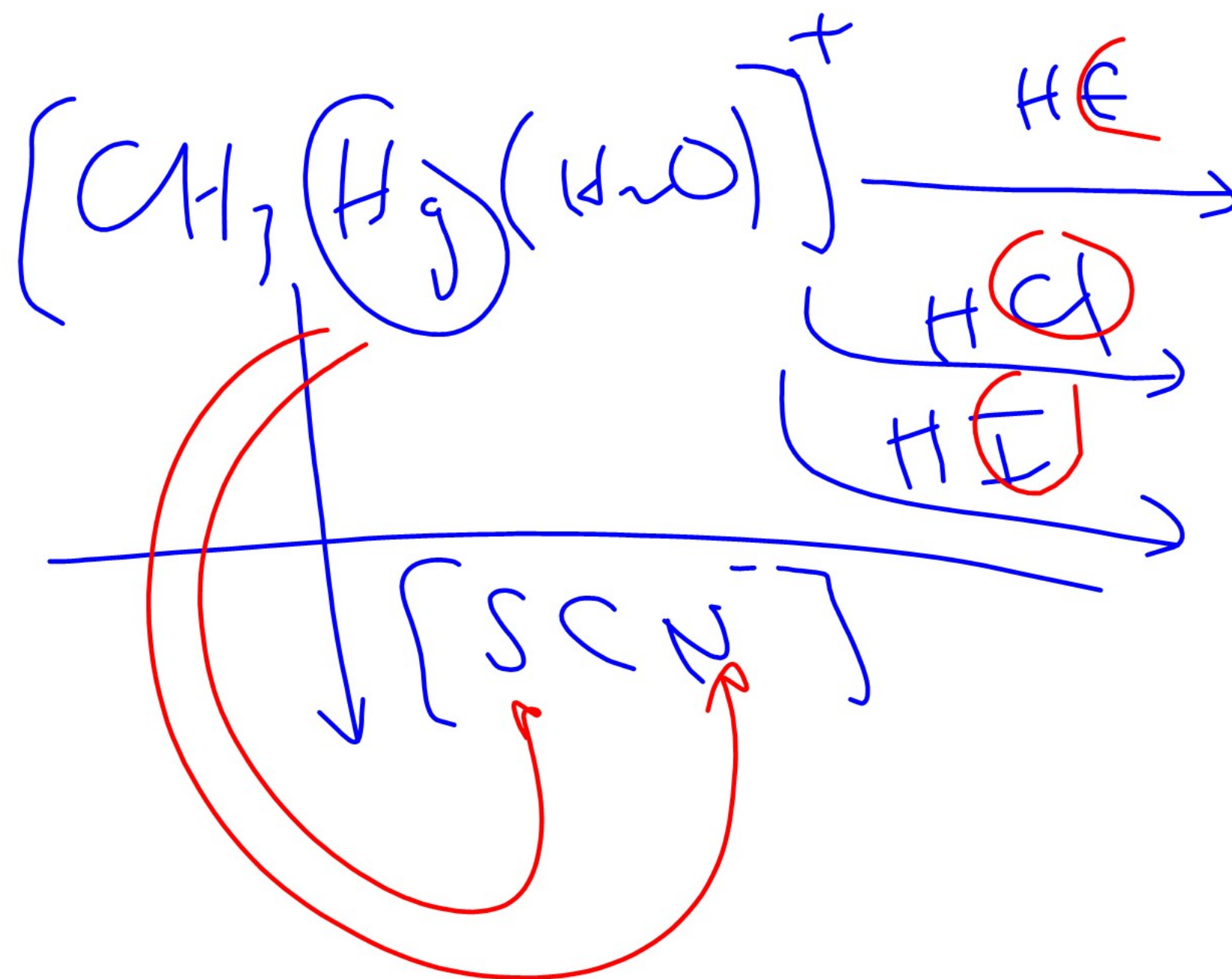


$I^-$



|      |                                                                                      | Size    | Polarizability |
|------|--------------------------------------------------------------------------------------|---------|----------------|
| acid |    | smaller | less polariz.  |
| acid |   | larger  | more polariz.  |
| base |   | smaller | ✓              |
| base |  | larger  |                |



