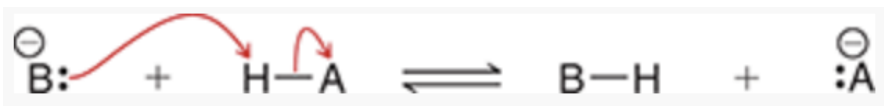
<u>Session 5 Worksheet</u>

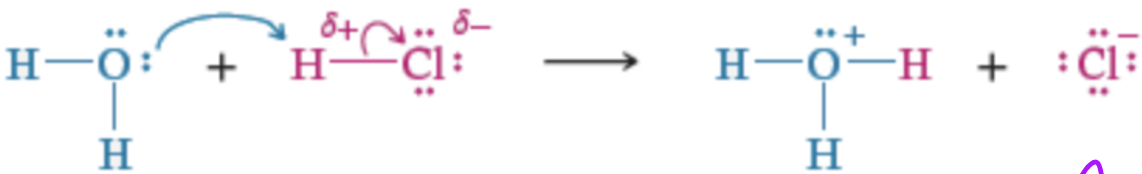
Curved Arrows (again)

- Shows movement of electrons
- In acid-base chemistry (and nearly all reactions) a bond has to ______________ break and é will go towards the more EN atom
- Bases grab protons



Acids and Bases

Formation of Hydronium:



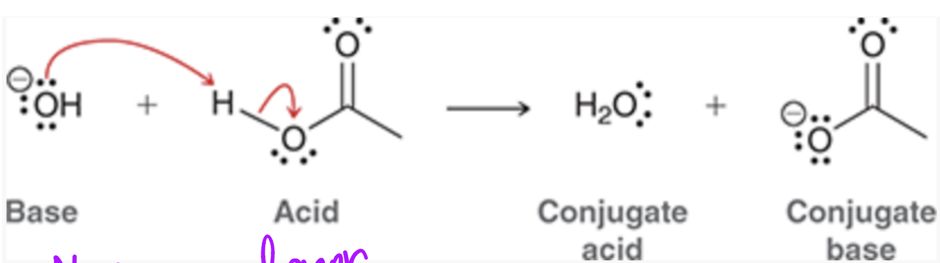
hydronium

spectator ion

Bronsted Lowry Acid: H^+ donor

Bronsted Lowry Base: H^+ acceptor

EX:



Acceptor donor

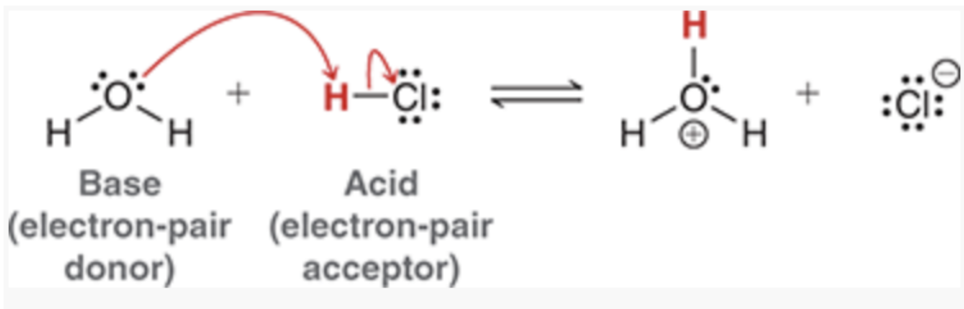
Lewis Acid:

e^- pair acceptors

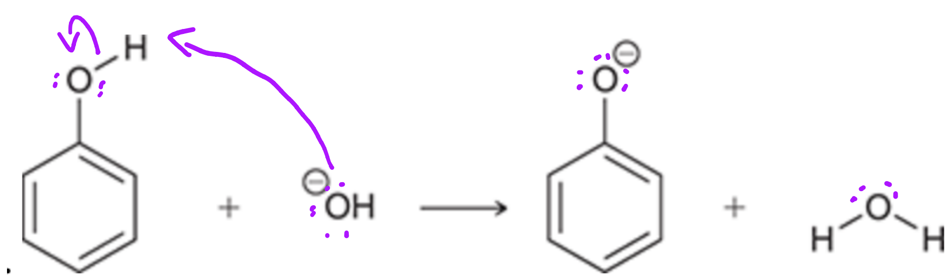
Lewis Base:

e^- pair donor

EX:



