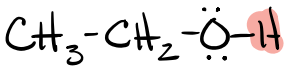
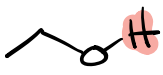
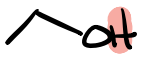
Problem Solving Session

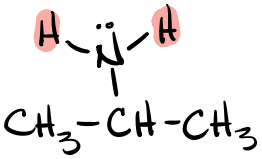
- All hydrogens must be shown on hetero atoms (N, O, S, P). In addition, aldehyde hydrogens are always shown.

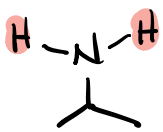




or

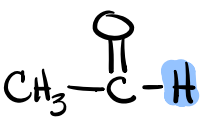




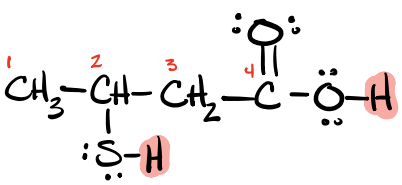


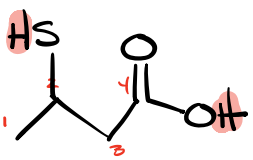
or

Aldehyde

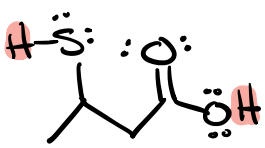


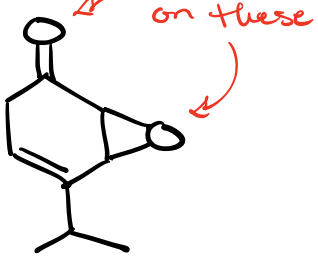
Not

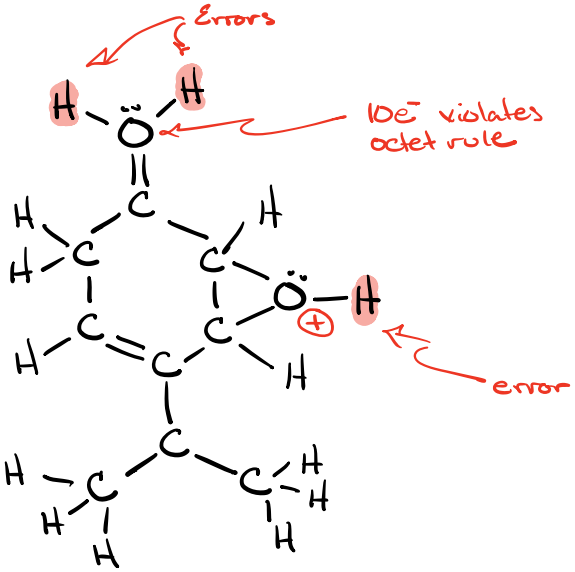




or



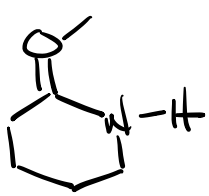


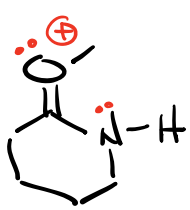


Wrong # of hydrogens due to the additions on oxygen.

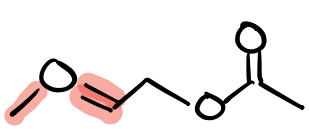
Add Lone pairs & formal Charges to the following bond-line formulas:

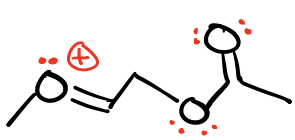
A)



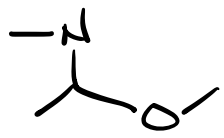


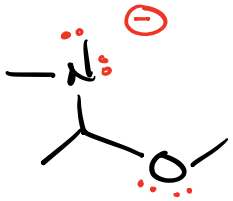
B)





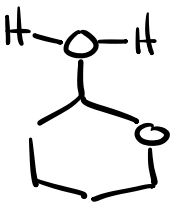
c)

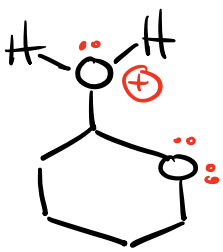




Oxygen

A)





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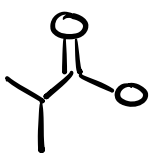