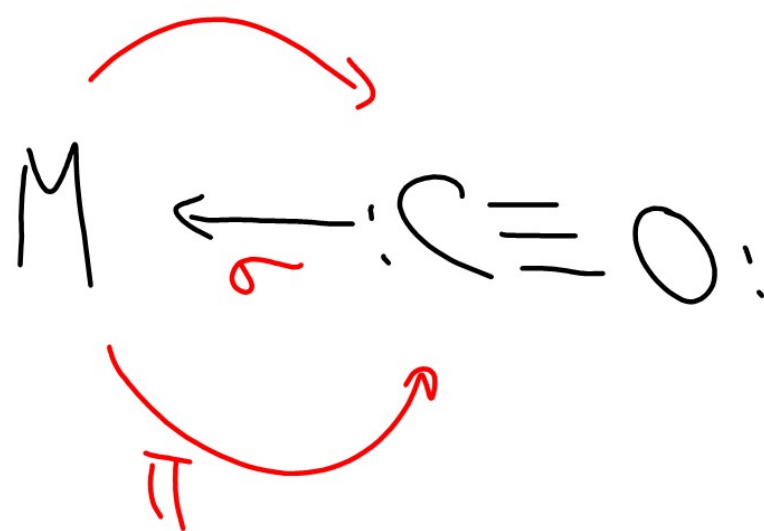
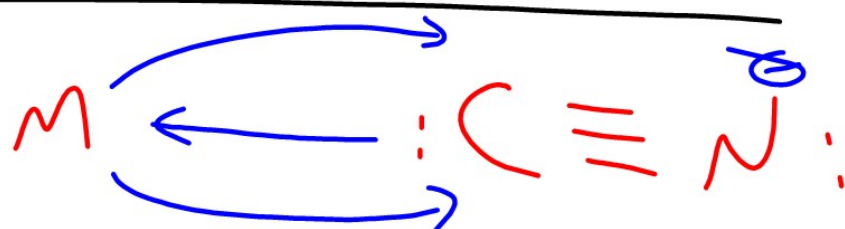


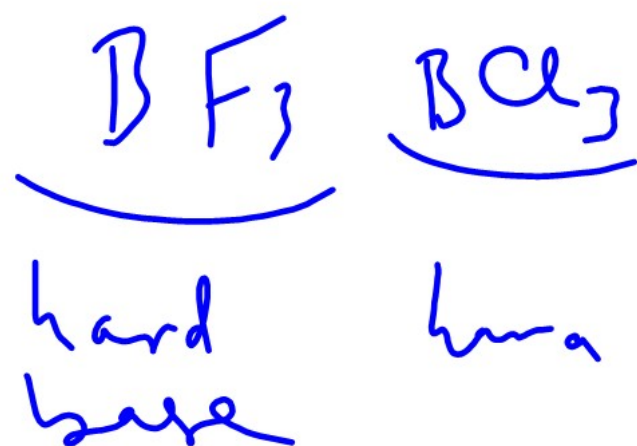
| bases                                                                                                 |                                                      |                                                                  |
|-------------------------------------------------------------------------------------------------------|------------------------------------------------------|------------------------------------------------------------------|
| Hard                                                                                                  | med                                                  | soft                                                             |
| $F^-$ , $Cl^-$<br>$H_2O$ , $OH^-$<br>$ClO_4^-$ , $NO_3^-$<br>$CO_3^{2-}$ , $SO_4^{2-}$<br>$PO_4^{3-}$ | $Br^-$<br>$SO_4^{2-}$<br>$NO_2^-$<br>$N_3^-$ , $N_2$ | $I^-$<br>$HS^-$ , $S^{2-}$ , $H_2S$<br>$(S)CN$<br>$CO$<br>$CN^-$ |

→ cov. soft

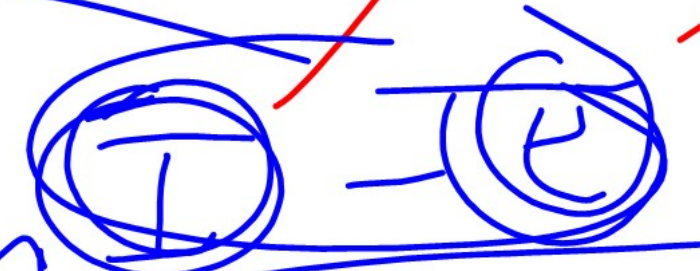
→ electr. bond

$\pi$ -bond.

