Session 5 Worksheet

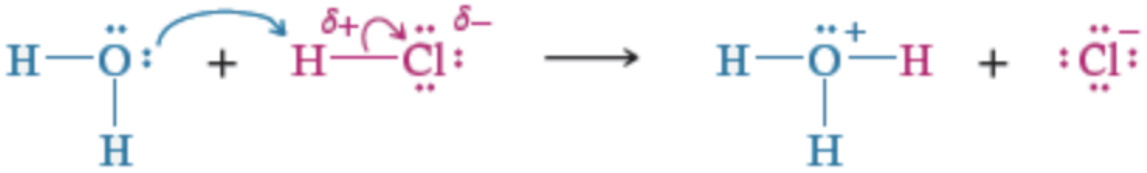
Curved Arrows (again)

- Shows movement of _____
- In acid-base chemistry (and nearly all reactions) a bond has to _____

  and electrons will go towards the more _____
- Bases _____ protons

Acids and Bases

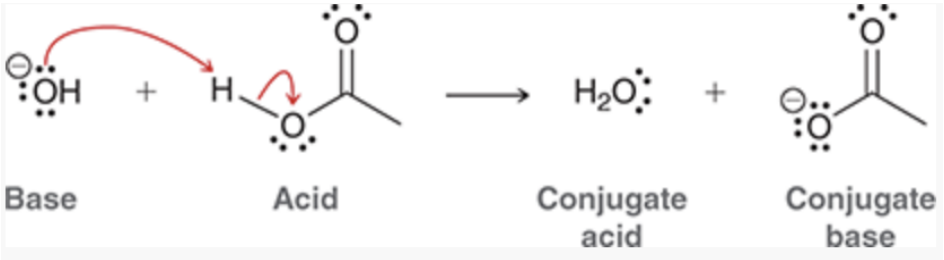
Formation of Hydronium:



Bronsted Lowry Acid:

Bronsted Lowry Base:

EX:

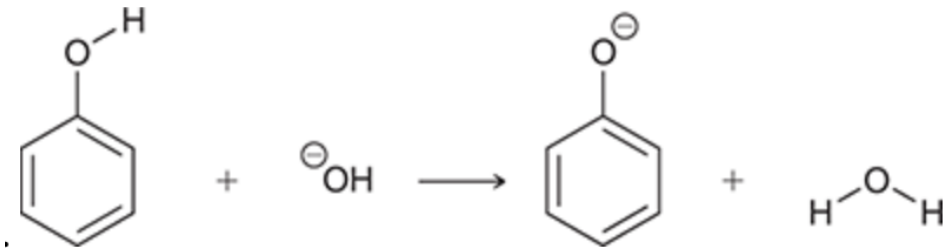


Lewis Acid:

Lewis Base:

EX:

Practice drawing the mechanism and labeling acid/base:



Deprotonated:

Protonated:

Conj. Acid:

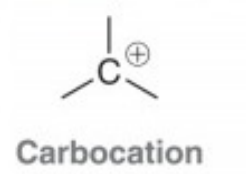
Conj. Base:

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

Nucleophiles:

Electrophiles:

Introducing Carbocations/anions:



Equilibrium (a traumatic flashback to chem 2)

Equilibrium:

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

Ka:

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

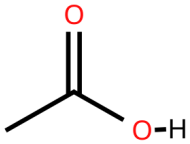
pKa=

Ka=

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

Which compound is more acidic? Given pKa

pKa = -9



pKa = 4

pKa = 3.2

pKa = 25

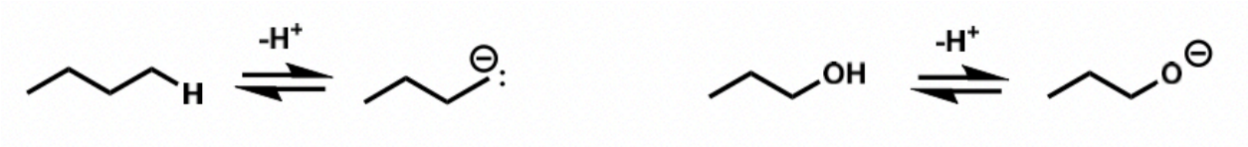
Most acidic to least acidic order:

ARIO

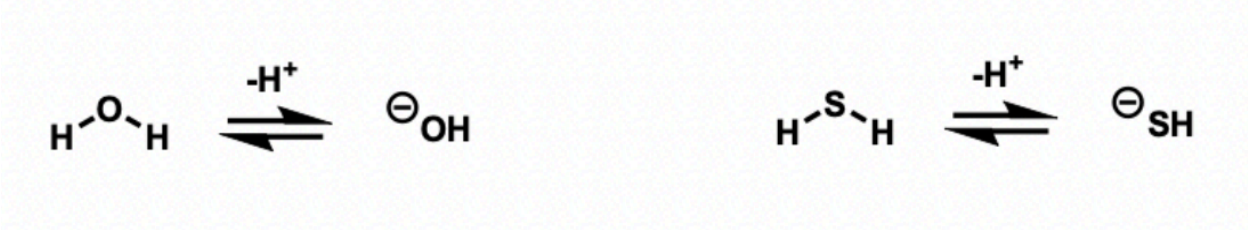
ARIO represents the key factors used to compare the _____ of a compound

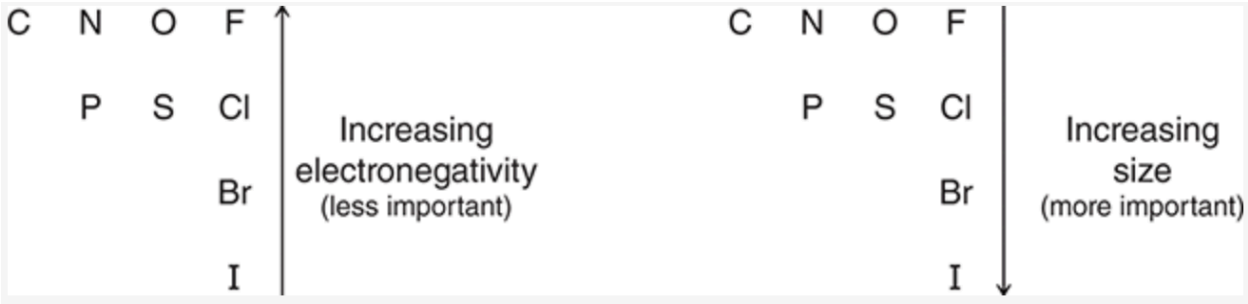
1. ATOM

Atoms in the same row:

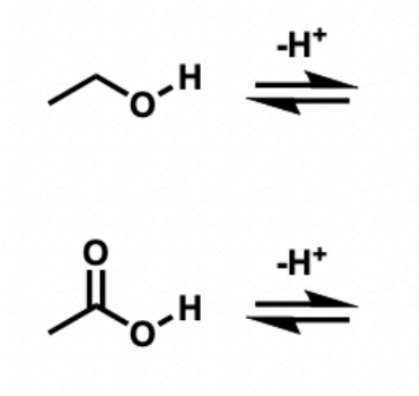


Atoms in the same column:

