

(12) Today

Sections 2.7 – 2.11: Acids and Bases

Section 2-12: Non-Covalent Interactions
Between Molecules

Section 2.7: Problem 2-11

Section 2.8: Problems: 2-12, 2-13

Section 2.9: Problems 2-14 – 2-16

Section 2.10 - 2:11: 2.11 Problems: 2-17,
2-18, 2-24, 2-25, 2-40 (2-42 is a good
question but the Lewis acid-base concept is
not strongly emphasized in our organic class),
2-43, 2-44, 2-46, 2-47, 2-48, 2-54, 2-55, 2-61,
2-64

(14) Second Class from Today

Section 3.2: Alkanes and Isomers

Section 3.3: Alkyl Groups

Section 3.4: Nomenclature

Next Class (13)

Section 2-12: Non-Covalent Interactions
Between Molecules

2.12 Problems: 2-19, 2-65

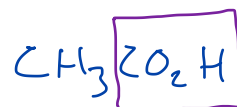
Section 3.1: Functional Groups

Section 3.2: Alkanes and Isomers

Third Class from Today (15)

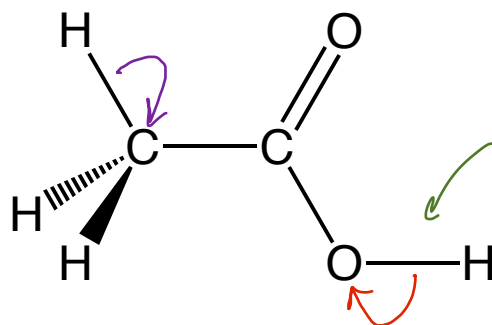
Test 1 on Chap 1 and 2

Which is the acidic H⁺ in acetic acid (HC₂H₃O₂)?



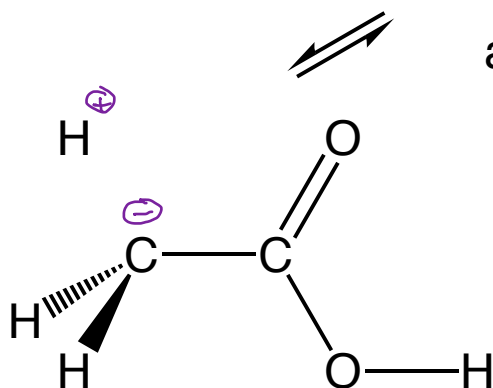
Section 2.6

carboxylic acid

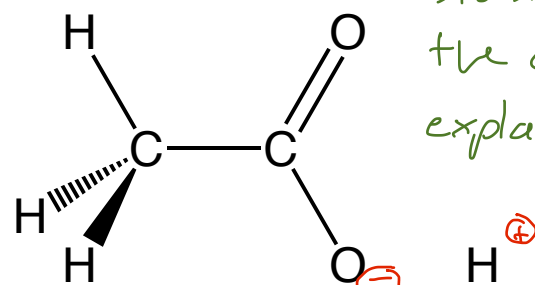


a.k.a. CH₃CO₂H

this one



?



stability of the conj. base explains acidity

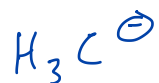
the C atom has 6⁺ in its nucleus

the O atom has 8⁺ in its nucleus

e⁻'s are more stable because they experience a higher \oplus charge

The one that leaves the more/most stable base behind

Same Period More Positive Nucleus

*weakest*CH₄ 6^+ nucleusNH₃ 7^+ H₂O 8^+

HF

 9^+ *strongest*

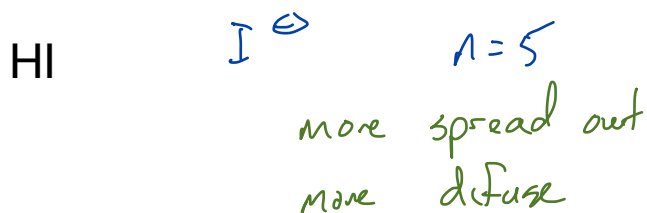
more \oplus nucleus
more attraction for
 e^- 's ...
 \ominus is more stable

this conjugate base is
the most stable...
easier to form
so the acid is the
strongest

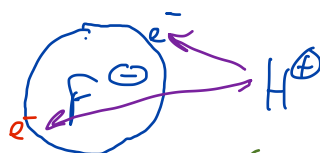
pK_a's CH₄, ~50 NH₃, ~36 H₂O, 15.6 HF, 3.18

