CONCEPT: FACTORS AFFECTING ACIDITY- ELEMENT EFFECTS

There are 5 major factors of acidity. We use these factors to determine relative acidity in the *following **two** situations:*

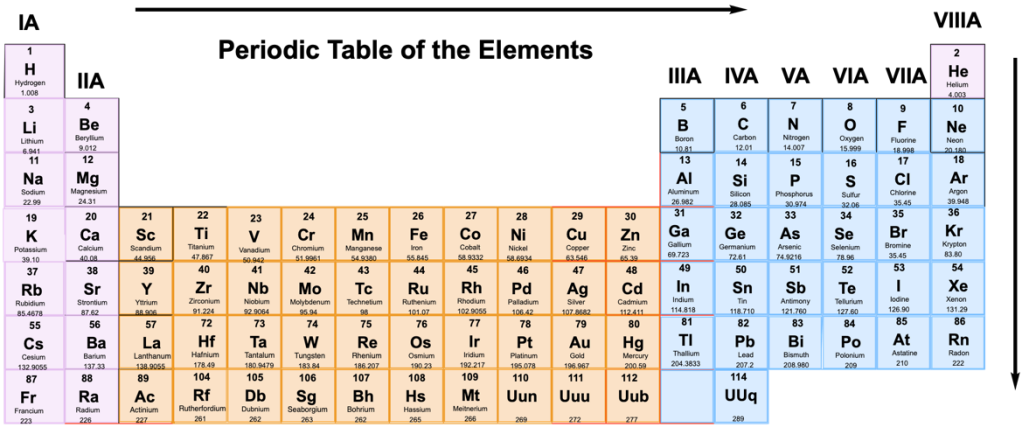
1. pKa information is _____ for a molecule
2. The pKas of two molecules are _____ to make a determination of highest acidity.

□ When analyzing these 5 factors of molecules, look at the stability of the _____ _____.

- The more stable the _____, the more willing the acid will be to donate a proton.

1. Element Effects:

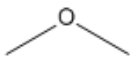
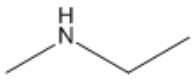
- The element effects determine how loosely or strongly a particular element bonds with _____
- We can use these effects to compare different protonated elements to each other. (i.e. NH_3 vs SH_2)
- Consists of two trends:
    1. Electronegativity – the stronger the electronegativity, the more willing to accept a lone pair.
    2. Size – the bigger (squishier) the atom, the more willing it will be to accept a lone pair.



EXAMPLE: Without using pKa values, which of the following pairs is more acidic?

1. NH_3 or SH_2

2. H_2O or CH_4

3.  or 

4. HI or HF

CONCEPT: FACTORS AFFECTING ACIDITY- INDUCTIVE EFFECTS

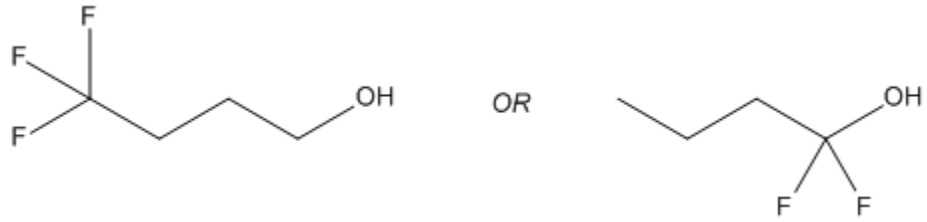
Inductive effects describe the stabilizing properties that _____ atoms **NOT CONNECTED** to the acidic hydrogen have on the overall acidity.

● Whenever a charge can be _____ over more than one atom, the more stable that charged species will be .

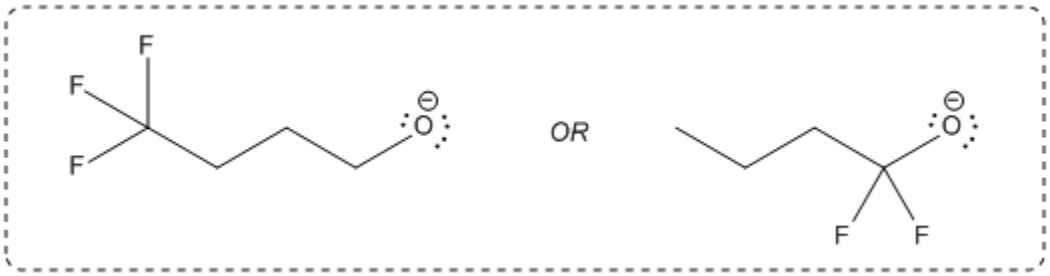
● Electronegative entities on *other parts* of the molecule can help "spread out" the negative change of the conjugate base through inductive effects.