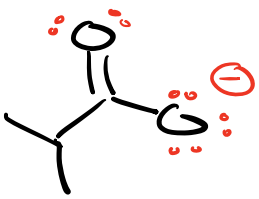

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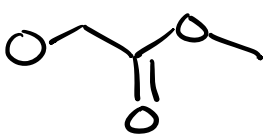
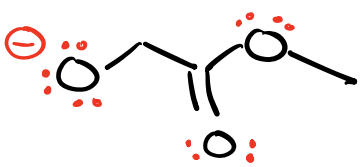
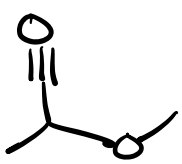
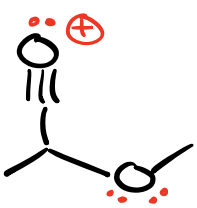
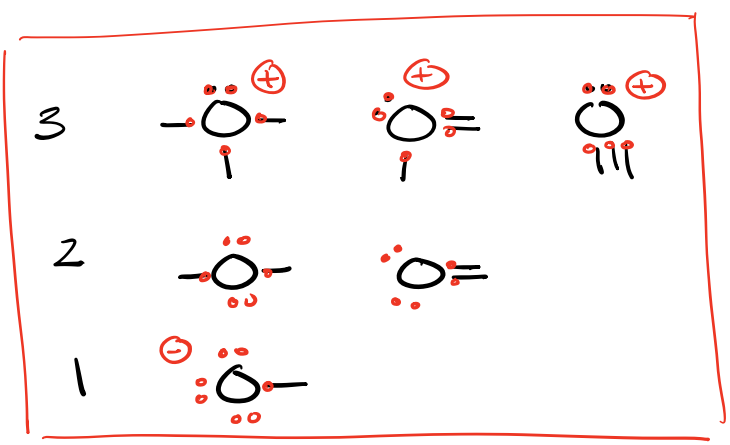




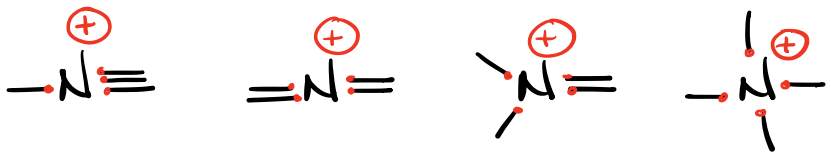
D)







N Key

4 

3 

2 

A) 

B) 

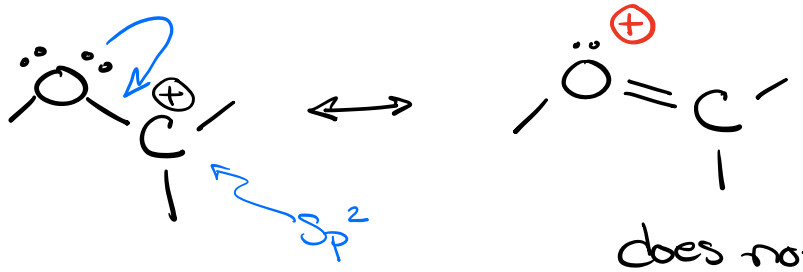
C) 

Resonance w/ Bond-line formulas

(Formal charges, # lone pairs, locations of H's)

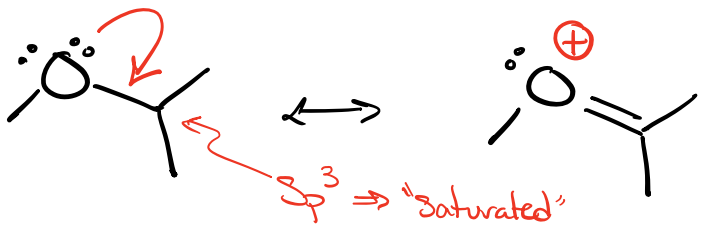
Good arrows vs. bad arrows

Good

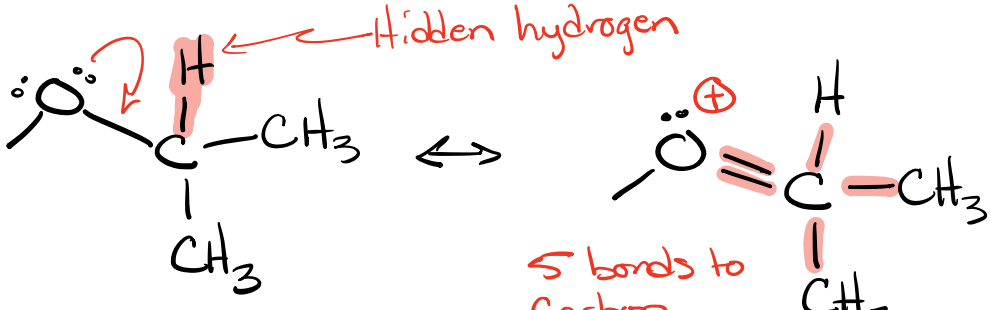


does not go over 8e⁻ for Carbon.
does not go over 8e⁻ for oxygen

Bad



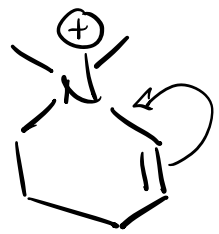
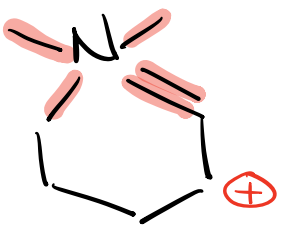
But