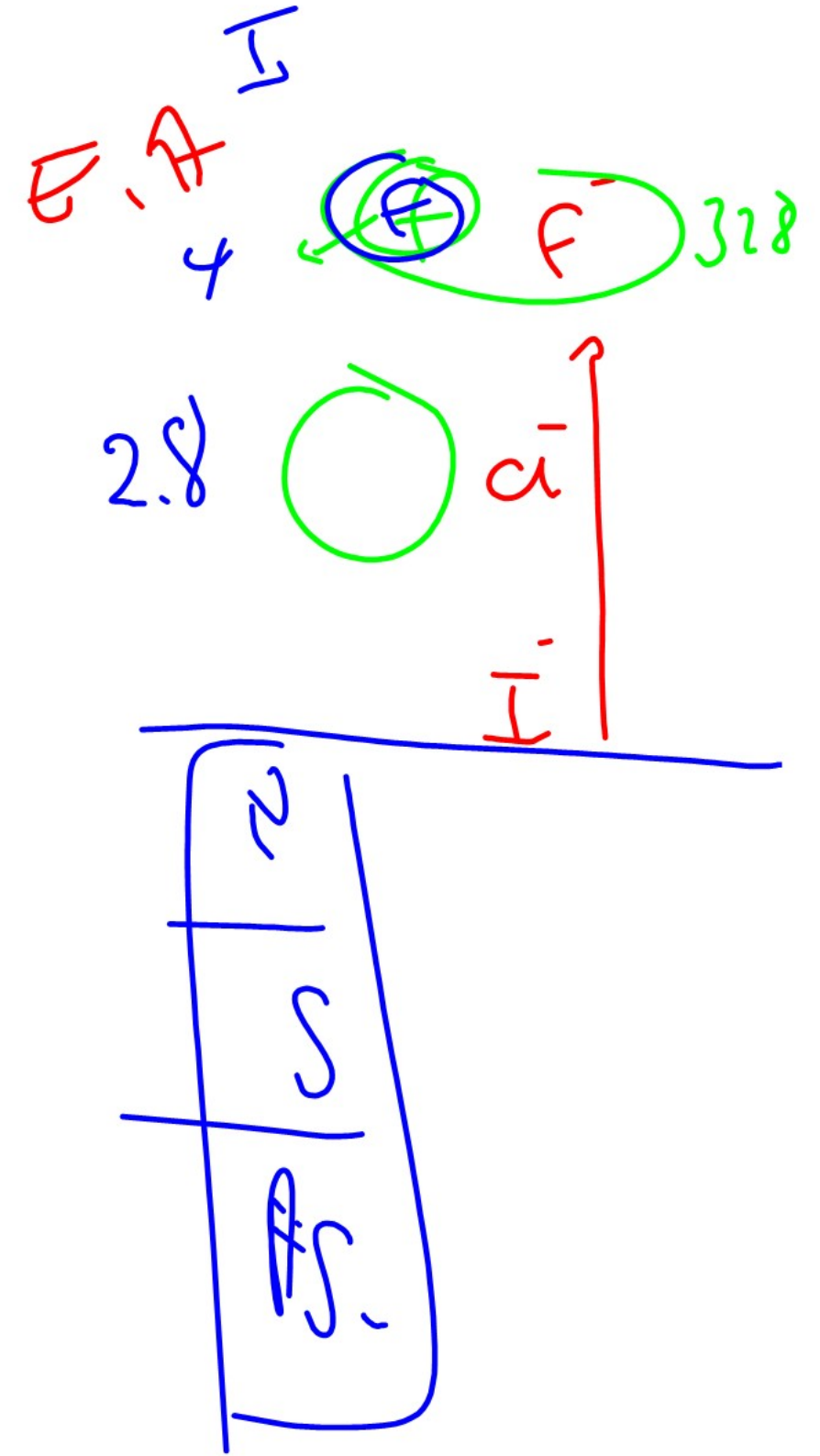


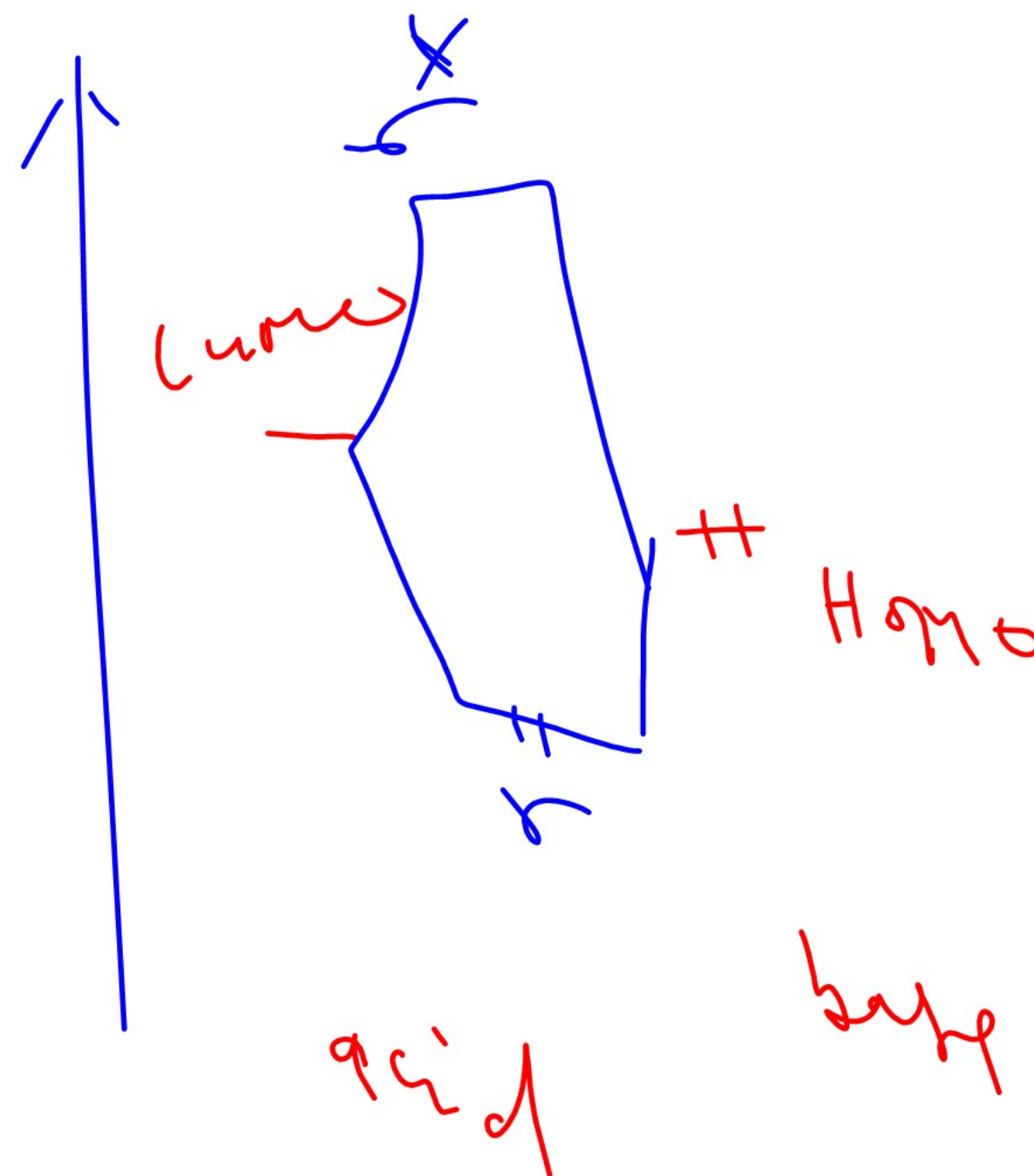