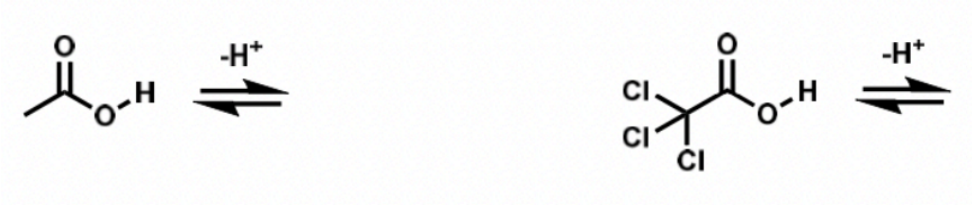




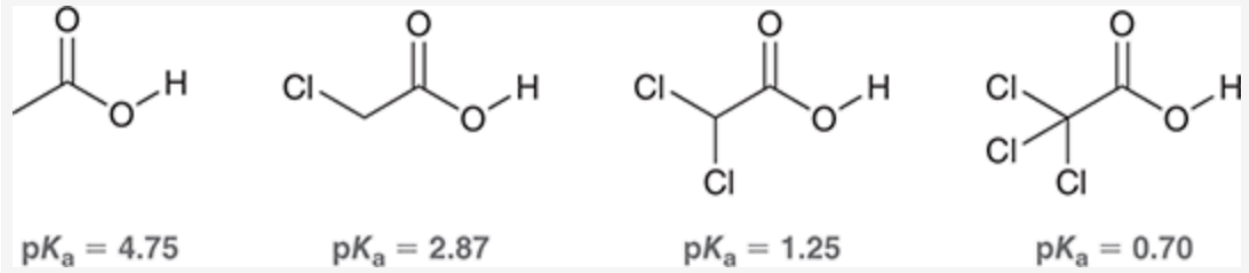
2. RESONANCE



3. INDUCTION

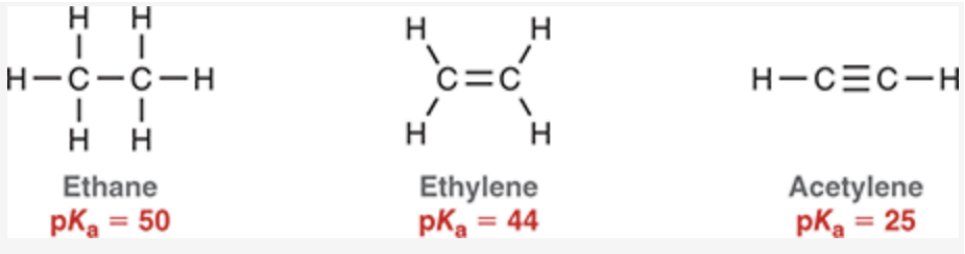


Induction effect example:

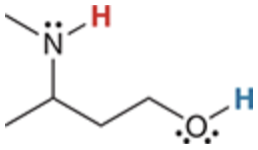


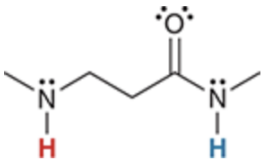
4. ORBITALS

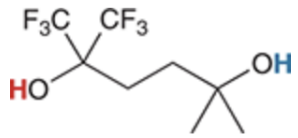
Electrons in sp orbitals are stabilized by:

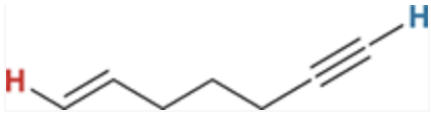


Which of the protons is more acidic?

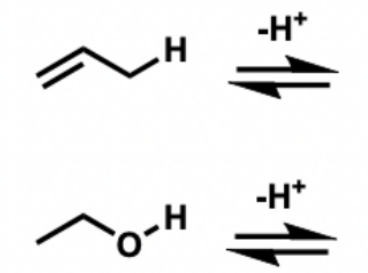




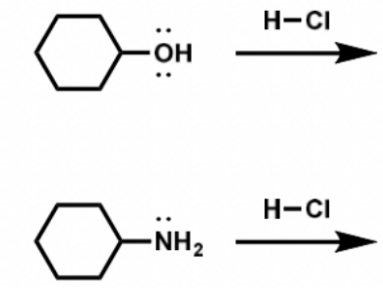




Practice: which of the compounds is the stronger acid?



Practice: which is the stronger base?

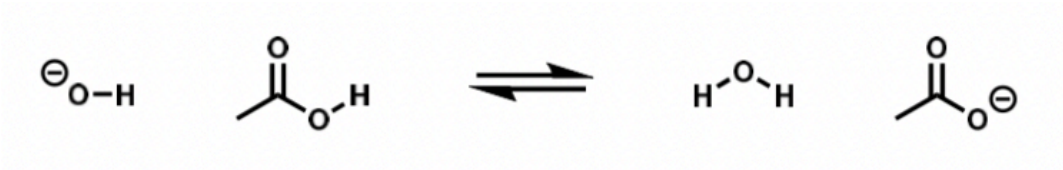


Favoring Equlibrium:

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

predict this, because they are the biggest contributor of _____

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



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

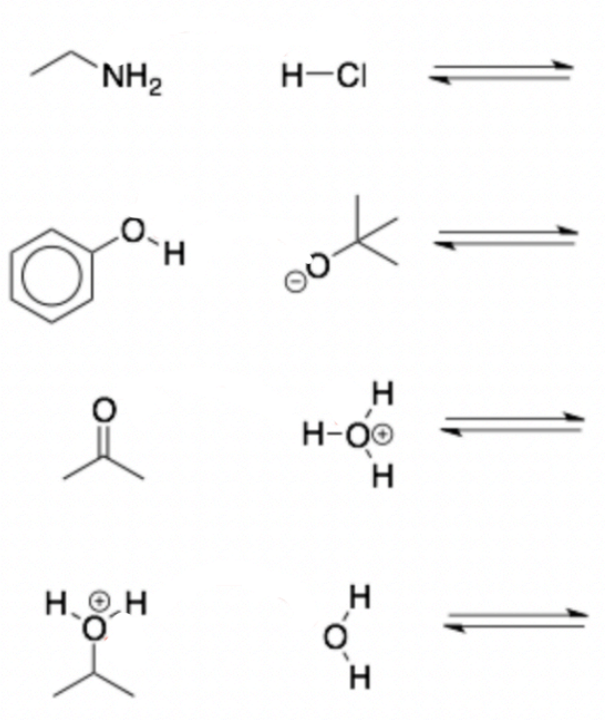


TABLE 3.1

Relative Strength of Selected Acids and Their Conjugate Bases

	Acid	Approximate pK_a	ConjugateBase	
Strongest acid	$HSbF_6$	< -12	SbF_6^-	**Weakest base**
	HI	-10	I^-	
	H_2SO_4	-9	HSO_4^-	
	HBr	-9	Br^-	
	HCl	-7	Cl^-	
	$C_6H_5SO_3H$	-6.5	$C_6H_5SO_3^-$	
Increasing acid strength	$(CH_3)_2\overset{+}{O}H$	-3.8	$(CH_3)_2O$	Increasing base strength
	$(CH_3)_2C{=}\overset{+}{O}H$	-2.9	$(CH_3)_2C{=}O$	
	$CH_3\overset{+}{O}H_2$	-2.5	CH_3OH	
	HNO_3	-1.4	H_2O	
	H_3O^+	0.0	NO_3^-	
	CF_3CO_2H	0.18	$CF_3CO_2^-$	
	HF	3.2	F^-	
	$C_6H_5CO_2H$	4.21	$C_6H_5CO_2^-$	
	$C_6H_5NH_3^+$	4.63	$C_6H_5NH_2$	
	CH_3CO_2H	4.75	$CH_3CO_2^-$	
	H_2CO_3	6.35	HCO_3^-	
	$CH_3COCH_2COCH_3$	9.0	$CH_3CO\bar{C}HCOCH_3$	
	NH_4^+	9.2	NH_3	
	C_6H_5OH	9.9	$C_6H_5O^-$	
	HCO_3^-	10.2	CO_3^{2-}	
	$CH_3NH_3^+$	10.6	CH_3NH_2	
	H_2O	14.0	HO^-	
	CH_3CH_2OH	16	$CH_3CH_2O^-$	
	$(CH_3)_3COH$	18	$(CH_3)_3CO^-$	
	CH_3COCH_3	19.2	$^-CH_2COCH_3$	
	$HC \equiv CH$	25	$HC \equiv C^-$	
	$C_6H_5NH_2$	31	$C_6H_5NH^-$	
	H_2	35	H^-	
	$(i\text{-}Pr)_2NH$	36	$(i\text{-}Pr)_2N^-$	
	NH_3	38	$^-NH_2$	
	$CH_2{=}CH_2$	44	$CH_2{=}CH^-$	
Weakest acid	CH_3CH_3	50	$CH_3CH_2^-$	**Strongest base**