Practice drawing the mechanism and labeling acid/base:



Deprotonated:

removing a proton

Protonated:

adding a proton

Conj. Acid:

- Bases get protonated
- $+ H^+$

Conj. Base:

- Acid is deprotonated
- $-H^+$

***In reactions, the acidity of a compound is based on the** Stability **of the conj. base ***

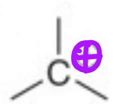
Nucleophiles:

- "nucleus-loving"
- $\ominus$ charged (most of the time)
- Lewis bases

Electrophiles:

- "electron-loving"
- $\oplus$ charged *
- Lewis Acids

Introducing Carbocations/anions:



Carbocation

- carbon w/ positive charge
- only has 3 bonds

Carbanion

- carbon w/ negative charge
- 3 bonds + a lone pair
- highly reactive

Equilibrium (a traumatic flashback to chem 2)

Equilibrium:

products

$$K_{eq} = \frac{[H_3O^+][A^-]}{[HA][H_2O]}$$

reactants

Ka:

products

$$K_a = K_{eq}\,[H_2O] = \frac{[H_3O^+][A^-]}{[HA]}$$

reactants

pKa= $-\log K_a$

Ka= 10^{-pKa}

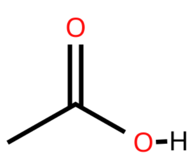
Main Idea: the reaction will depend on the concentration of hydronium

Which compound is more acidic? Given pKa

1

pKa = -9

2



pKa = 4

3

pKa = 3.2

4

pKa = 25

Most acidic to least acidic order: 1, 3, 2, 4

ARIO

ARIO represents the key factors used to compare the Acidity and Basicity of a compound

1. ATOM

Atoms in the same row: EN is dominant factor

⊖ on carbon is unstable

O can stabilize the ⊖ charge

weak acid

unstable = strong conj base

strong acid

stable = weak conj base

Atoms in the same column:

