Today

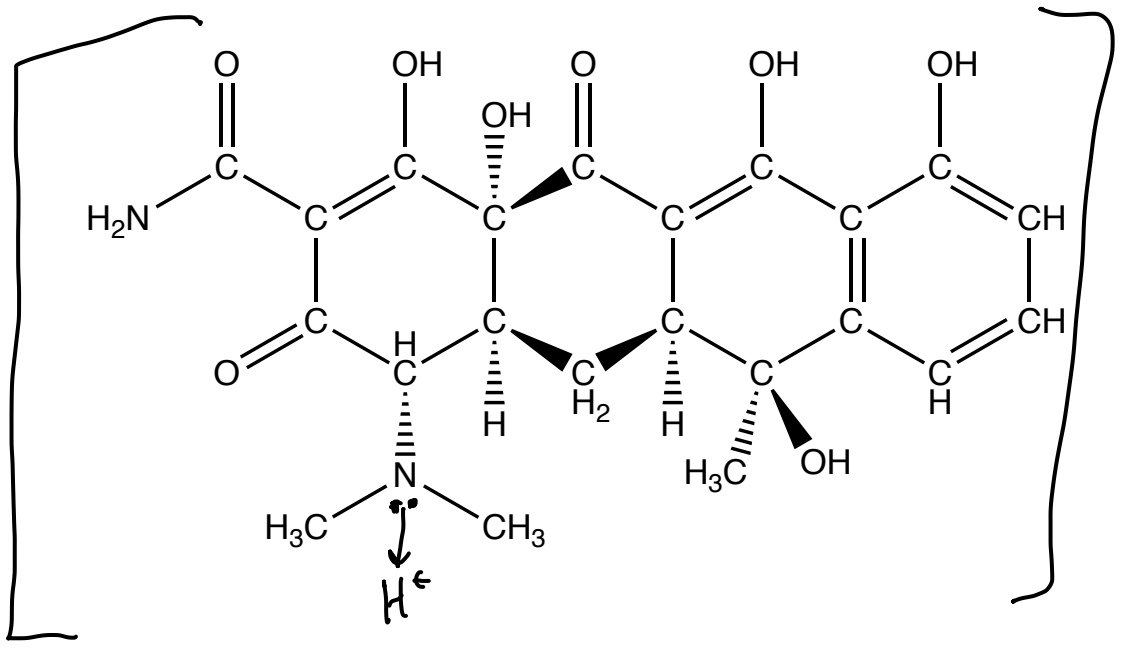
Sections 2.6 - 2.9
How structure affects acidity and basicity

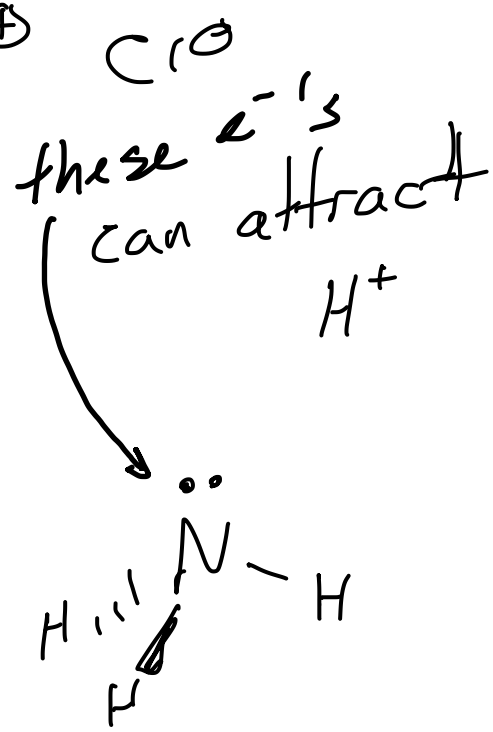
Next Class

Sections 3.1-3.3
Nomenclature of Alkanes and Cycloalkanes, Alkyl Halide, Ethers, and Alcohols

It is our first attempt to relate structure to reactivity using a chemistry that you have already studied.

Also…

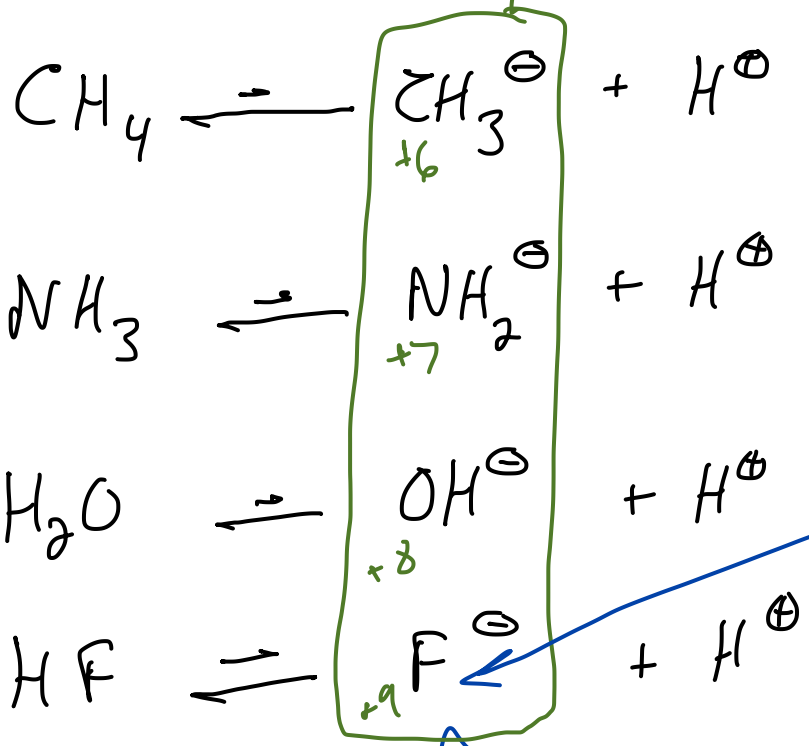




this N is an ammonia analogue

Same Shell More Positive Nucleus

make these more stable and $H^{\oplus}$ will come off more easily



weakest acid

all the ⊖ charged atoms are using the $n=2$ valence shell

more positive nucleus

strongest acid

stabilizes

conjugate base

the weaker the conjugate base the stronger the acid

CH_4, ~50 NH_3, ~36 H_2O, 15.6 HF, 3.18

HCl

Same Column Larger Valence Shell

n = 2

3,18

$H-F \rightleftharpoons F^{\ominus} + H^{\oplus}$

-7

$H-Cl \longrightarrow Cl^{\ominus} + H^{\oplus}$

-9

$H-Br \longrightarrow Br^{\ominus} + H^{\oplus}$

-10

$H-I \longrightarrow I^{\ominus} + H^{\oplus}$

concentrated charge is higher in E less stable more reactive than diffuse charge

n = 5

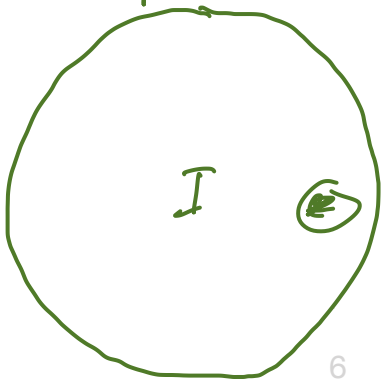
highest ⊕ charge but e^-'s are also most diffuse

diffuse e^-'s

HF, 3.18 HCl, -7 HBr, -9 HI, -10

H⊕

106 bill



Stabilizing electrons by spreading them out

Same Column Larger Valence Shell

HF, 3.18 HCl, -7 HBr, -9 HI, -10

Size

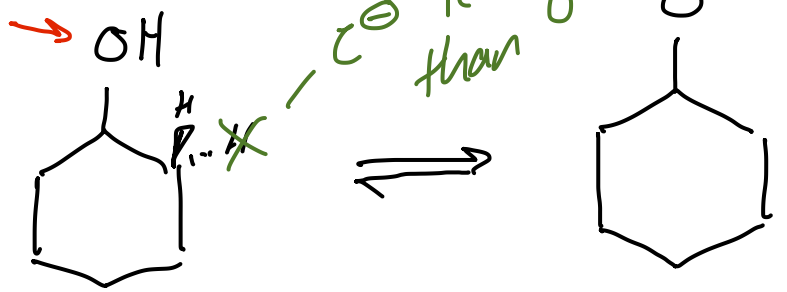
Stabilizing electrons by spreading them out by resonance

Resonance

cyclohexanol, 16.0	phenol, 10.0

stronger

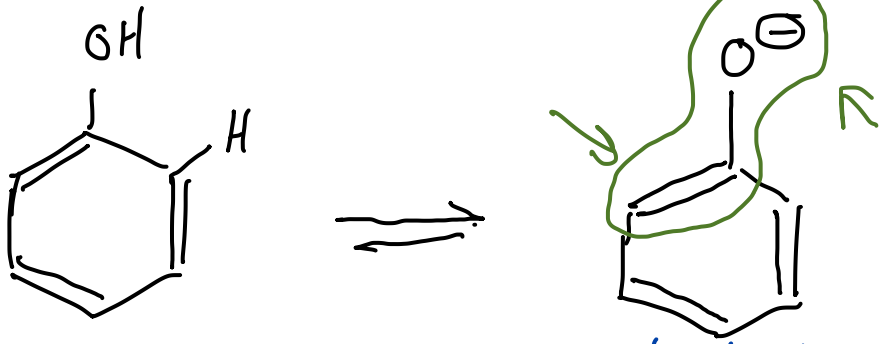
16 10



e⁻ less stable than O⊖

e⁻'s are stuck here on the O atom

H⊕

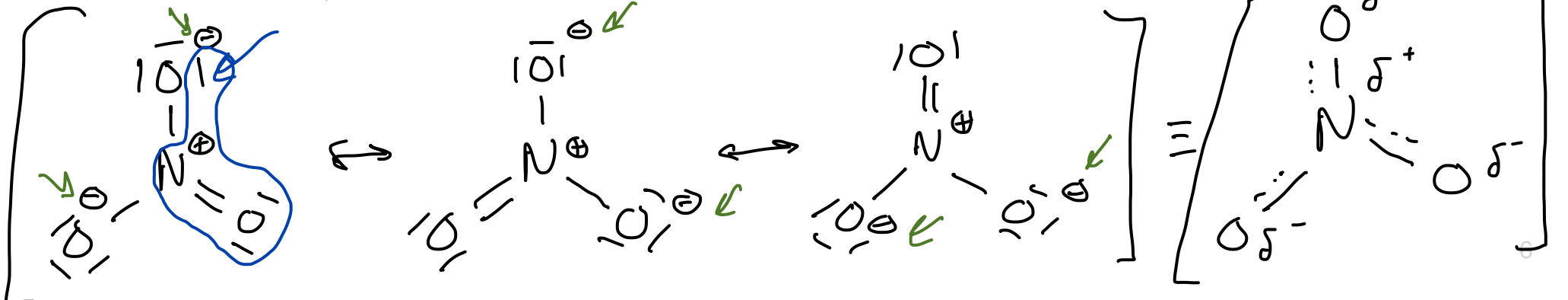


the e⁻'s on the O atom are part of the delocalized π system

H⊕

resonance contributors

resonance hybrid



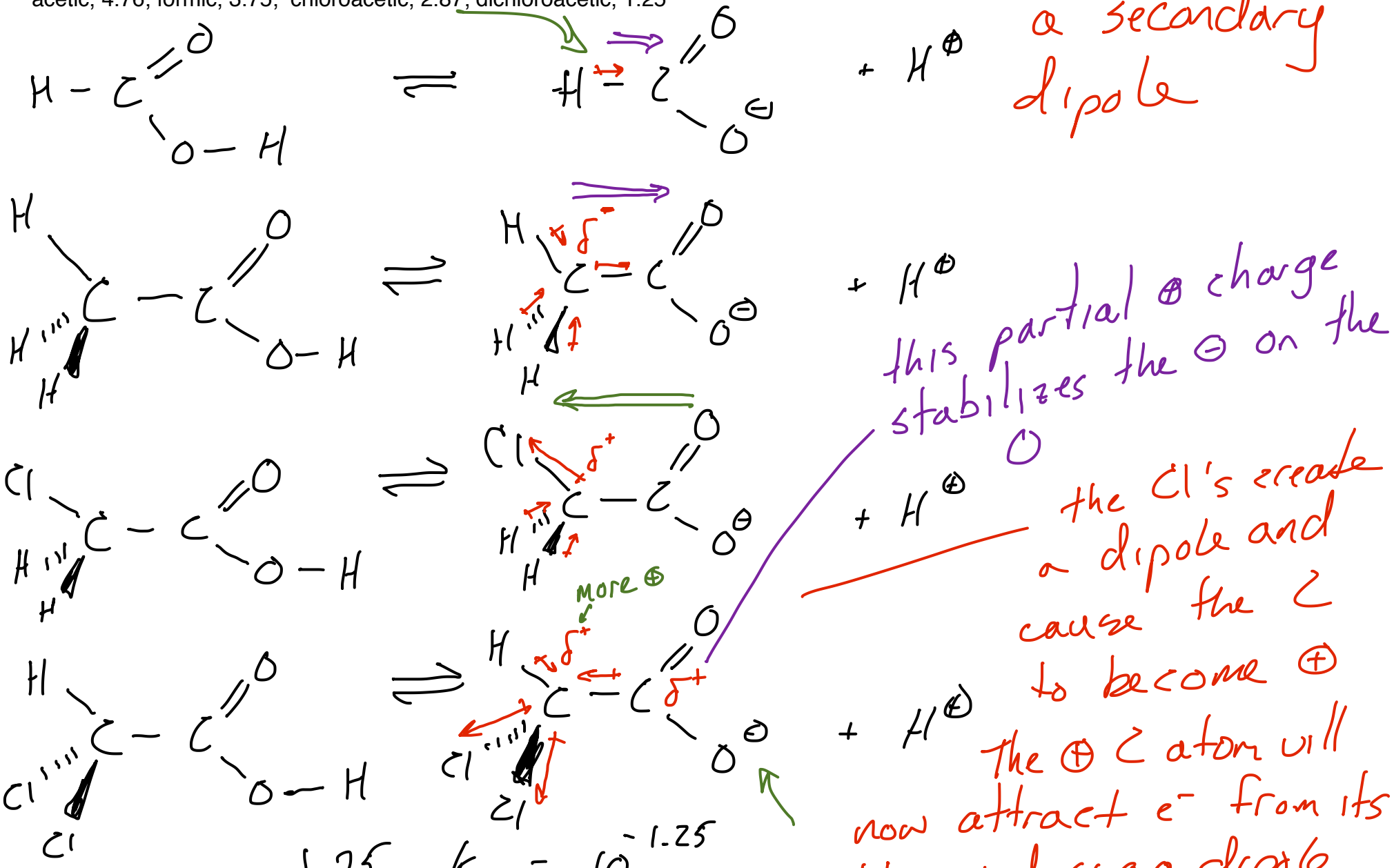
Stabilizing electrons by spreading them out

Inductive effect

Section 2.6 – 2.9

Inductive Effect

acetic, 4.76; formic, 3.75; chloroacetic, 2.87; dichloroacetic, 1.25

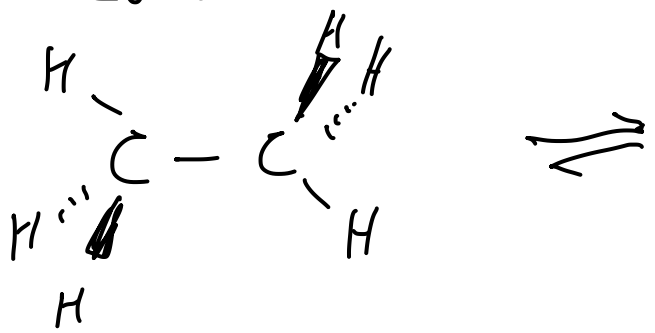


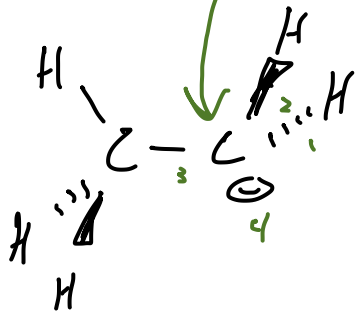
Hybridization

Examine atom that bares the electrons after the H^+ is lost

Compare methods of stabilization

ethane





orbitals are sp^3

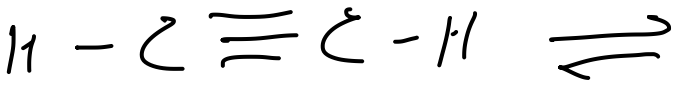
25% s 75% p

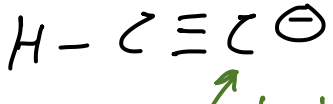
$H^{\oplus}$

$pk_a \approx 50$

vs

not resonance stabilized





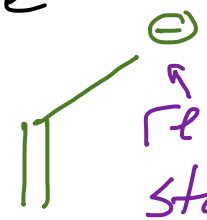
$H^{\oplus}$

stronger acid

$pk_a \approx 25$

orbitals are sp

ethyne



resonance stabilized

50% s 50% p

★ more s character means e⁻ closer to nucleus so more stable

Practice: For each molecule, which proton is the most likely to be lost and for each pair, which is the stronger acid