(11) **Today**

Section 2.4 - 2.6: Resonance/Electron Delocalization

Section 2.7 and 2.11: Acids and Bases - Brønsted–Lowry and Lewis Definitions

Next Class

Test on Chap 1 and Chap 2 through section 2.6

(13) **Second Class from Today**

Section 2.7 and 2.11: Acids and Bases - Brønsted–Lowry and Lewis Definitions

Acid and Base Strength, Acid-base Reactions, Organic Acids and Bases

Third Class from Today (14)

Section 2.7 and 2.11: Acids and Bases - Brønsted–Lowry and Lewis Definitions

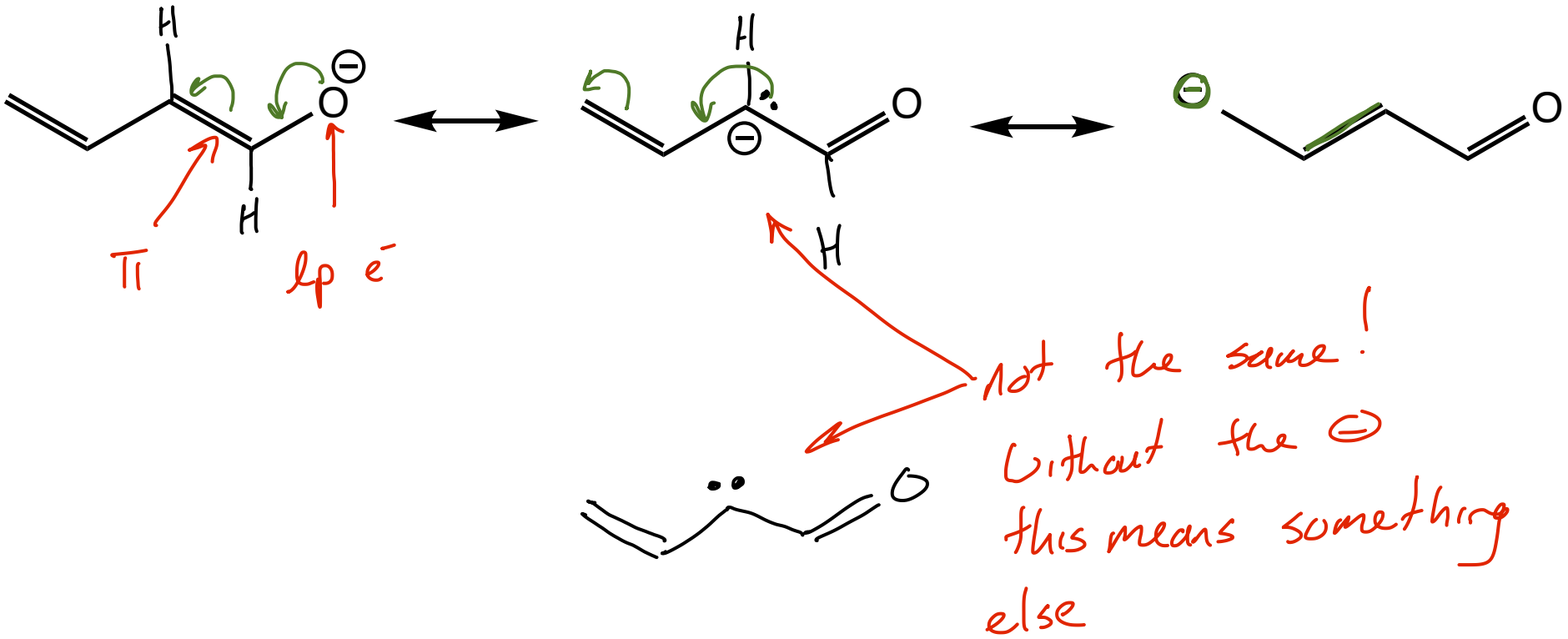
Acid and Base Strength, Acid-base Reactions, Organic Acids and Bases

Section 2.12 Noncovalent Interaction Between Molecules

Review Session
Sunday, September 28 from 7:30 pm to 9:00 pm
in
Wilson 314 and Zoom

Rules for drawing Resonance Contributors

1. **don't move atoms**, only electrons
2. **don't move σ bonds**, only π bonds, lone pair e–'s, or unpaired e–'s (radicals)
3. the total number of electrons must stay the same, **don't change the net charge**
4. p orbitals must be able to line up parallel to each other