EXAMPLE: Draw rough sample electron clouds over the following pairs of conjugate bases of their respective alcohols. Which is more stable? Which alcohol would have had the lower pKa?:

Acids



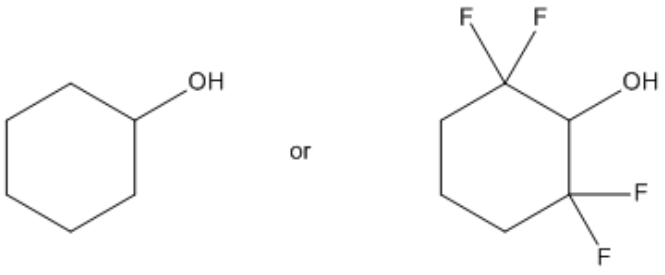
Conjugate Bases



Factors that increase inductive effects:

1. Strength of the electronegative entities _____
2. Number of electronegative entities _____
3. Proximity of electronegative entities _____

EXAMPLE: Without using pKa values, which of the following pairs is more acidic?

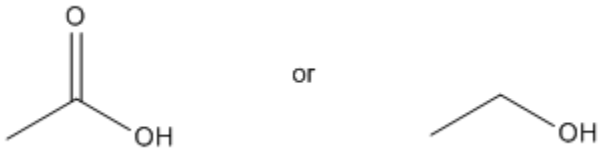


CONCEPT: FACTORS AFFECTING ACIDITY- OTHER EFFECTS

Resonance Effects:

Definition: Whenever the donation of a proton leads to the formation of a possible _____, that conjugate base will be _____ stable, and the molecule will be a _____ acid.

EXAMPLE: Which of the following pairs of acids would have the lower pKa? Explain why.

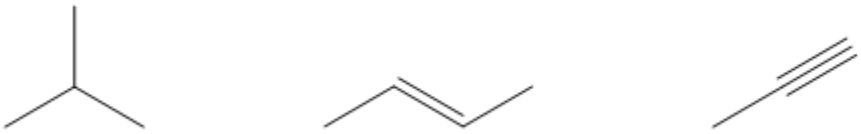


Hybridization Effects:

Definition: The more s-character in the acid, the closer to the nucleus extra lone pairs will be held to it, making the conjugate base _____ stable.

Acidity Trend = *sp C – H* _____ *sp²* *C – H* _____ *sp³* *C – H*

EXAMPLE: Which of the following hydrocarbons is the most acidic?

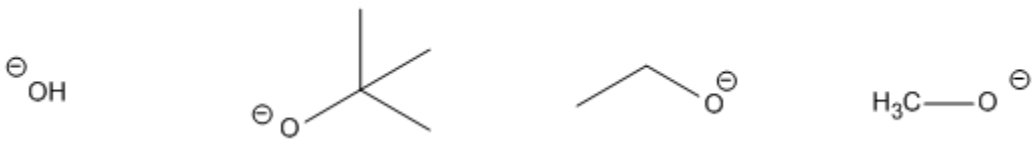


Steric Effects:

Particularly with alcohols, the more easily solvated the conjugate base is, the more stable it will be.

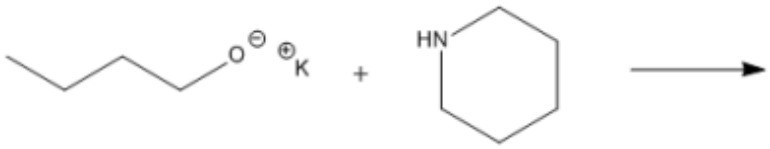
- The smaller the R group, the more _____ the alcohol
- The bigger the R group, the more _____ the alkoxide

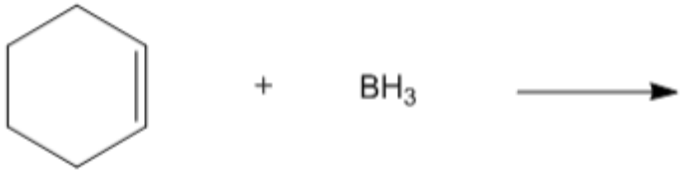
EXAMPLE: Which of the oxides is the most basic?



CONCEPT: FACTORS AFFECTING ACIDITY- OTHER EFFECTS

PRACTICE: Would the following reactions go to the right or the left? Draw the products and label ALL species. Provide the full mechanism.

a. 

b. 

c.