(11) **Today**

Sections 2.7 – 2.11: Acids and Bases

Section 2-12: Non-Covalent Interactions Between Molecules

Section 2.7: Problem 2-11
Section 2.8: Problems: 2-12, 2-13
Section 2.9: Problems 2-14 – 2-16
Section 2.10 - 2:11: 2.11 Problems: 2-17, 2-18, 2-24, 2-25, 2-40 (2-42 is a good question but theLewis acid-base concept is not strongly emphasized in our organic class), 2-43, 2-44, 2-46, 2-47, 2-48, 2-54, 2-55, 2-61, 2-64

Next Class (12)

Section 2-12
Non-Covalent Interactions Between Molecules

2.12 Problems: 2-19, 2-65

(13) **Second Class from Today**

Section 3.1
Functional Groups

Section 3.2
Alkanes and Isomers

Section 3.3
Alkyl Groups

Section 3.4
Nomenclature

Third Class from Today (14)

Section 3.1
Functional Groups

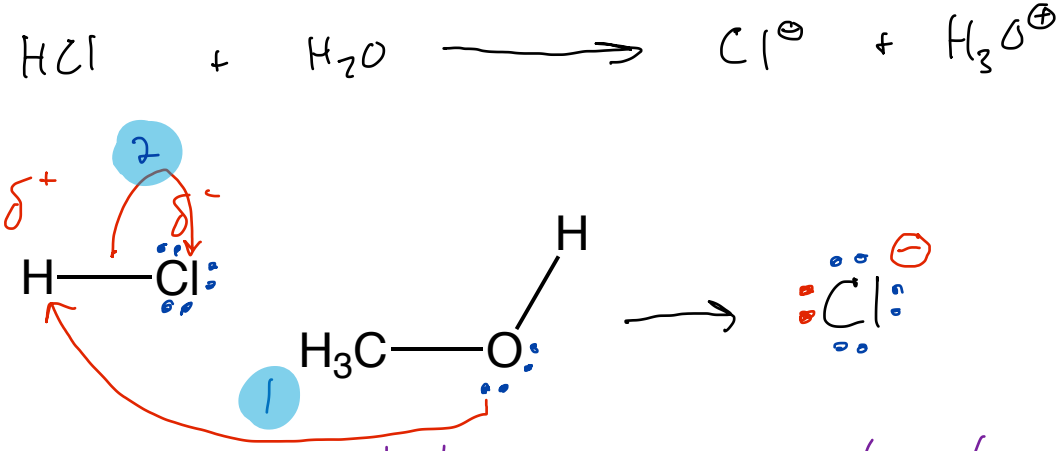
Section 3.2
Alkanes and Isomers

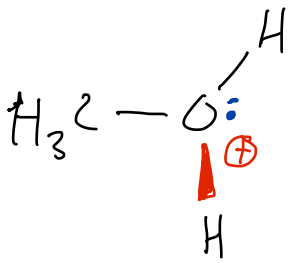
Section 3.3
Alkyl Groups

Section 3.4
Nomenclature

A Brønsted-Lowry acid is a proton, H^+, DONOR.

A Brønsted-Lowry base is a proton, H^+, ACCEPTOR.



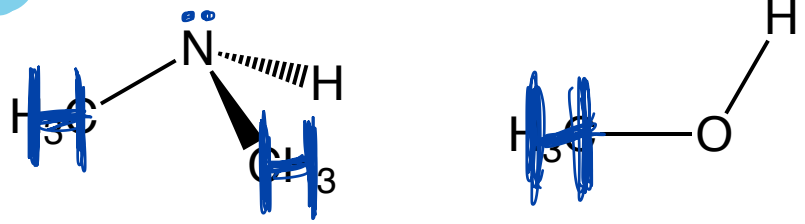


Curved arrow notation: a way to keep track of where we are making + breaking bonds