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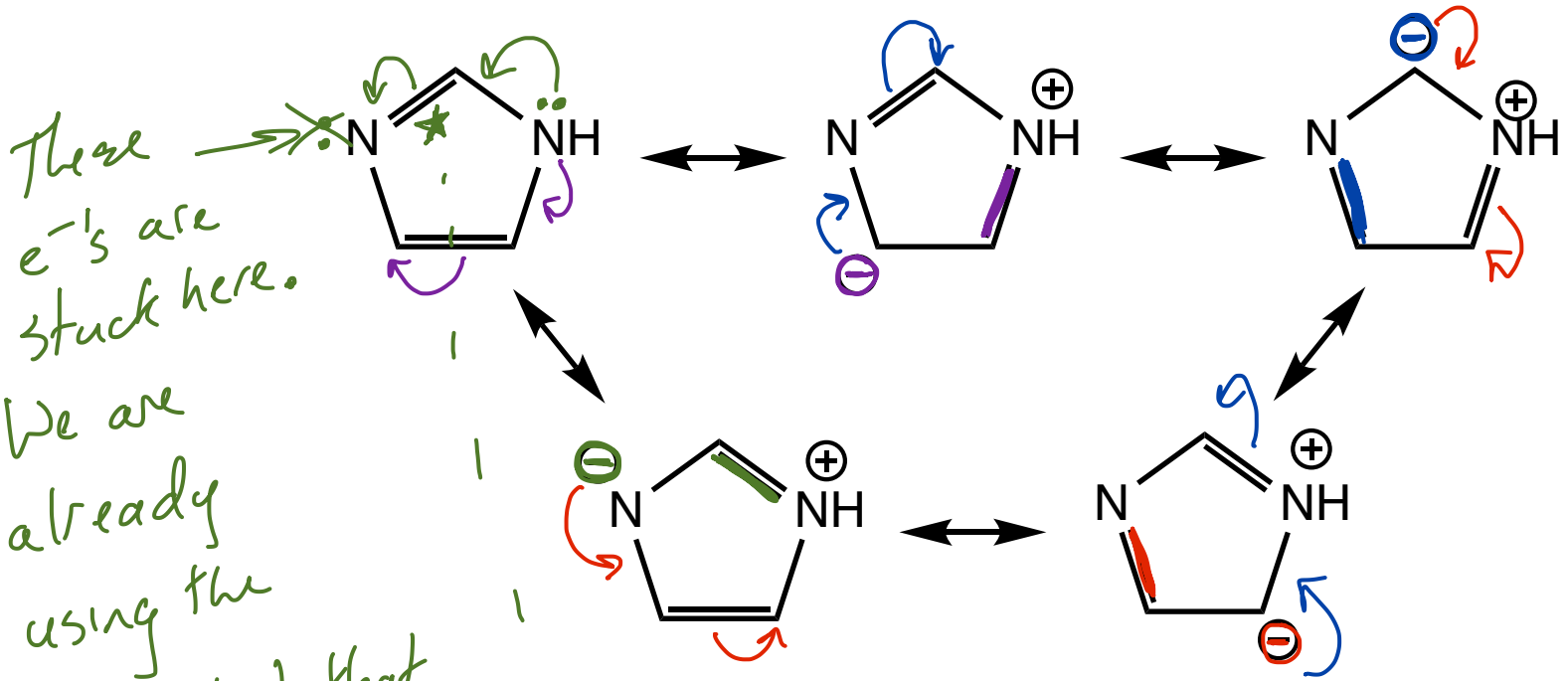


These e⁻'s are stuck here. We are already using the p orbital that comes out of the screen to make this ★ bond

The more stable the resonance contributor is, the more it contributes to the resonance hybrid

What factors make the contributor less stable

1. Charge separation

⊕ on C + ⊖ on O

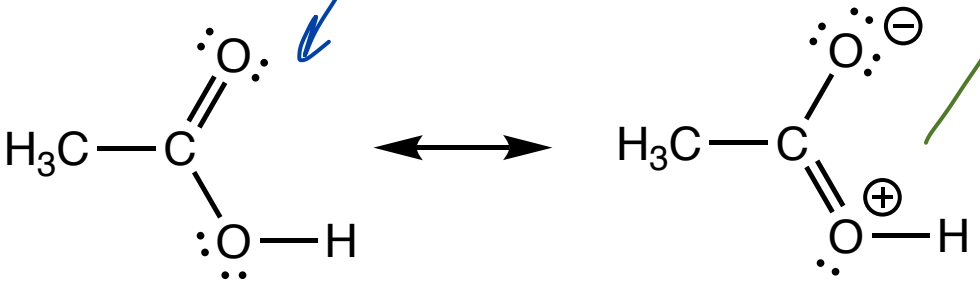
2. "~~Wrong~~ Weird" charges
   - negative charge is not on the most electronegative element and
   - a positive charge is on the most electronegative element

3. Incomplete octets

The actual molecule is closer to this contributor

created ⊖ & ⊕ issue #1

Follows all the Lewis structure rules... no formal charges



Higher E resonance contributor

When averaging resonance contributors to consider the actual molecule (the resonance hybrid) the average is weighted towards the low E contributor

The more stable the resonance contributor is, the more it contributes to the resonance hybrid

What factors make the contributor less stable

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   - negative charge is not on the most electronegative element and
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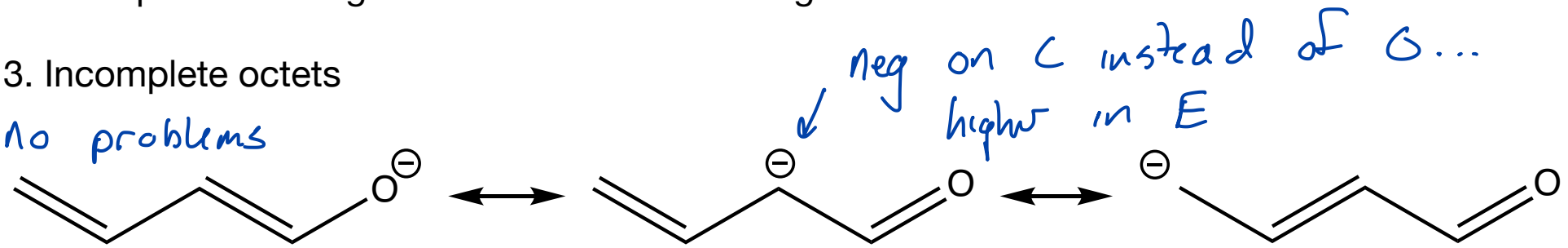
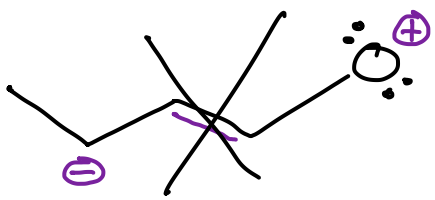


Drawing the Resonance Hybrid

The more stable the resonance contributor is, the more it contributes to the resonance hybrid

What factors make the contributor less stable

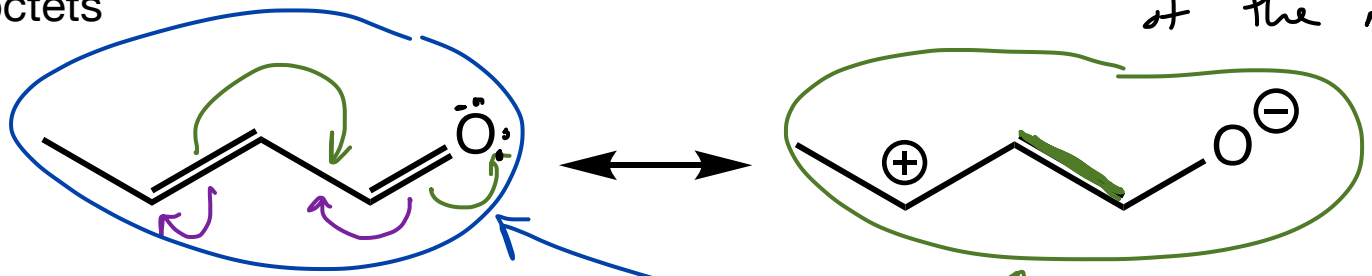
1. Charge separation



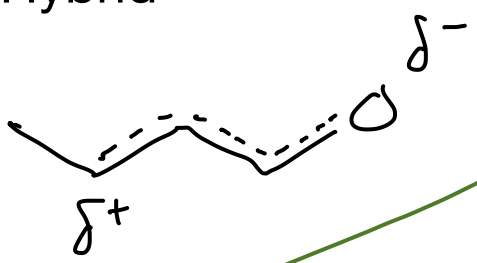
all three problems present so not a significant contributor to our understanding of the molecule

2. "Wrong" charges
   - negative charge is not on the most electronegative element and
   - a positive charge is on the most electronegative element

3. Incomplete octets



Drawing the Resonance Hybrid



resonance hybrid more strongly resembles this molecule and this one helps us understand that 1 of the C atoms is δ+

Identify ionic interactions, polar covalent bonds, and nonpolar covalent bonds ✓

Interpret electrostatic potential maps ✓

Identify polar bonds and molecules ✓

Determine the formal charge of atoms in a molecule ✓

Interpret formal charge ✓

Draw resonance contributors ✓

Draw resonance hybrids ✓

Weight the amount a contributor contributes to the resonance hybrid ✓

Interpret the effects of electron delocalization ✓

Identify Brønsted-Lowry acid and bases in acid-base reactions

Determine acid or base strength based on pK_a

Determine or explain acid or base strength based on molecular structure

Identify noncovalent interactions molecules use to interact with other molecules

Explain differences in MP, BP, or solubility using noncovalent interactions

Acids and Bases and Language

In aqueous solutions, the solution is considered **acidic** if the concentration of **H^+** is **greater than** the concentration of **OH^-**. At 25 °C, this occurs when the pH is less than 7.

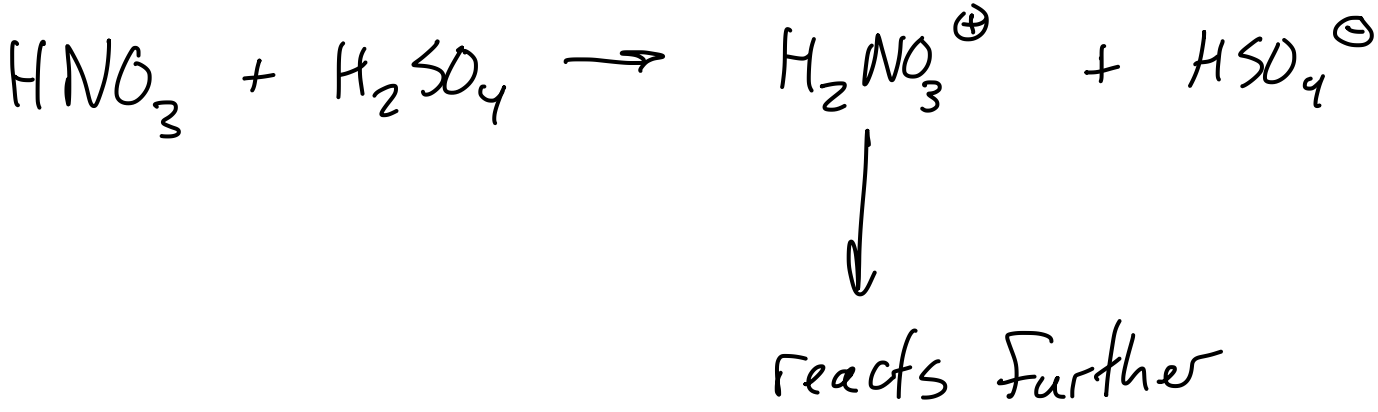
In every day language, we might say that the solution is an acid. More precisely, there is a molecule **in the solution that acing as an acid and is causing the solution to be acidic**.

We will call molecules or ions **acids or bases based on how they react** (or could react).

There are **many molecules** that can **act as a base** in some circumstances **or an acid** in other circumstances.

Molecules or compounds that are very likely to react as an acid are often called acids, but technically, the molecules are referred to as acids and bases based on how they react.

HNO_3, for example...



A Brønsted-Lowry acid is a proton (H^+) donor.

acid base conjugate acid conjugate base

$H\text{-}Cl + H_2O \rightarrow H_3O^{\oplus}_{(aq)} + Cl^{\ominus}_{(aq)}$

(take the H^+ off + see what's left)

$H\text{-}Cl_{(g)} \xrightarrow{H_2O} H^+_{(aq)} + Cl^-_{(aq)}$

reaction goes to completion

A Brønsted-Lowry base is a proton (H^+) acceptor.

$NH_3 + H_2O \rightleftharpoons NH_4^{\oplus}_{(aq)} + OH^{\ominus}_{(aq)}$

reaction exist in a dynamic equilibrium