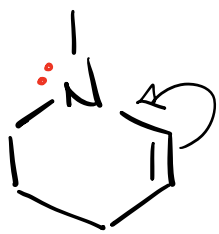
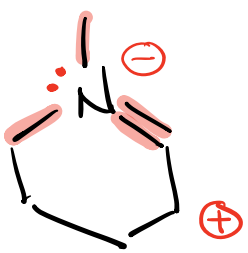
5 bonds to Carbon
10e⁻ on Carbon

Sp^3 hybridized Carbons do not participate in resonance.

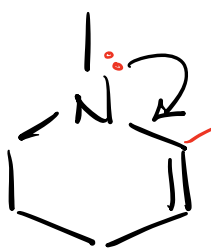
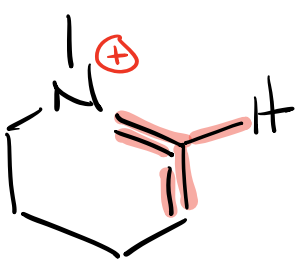
Good or Bad?

A)  Bad Reason: 

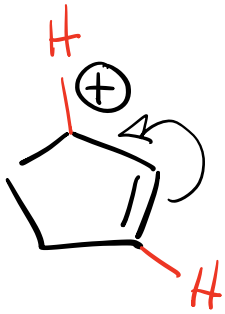
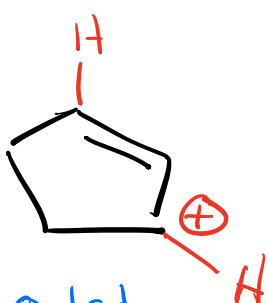
10$\bar{e}$ on N

B)  Bad Reason: 

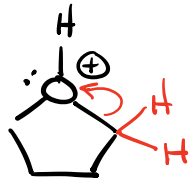
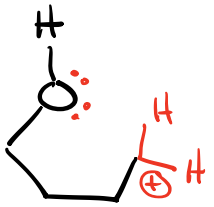
10$\bar{e}$ on N

C)  Bad Reason: 

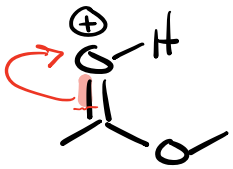
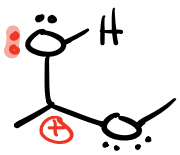
5 bonds to C
10$\bar{e}$ on C

D)  Good 

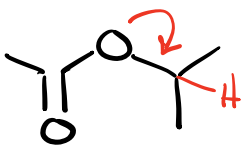
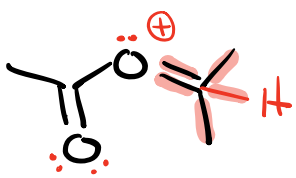
No octet violations

E)  Bad Reason 

Broken σ bond
only use lone pairs & π-bonds

F)  Good Reason 

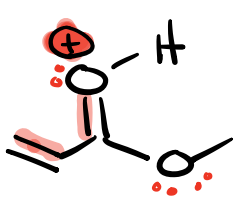
No violations

G)  Bad Reason 

5 bonds to Carbon
10 $\bar{e}$ on Carbon

Resonance Practice

Provide the resonance structures for each molecule or ion.