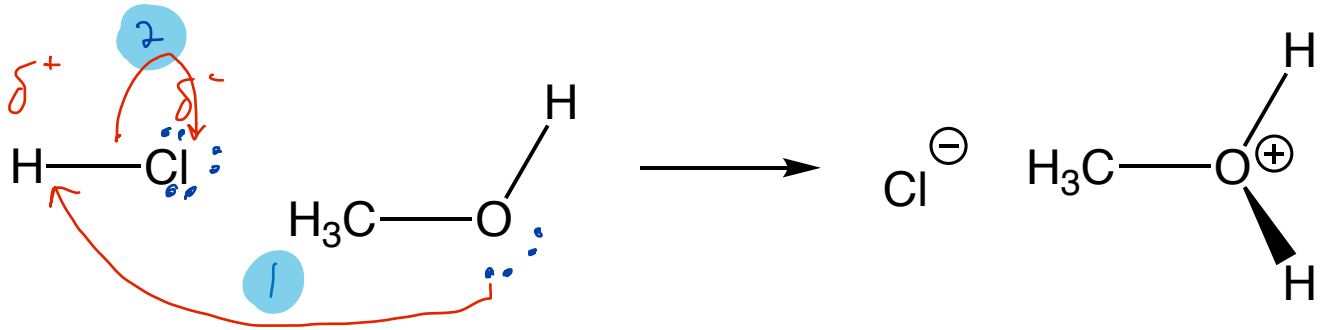
arrows start at e⁻'s and the arrow ends at where the e⁻'s are going

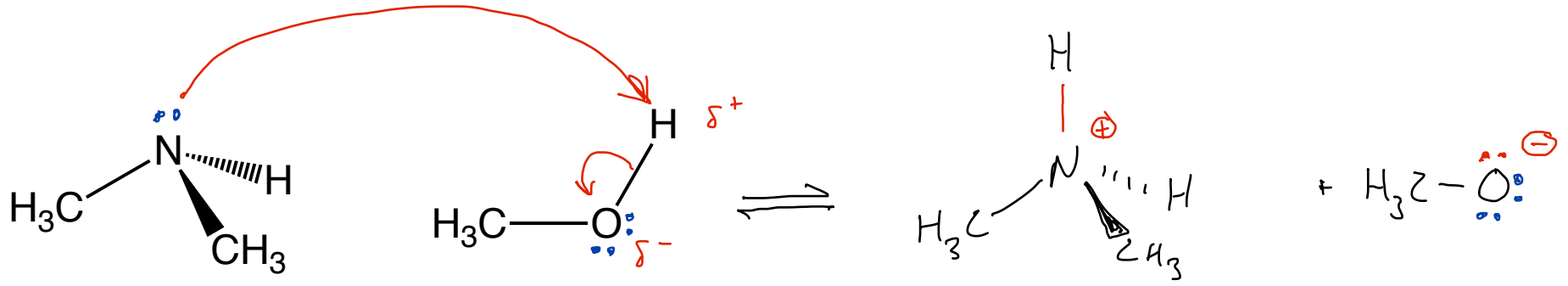
1 in this case the arrow means we are making an O to H bond