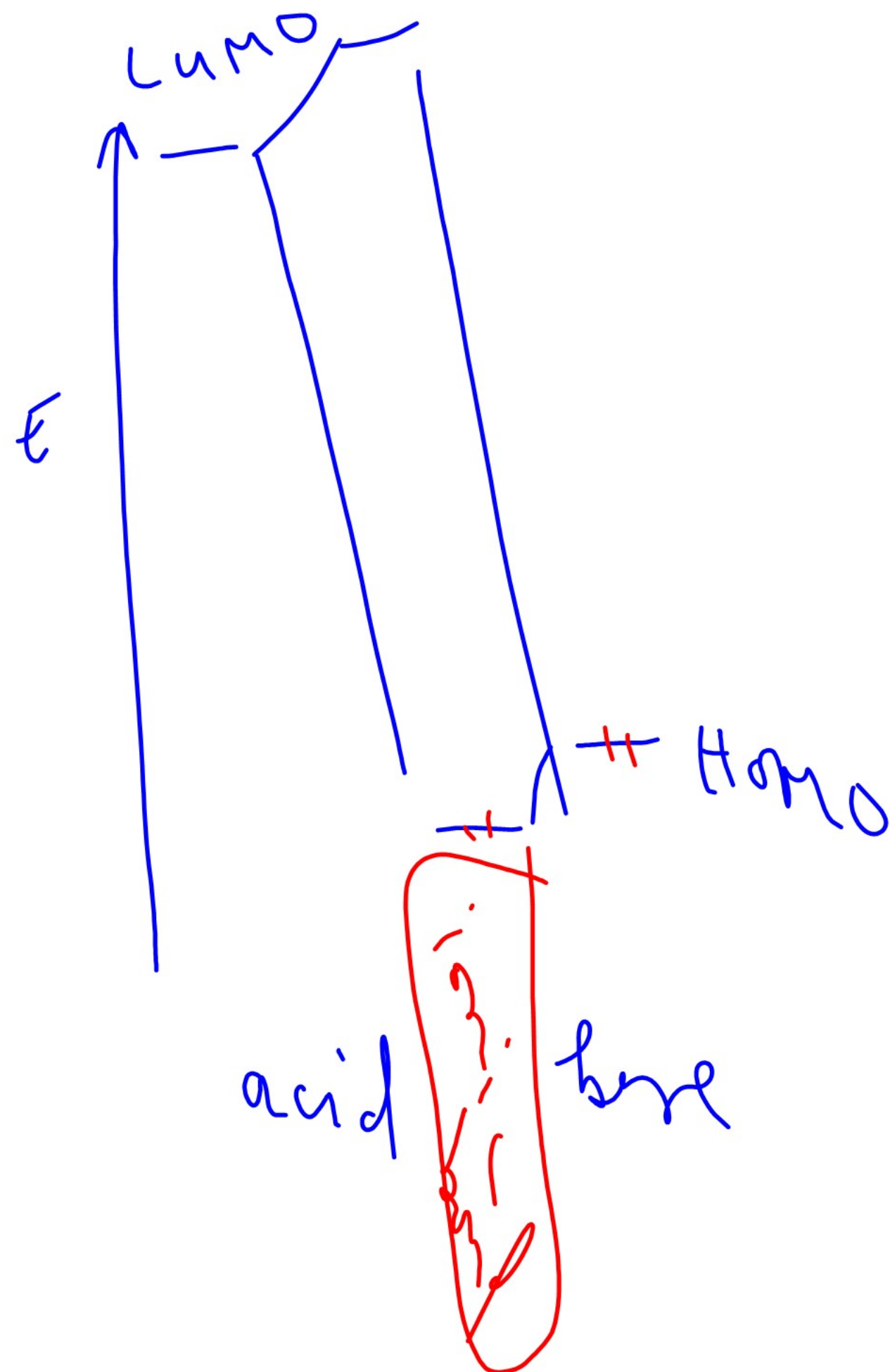