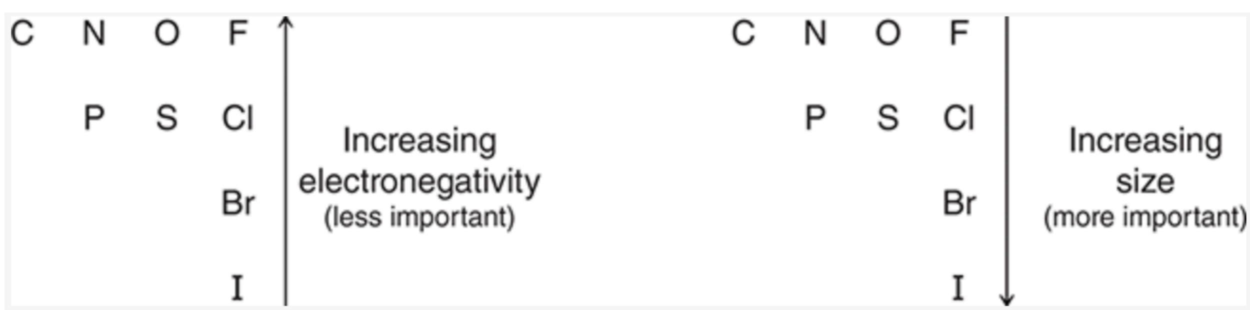
Size matters

weak acid

strong (unstable) conj. base

Strong acid

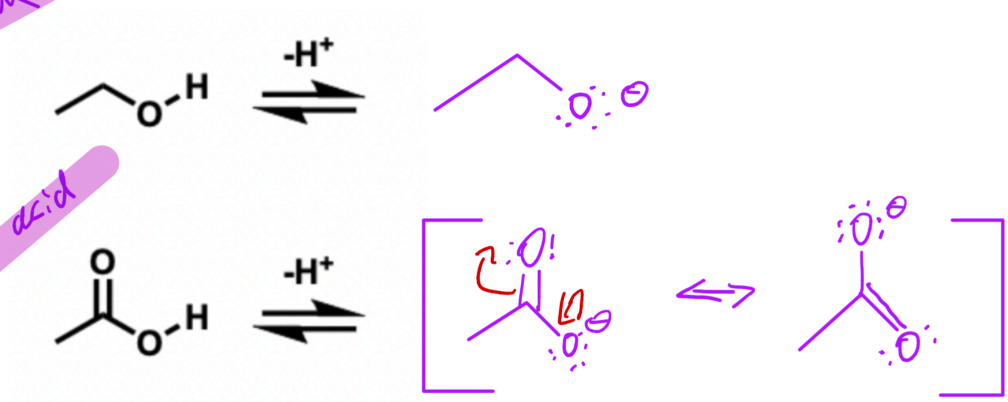
weak (stable) conj. base



2. RESONANCE

no resonance

weak acid



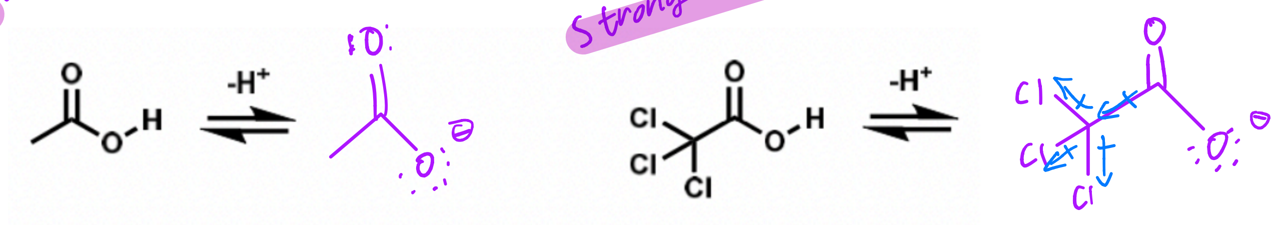
strong acid

resonance stabilizes (weakens) the conj. base

3. INDUCTION

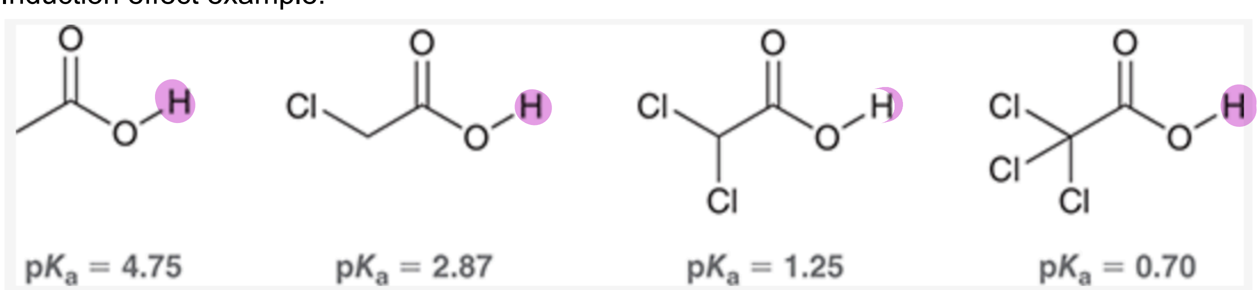
weak acid

Strong acid



weak conj. base

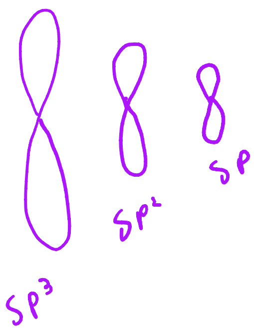
Induction effect example:

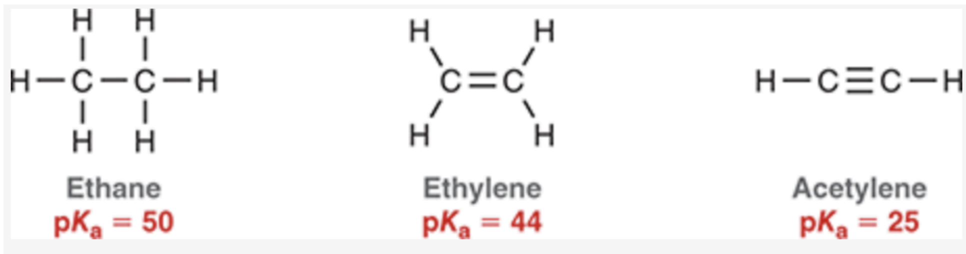


4. ORBITALS

Electrons in sp orbitals are stabilized by:

being closer to the nucleus

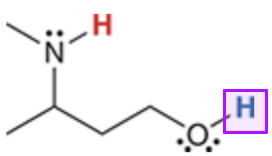


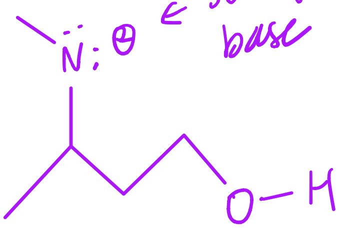


Which of the protons is more acidic?

ARIO

Draw conj. bases, compare stabilities

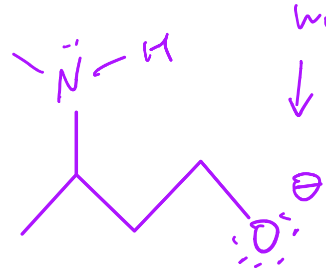


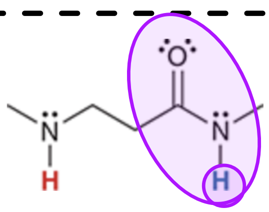


← strong conj. base

VS

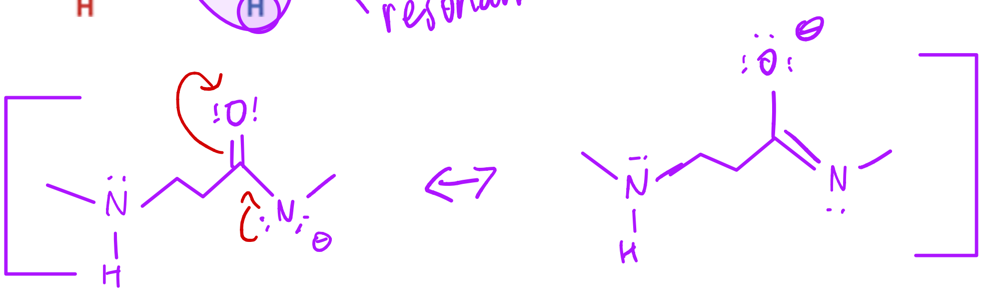
weak conj. base ↓

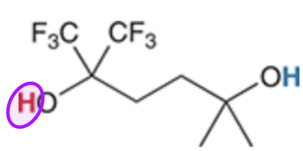




resonance here

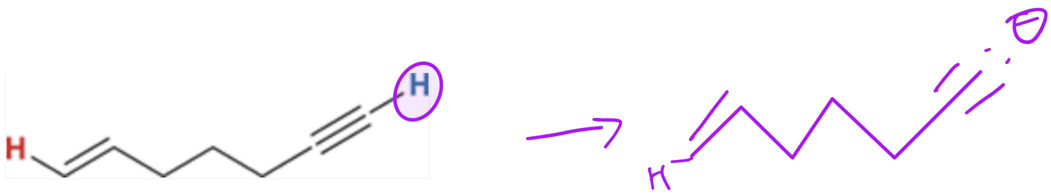
draw:





conj. base is stabilized by the inductive effects of F

$\ominus$ is stabilized by being closer to the nucleus of C in the triple bond



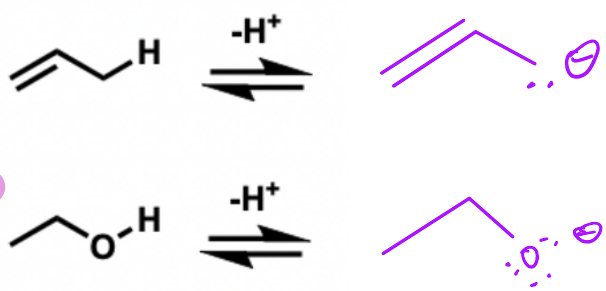
Practice: which of the compounds is the stronger acid?