Same Column Larger Valence Shell

strongest acid



HBr

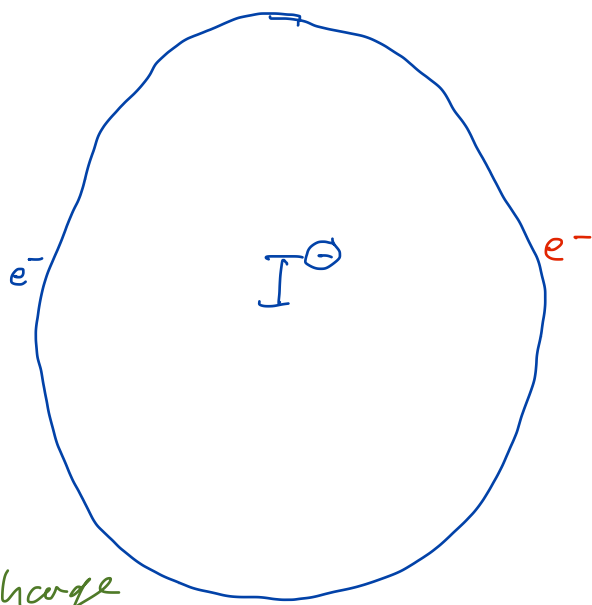


HCl

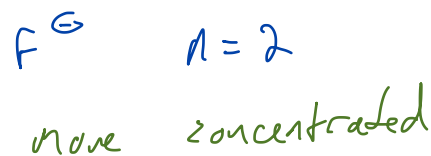
on average

the \ominus charge

is farther away on I^{\ominus} than on F^{\ominus}
 so the H^+ is less strongly attracted



HF



weakest acid

pK_a's HF, 3.18 HCl, -7 HBr, -9 HI, -10



10,000 pennies

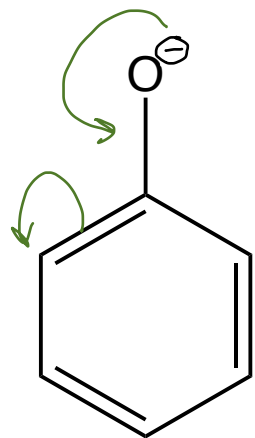
Five ways to stabilize the electrons on the conjugate base

Section 2.8, 2.10

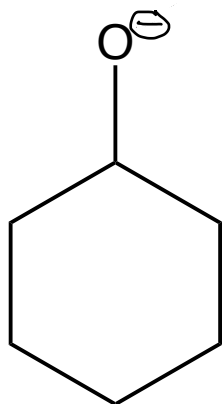
Resonance

spreading \ominus charge via e^- delocalization stabilizes the \ominus
 • more diffuse, less attractive • \ominus experiences more \oplus charges of more nuclei

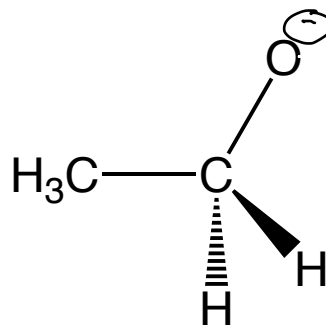
lp e^- 's delocalized



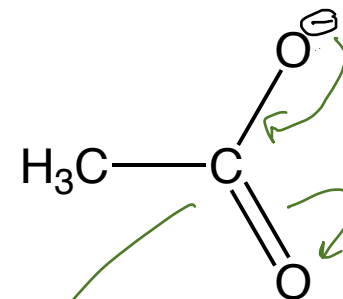
phenol



cyclohexanol

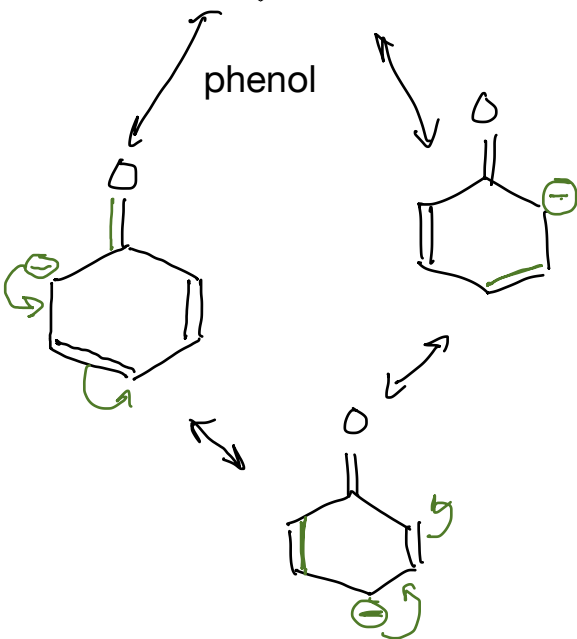


ethanol



acetic acid

delocalized
 e^- are more stable



pKa's

cyclohexanol, 16.0

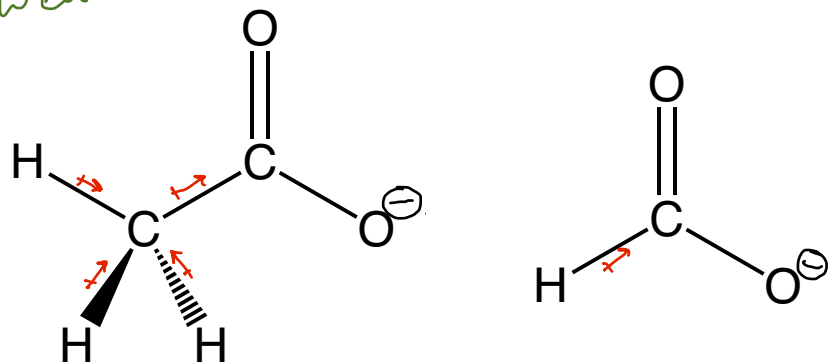
phenol, 10.0

ethanol 16.0

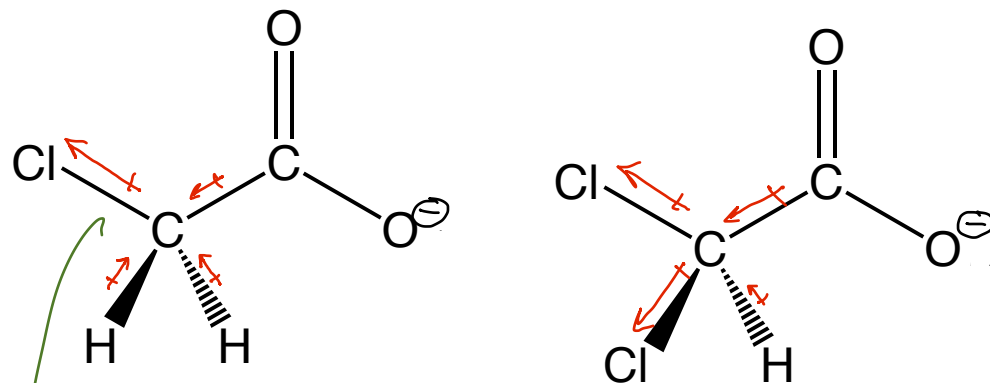
acetic acid 4.74

Inductive Effect

weakest



strongest



In this case the inductive effect is putting \ominus near the \ominus
 The repulsion between $\ominus \leftarrow \ominus$ means these are higher in E

the C to Cl dipoles are inducing new dipoles... which are putting a \oplus near the \ominus
 the \ominus will be stabilized by the \oplus
 The inductive effect induced dipoles then pulled the \ominus from the O into the molecule

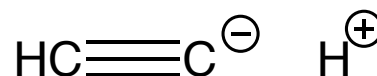
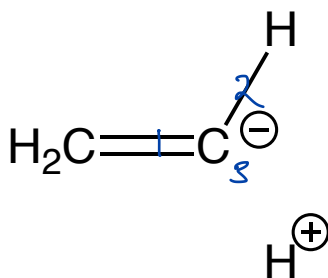
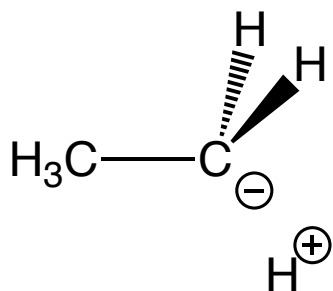
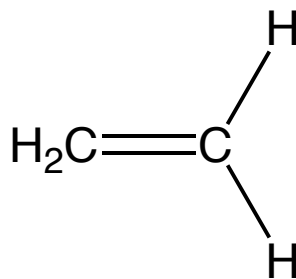
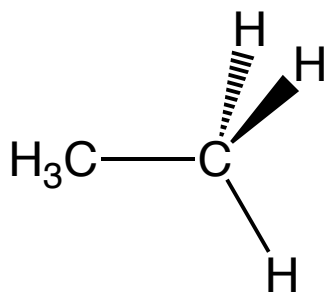
acetic, 4.76; formic, 3.75; chloroacetic, 2.87; dichloroacetic, 1.25