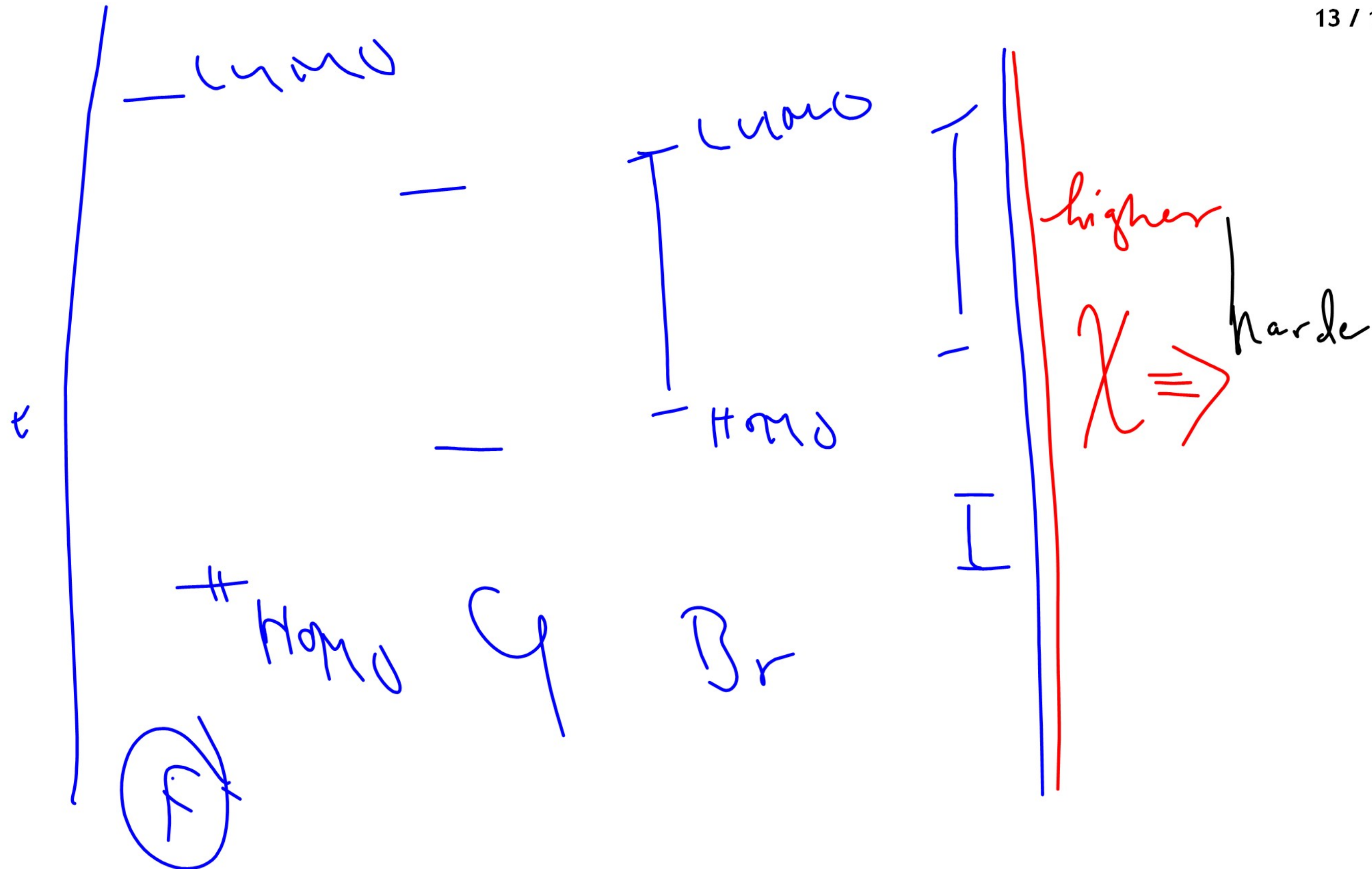
Pearson

$$\frac{1}{\sigma} = \frac{2}{2} = 1$$


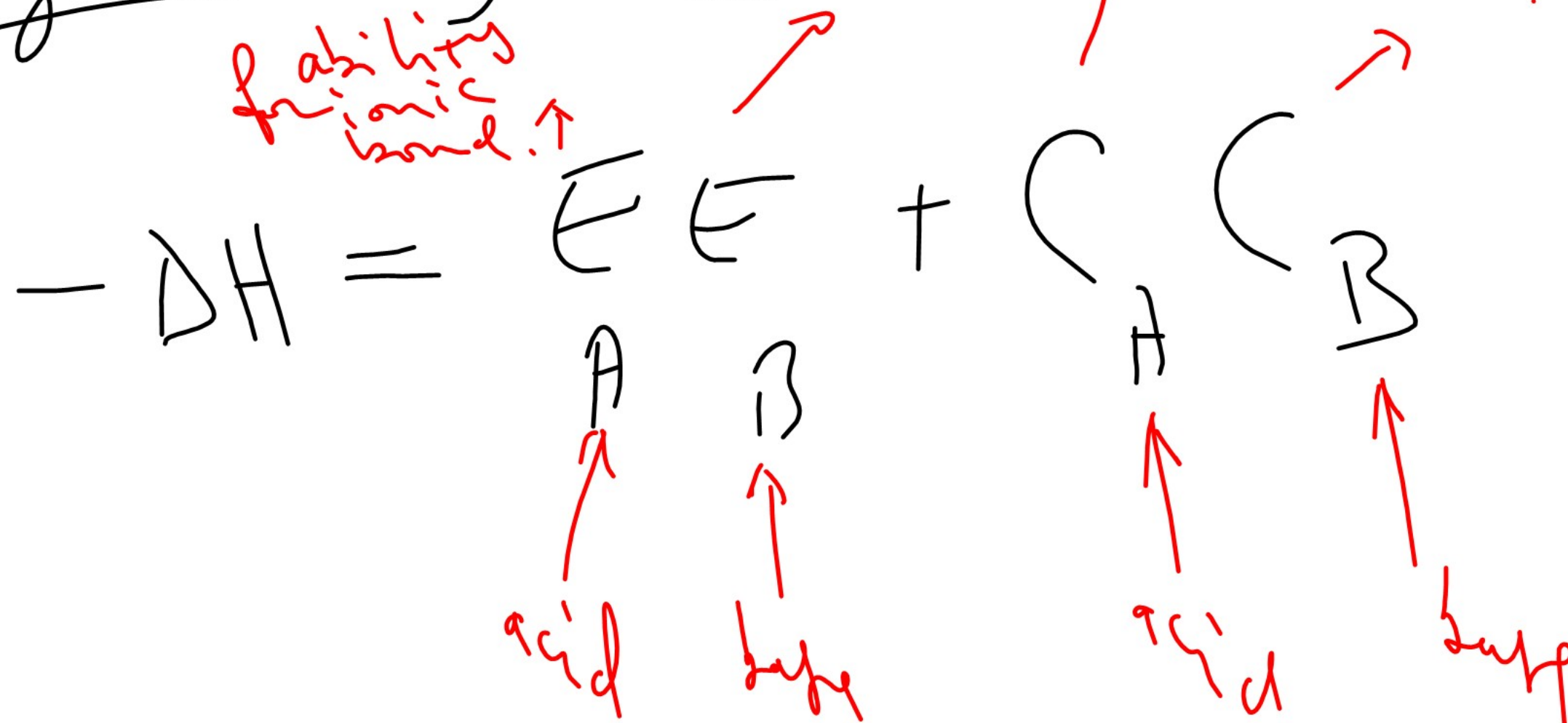
higher difference  $\Rightarrow$  harder







# Drago & Wayland



$\sqrt{A}^{3\gamma}$ 

$$\frac{I + E}{\sim}$$

$$= \frac{\chi}{74.22}$$

$$\frac{n}{41} \frac{I - E}{\sim}$$

 $K^+$ 

18

14

 $2n^{2+}$ 

29

11

| acid              | $C_A$ | $E_A$ |
|-------------------|-------|-------|
| $I_2$             | 1.00  | 1.00  |
| B Me <sub>3</sub> | 1.7   | 6.14  |