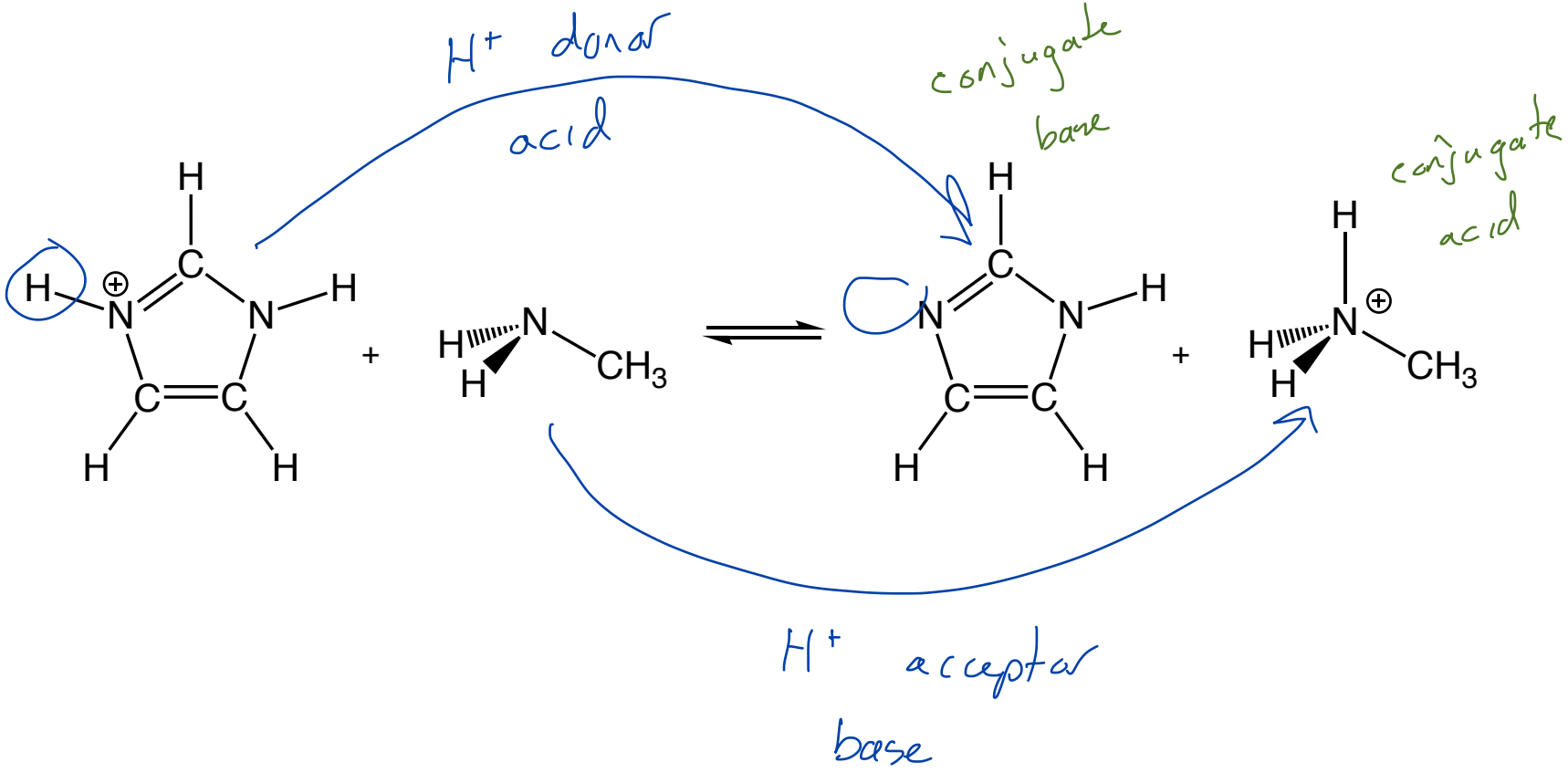
2 in this case the arrow means the e⁻'s in the bond are moved to the Cl



K_B


2
1
H
Cl
H3C
O
Cl
H
H3C
O
H


N
H3C
H
CH3
H
H3C
O
H
N
H3C
H
H3C
O


H+ donor
acid
conjugate
base
conjugate
acid
H+ acceptor
base

a little a lot

$$HA(aq) \rightleftharpoons H^+(aq) + A^-(aq)$$

a lot a little

$$K_a = \frac{[prod]}{[reactants]} = \frac{[H^+][A^-]}{[HA]}$$

a lot / a little

Do strong acids (things that are good at releasing H^+) have large or small K_a's?

weak acid (small / big $\frac{\text{a little}}{\text{a lot}} = K_a$) small K_a

the "p" in pK_a is the same p as the p in pH

$$pK_a = -\log K_a$$

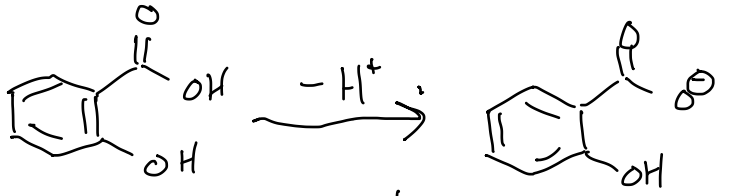
$$K_a = \frac{[H^+][A^-]}{[HA]}$$

$$-\log K_a = -\log\left(\frac{[H^+][A^-]}{[HA]}\right)$$

rearrange

$$pH = pK_a + \log \frac{[A^-]}{[HA]}$$

Why Tables of pK_a instead of K_a?



keep in aqueous layer

$$pK_a = -\log K_a$$

acetate buffer @ pH = 4.00

buffers

sodium acetate

$$pH = pK_a + \log \frac{[A^-]}{[HA]}$$

acetic acid

$$4.00 = 4.78 + \log \frac{[\text{acetate}]}{[\text{acetic acid}]}$$

10000

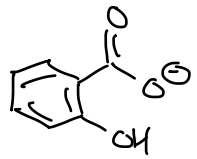
$$pH = pK_a + \log \frac{[A^-]}{[HA]}$$

1

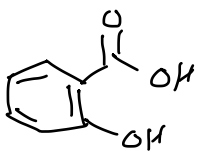
$$= 2.98 + \log \frac{10000}{1}$$

$$pH = 2.98 + 5$$

at a pH of 8 the



to



will be

10000 to 1

pK_a - Which is the strongest acid?

$pK_a = -\log K_a$

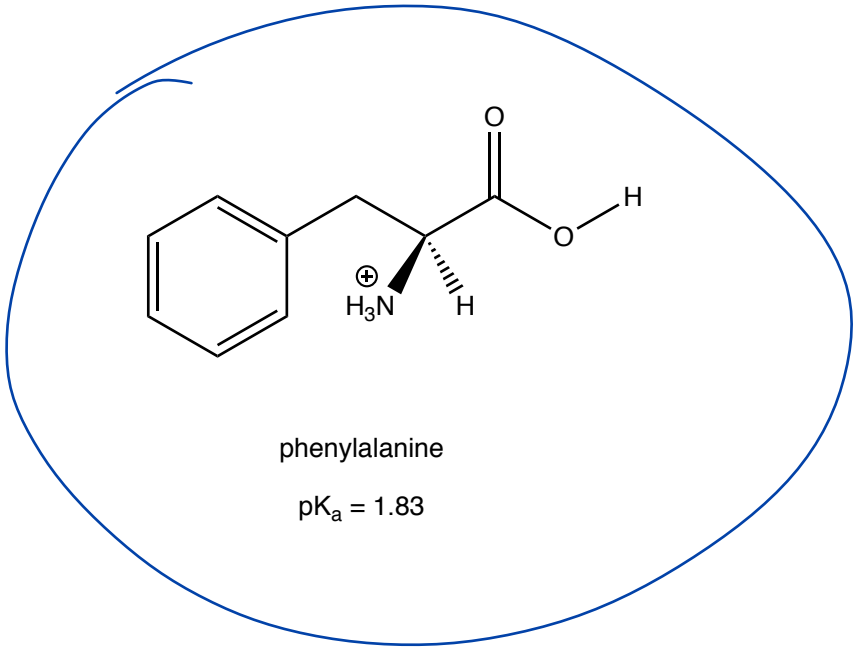
the larger the pK_a the weaker the acid

pK_a		
50	CH_4	$K_a = 10^{-50}$
36	NH_3	
15.6	H_2O	
3.18	HF	strongest acid

the smaller the pK_a the stronger the acid

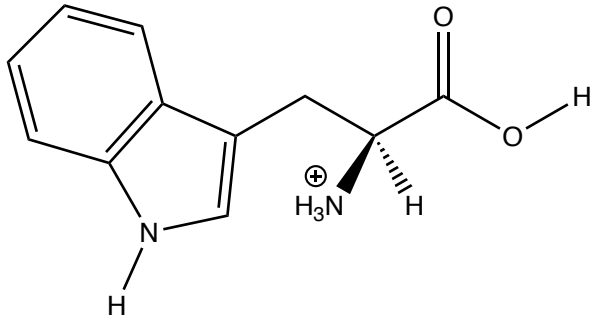
pK_a's CH_4, ~50 NH_3, ~36 H_2O, 15.6 HF, 3.18

pK_a - Which is the stronger acid?



phenylalanine

pK_a = 1.83



tryptophan

pK_a = 2.83

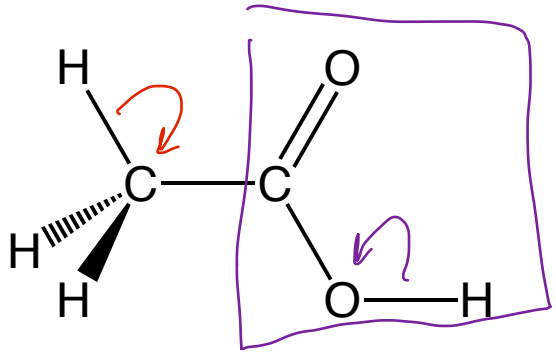
pK_a values from Organic Chemistry, 10th ed. McMurry, (2023) openstax.