weak acid

strong base

Strong acid

weak base



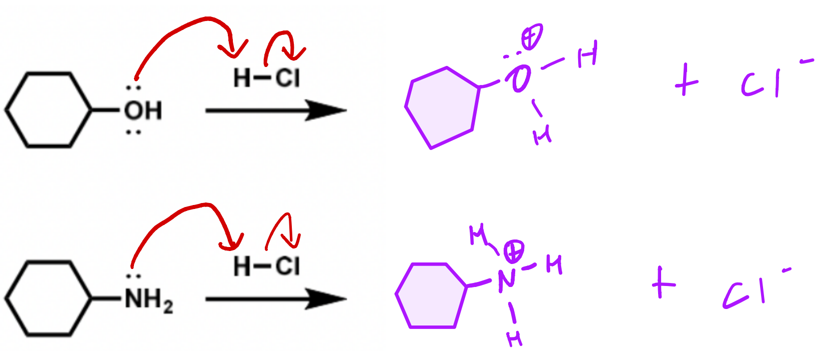
C^- vs O^-

O^- can stabilize a $\ominus$ charge better, making the conj. base weak

Practice: which is the stronger base? → will form the weak acid

weak base

Strong base



O^+ (more EN) forms a strong (unstable) conj. acid

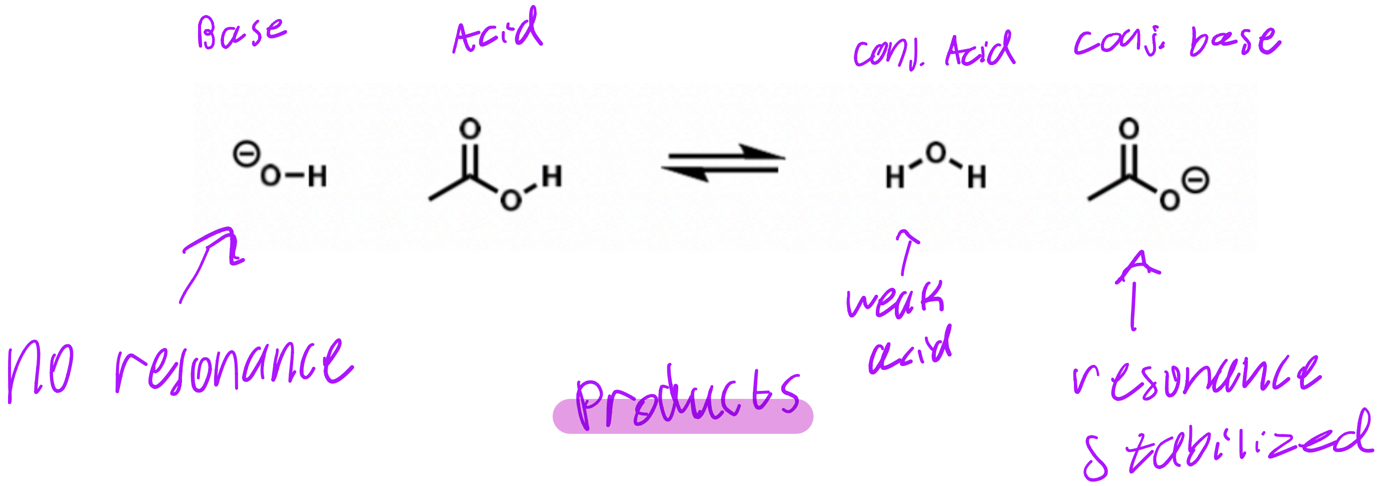
N^+ (less EN) forms a weak (Stable) conj. acid

Favoring Equlibrium: favors the most stable ions and weaker acid

To see if a reaction will favor the products of reactants, we compare ___ions___ to

predict this, because they are the biggest contributor of ___instability___

Example: Determine if the products or reactants are favored in the following reaction:



Draw the correct arrow pushing mechanism to predict the products below: