(11) **Today**

Sections 2.4 - 2.6
Electron Delocalization

Bring Modeling Kits

Next Class (12)

Sections 2.4 - 2.6
Resonance/Electron Delocalization

Bring Modeling Kits

Sections 2.7 – 2.11
Acids and Bases

(13) **Second Class from Today**

Sections 2.7 – 2.11
Acids and Bases

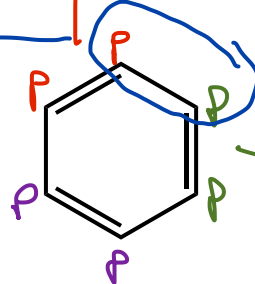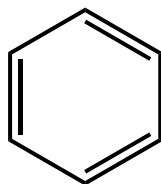**Third Class from Today** (14)

Test 1
Chap 1 and Chap 2.1 - 2.6

Resonance: A Way to Deal with Delocalized Electrons

Also a way to move charge around a molecule...

why don't these
p orbitals overlap
& make a π bond

They do... in MO theory

Which one is correct?

two p orbitals
overlap to make
a π bond

two p orbitals
overlap to make
a π bond

both and neither

these drawings make a prediction that is not true.

Benzene has alternating short & long bonds. **except
it doesn't**

resonance is a way to deal with extended π systems (3 or more p orbitals in a row) without resorting to MO theory
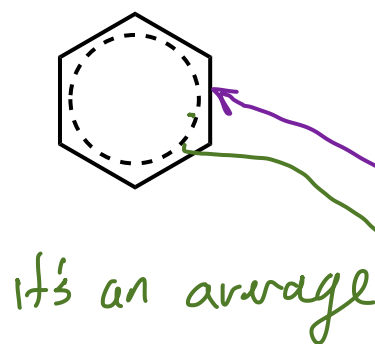
Whenever 3 or more p orbitals are in a row experiments and MO theory say that the electrons are delocalized over all of the p orbitals.

resonance contributors
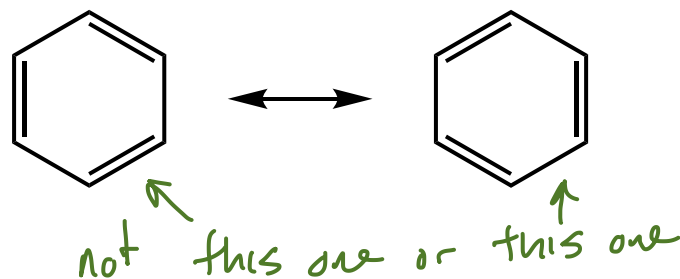
rxn goes to completion

equilibrium arrow

not this one or this one

resonance contributor arrow

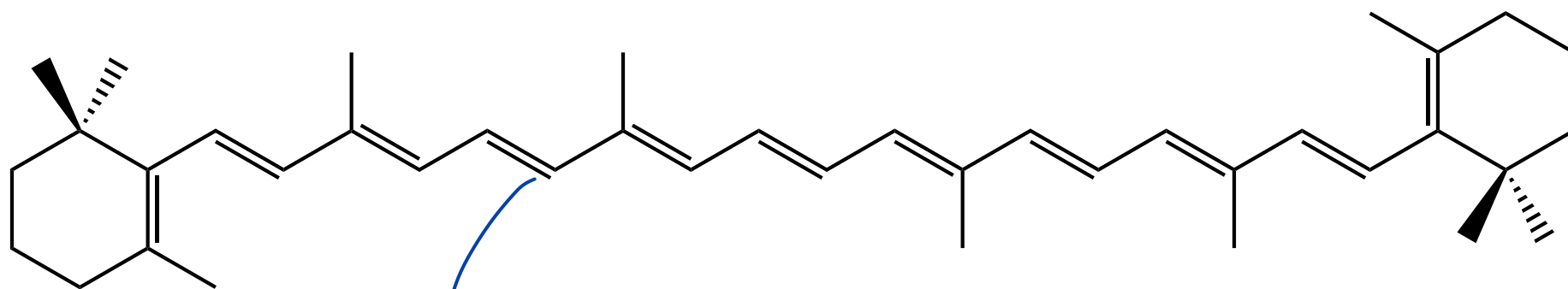resonance hybrid is the average of our resonance contributors is our best model for the molecule

It's an average

Solid line means single bond

dotted line means + a little more

So the C atoms are connect by bonds that have the strength of 1.5 bonds

Resonance: Where else do we see extended π systems/electron delocalization
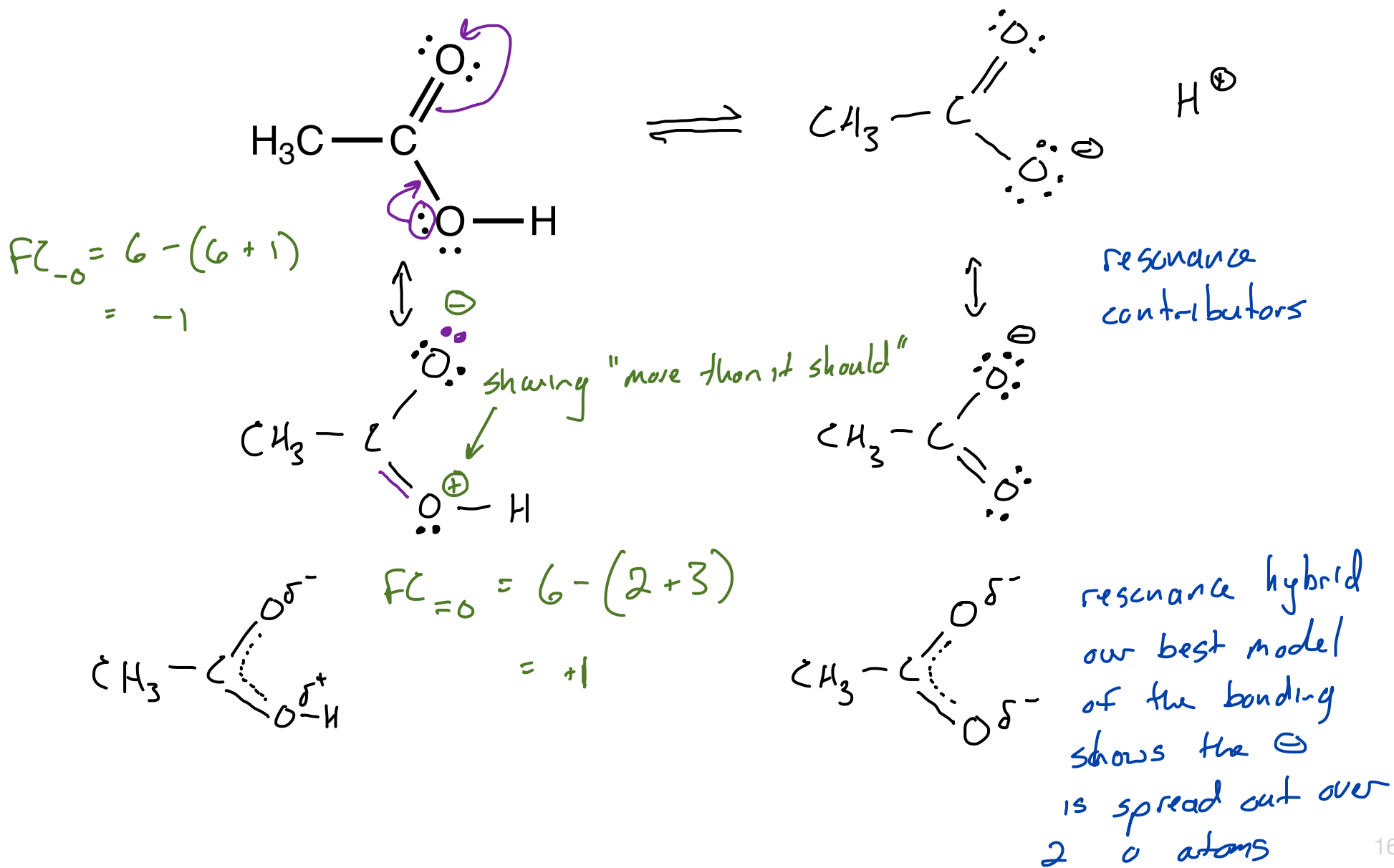

β-carotene

extended π system

radical scavenger

3 or more p orbitals in a row

π bond adjacent to lp e⁻'s

Whenever 3 or more p orbitals are in a row experiments and MO theory say that the electrons are delocalized over all of the p orbitals.

$$H_3C-C \quad \rightleftharpoons \quad CH_3-C \qquad H^{\oplus}$$

$$FC_{-O} = 6 - (6+1)$$
$$= -1$$

$$CH_3-C$$

sharing "more than it should"

$$FC_{=O} = 6 - (2+3)$$
$$= +1$$

resonance contributors

$$CH_3-C$$

resonance hybrid
our best model
of the bonding
shows the ⊖
is spread out over
2 O atoms
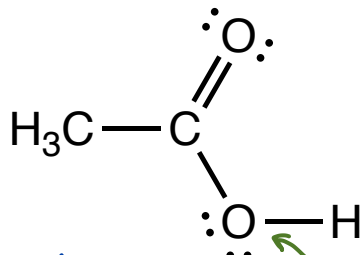
The more stable the resonance contributor is, the more it contributes to the resonance hybrid
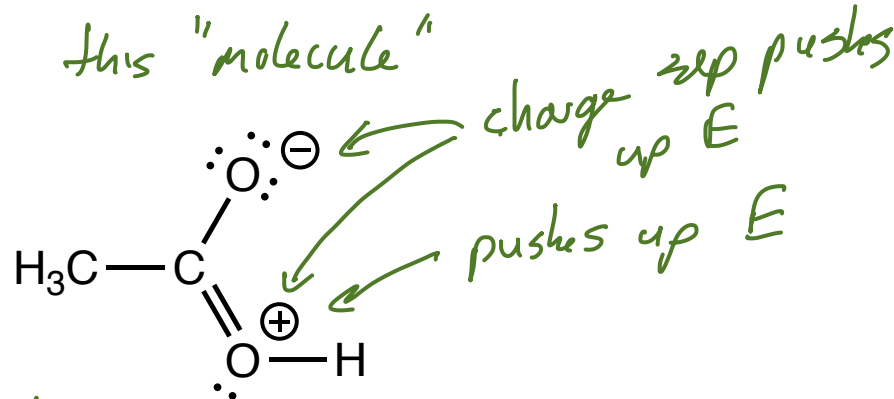
1. Incomplete octets   *weird*
2. "Wrong" charges
      - negative charge is not on the most electronegative element
      - a positive charge on an electronegative element
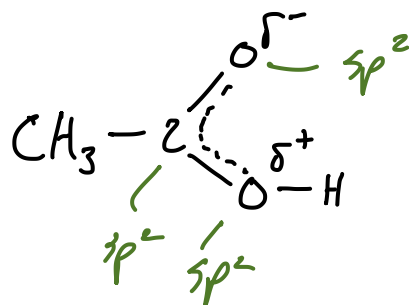3. charge separation

this "molecule" would   *this "molecule"*

not real

H_3C-C (with double bond O above, $:O-H$ below)

$then$

H_3C-C (with $:O:^{\ominus}$ above, $O^{\oplus}-H$ below)

charge sep pushes up E

pushes up E

*be lower in E*   *looks sp³ but*
isn't due to ē delocalization

resonance hybrid is a weighted average

the resonance hybrid will more strongly resemble

the resonance contributor that is lower in E

real

CH_3-C (with O^{δ^-} sp^2, and $O^{\delta^+}-H$, labeled sp^2, sp^2, sp^2)

radical means odd # of e⁻'s

Whenever 3 or more p orbitals are in a row experiments and MO theory say that the electrons are delocalized over all of the p orbitals.

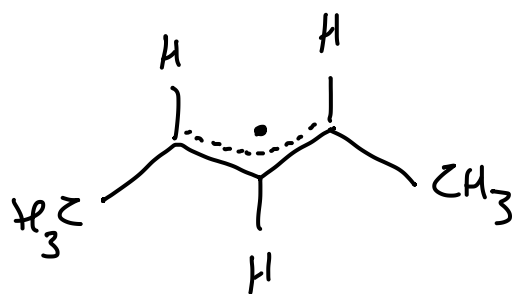not a stable molecule ... extremely reactive
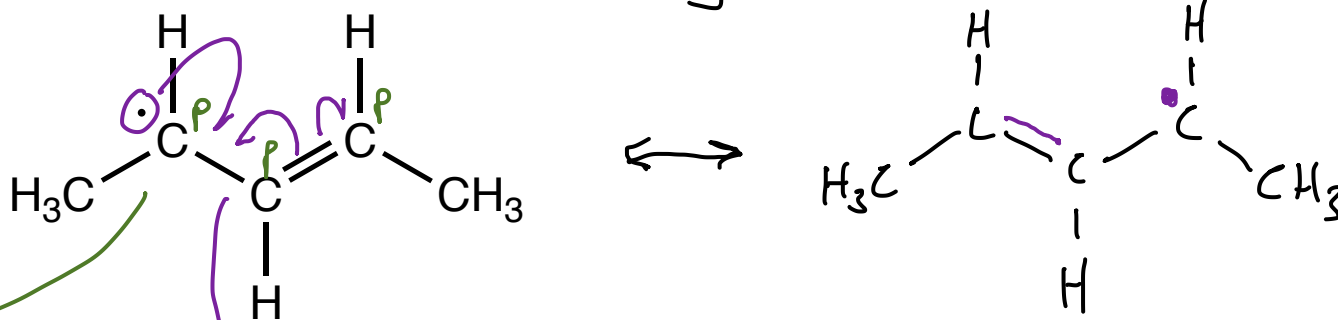
$3p^2$ hybridized C

a single e⁻ in an unhybridized p orbital

3 p orbitals in a row ... extended π system

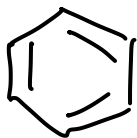Must draw a resonance contributor to better understand the molecule

the C with a radical is missing e⁻'s but since the π bond is being shared the C is getting some e⁻ density to stabilize itself
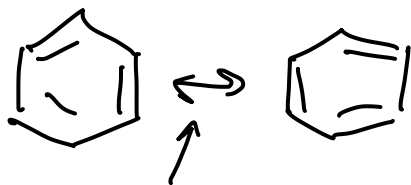
⤴ moves 2 e⁻'s

↗ moves 1 e⁻

no arrow   Same molecule
rotated 60°

this arrow means I'm drawing
resonance contributors

the arrows add meaning