Effects on Acidity and Basicity

1) Element Effect
2) Resonance Effect
3) Inductive (polar) Effect
4) Charge Effect

\[ \text{CH}_3\text{COH} \text{ vs. CH}_3\text{CH}_2\text{OH} \]
\[ \text{CH}_3\text{COH} \text{ vs. CH}_3\text{CH}_2\text{OH} \]

Resonance Effect

Inductive or Polar Effect

Electron-withdrawing groups acidify

- Electron-withdrawing groups through sigma bonds
- Electron-withdrawing group helps stabilize negative charge by pulling electrons through σ bonds

\[ \text{CH}_3\text{CH}_2\text{C}-\text{O}-\text{H} \]
\[ \text{CH}_2\text{CH}_2\text{C}-\text{O}-\text{H} \]
\[ \text{CH}_3\text{CH}_2\text{C}-\text{O}-\text{H} \]

- Cl most acidic
- Most acidic

- Chlorine, an electronegative electron-withdrawing group, helps stabilize negative charge by pulling electrons through σ bonds
Charge Effect

\( \text{H}_3\text{O}^+ \) vs. \( \text{H}_2\text{O} \) acidity

more acidic

\( \text{NH}_3 \) vs. \( \text{NH}_2^+ \) basicity

To use the charge effect to explain differences in acidity and basicity, the two acidic H's must be attached to the same atom in the acids (or conjugate acids of the bases).
Submit a Single-sided Copy to the Office
DO NOT STAPLE

* See Acid/Base Equation Handout *

\[
\frac{[HA]}{[A^-]} = 1, \quad [HA] = [A^-]
\]

\[
\frac{[CH_3-C-OH]}{[CH_3CO\Theta]} = 1
\]

\[pK_a = 5 \text{ for acetic acid}\]

\[
[CH_3C-OH] = [CH_3CO\Theta]
\]

\[\text{at pH = 5} \rightarrow \text{more CH}_3\text{CO\Theta}\]

\[\text{at pH = 7} \rightarrow \text{more CH}_3\text{COH}\]

\[\text{at pH = 3} \rightarrow \text{more CH}_3\text{COH}\]