Five ways to stabilize the electrons on the conjugate base

Section 2.8, 2.10

Greater s character
weakest acid

strongest acid



lp e⁻'s are in an sp³
hybrid

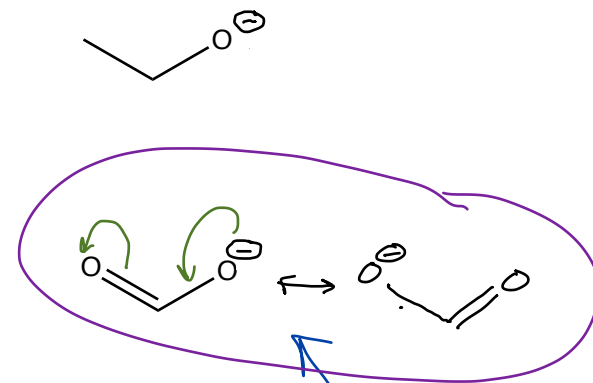
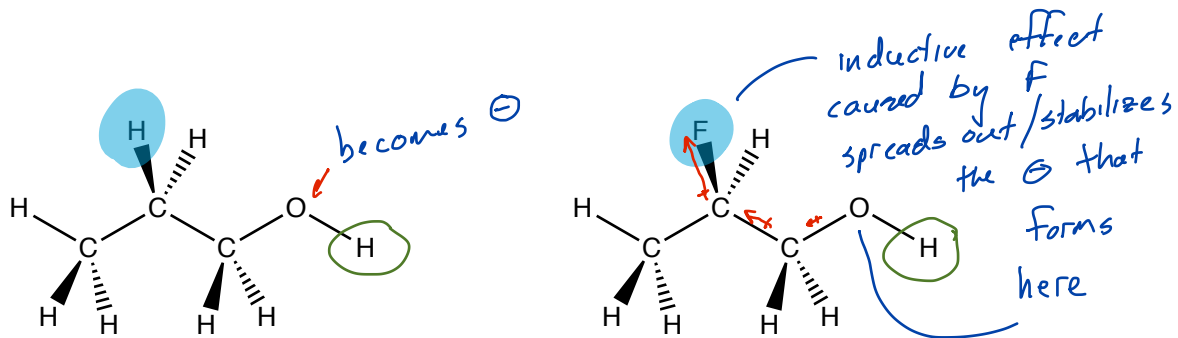
sp²

lp e⁻'s are in an sp
hybrid

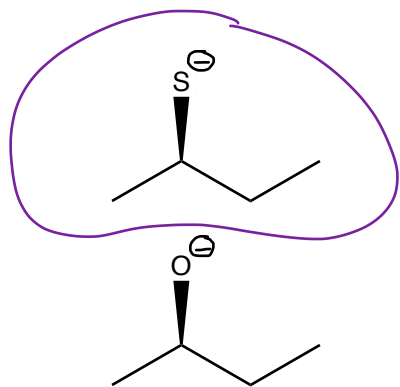
pK_a's ethane 50, ethene 44, ethyne 25

58% s character means e⁻'s
can get closer to the nucleus...
more stable

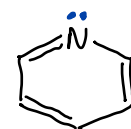
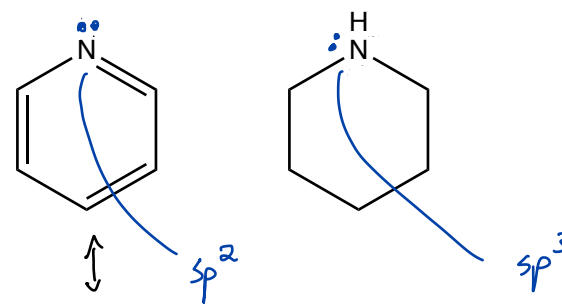
Practice: For each molecule, which proton is the most likely to be lost and for each pair, which is the stronger acid



e^- delocalization stabilizes \ominus .
Therefore, conj. base is lower in E and acid it came from is the stronger acid



$\text{HF} < \text{HCl} < \text{HBr} < \text{HI}$
weaker stronger
 $\text{R-OH} < \text{R-SH}$



33%
s

more stable e^- \therefore conj. acid stronger acid