Which is the acidic H^+ in acetic acid ($HC_2H_3O_2$)?

CH_3CO_2H

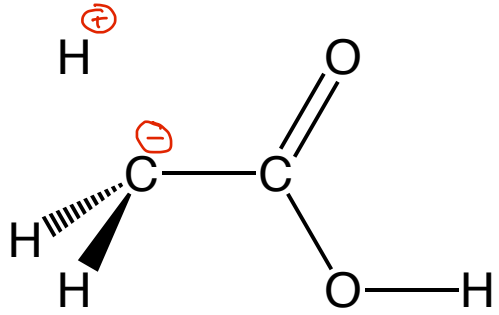
carboxylic acid

Section 2.6

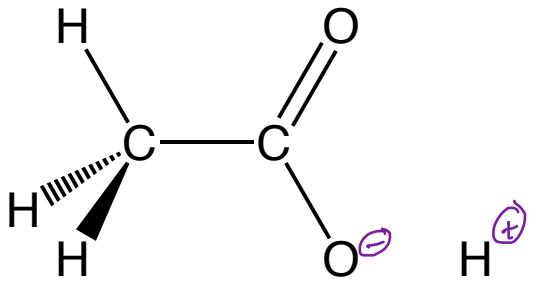


a.k.a. CH_3CO_2H

this side



?



C atoms have a 6^+ nucleus

these e^-'s experience less attraction

these e^-'s would be less stable

these e^-'s would be higher in E

O atoms are better at holding onto e^-'s...

O atoms have 8^+ nucleus

e^- experience a greater $\oplus$ charge... more attraction...

lower in E

The one that leaves the more/most stable base behind

Same Period More Positive Nucleus

CH_4

NH_3

H_2O

HF

pK_a's CH_4, ~50 NH_3, ~36 H_2O, 15.6 HF, 3.18

Same Column Larger Valence Shell

HI

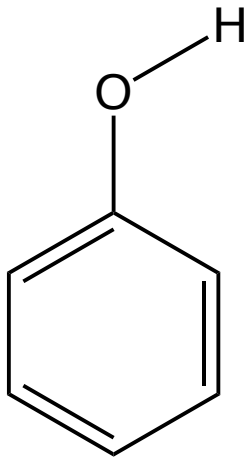
HBr

HCl

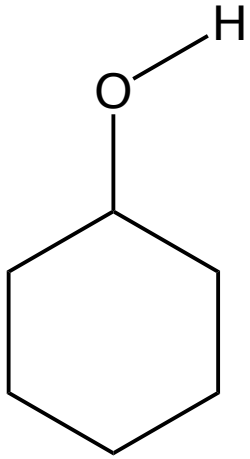
HF

pK_a's HF, 3.18 HCl, -7 HBr, -9 HI, -10

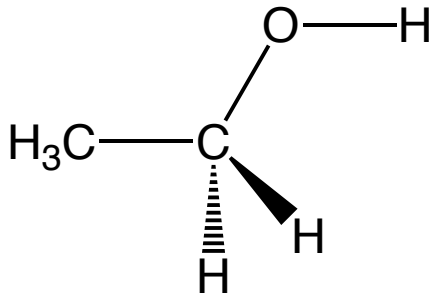
Resonance



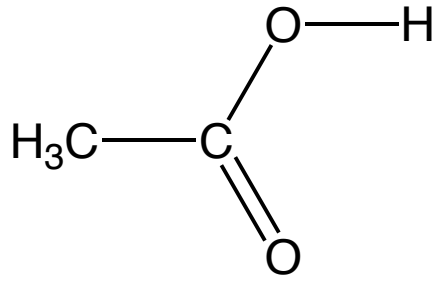
phenol



cyclohexanol



ethanol



acetic acid

pK_a's cyclohexanol, 16.0 phenol, 10.0 ethanol 16.0 acetic acid 4.74

Inductive Effect

acetic, 4.76; formic, 3.75; chloroacetic, 2.87; dichloroacetic, 1.25

Greater s character

pK_a's ethane 50, ethene 44, ethyne 25

Practice: For each molecule, which proton is the most likely to be lost and for each pair, which is the stronger acid