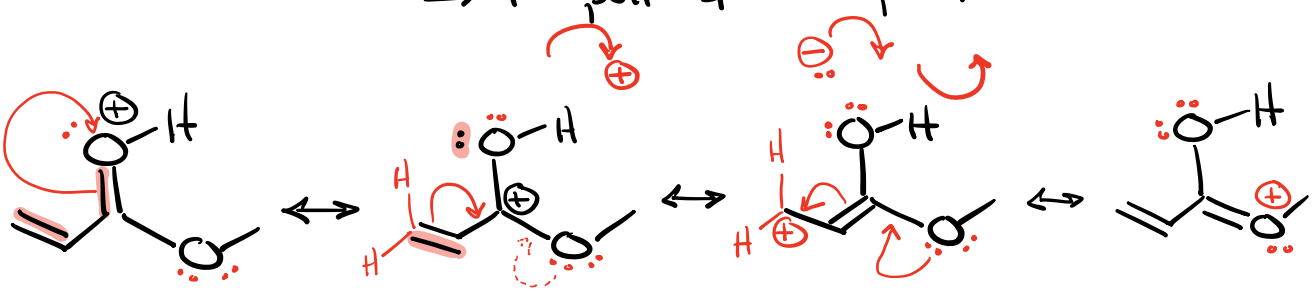


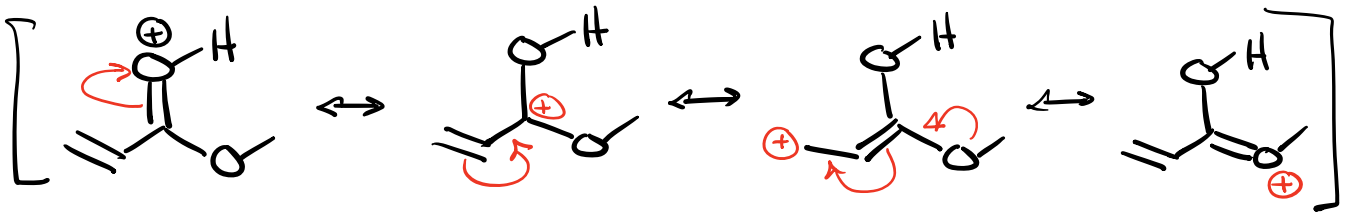
Where to start?

⇒ Look at lone pairs & π-bonds

⇒ For ions, start with the charge

⇒ + = pull & − = push



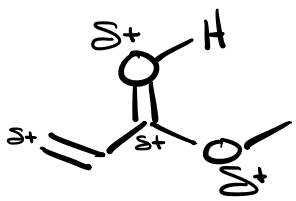


#Covalent 2 1 1 2

+ on oxygen

oxygen

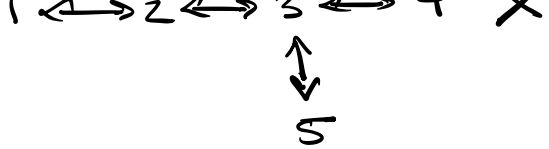
Both major

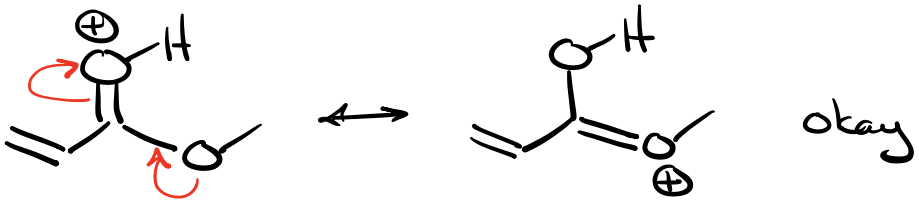


Weighted average of charge distribution

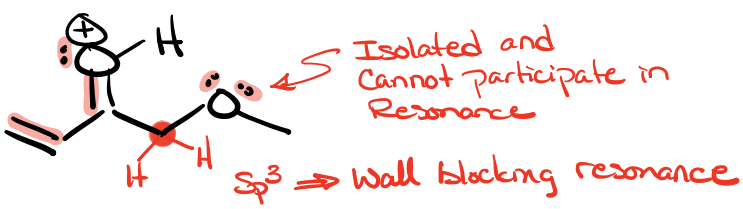
Resonance should be linear [1 ↔ 2 ↔ 3 ↔ 4 ↔ 5] ✓

Should not branch



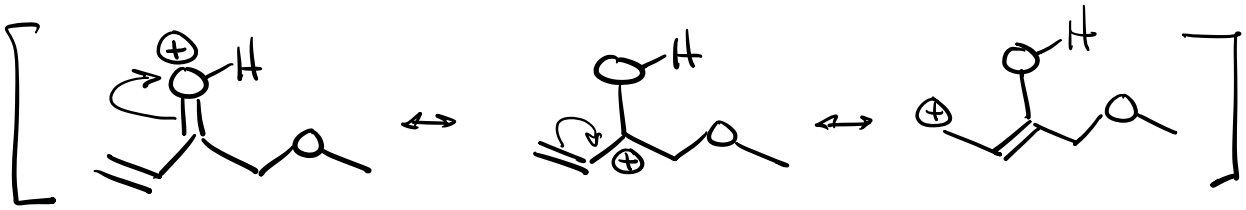


okay



Isolated and Cannot participate in Resonance

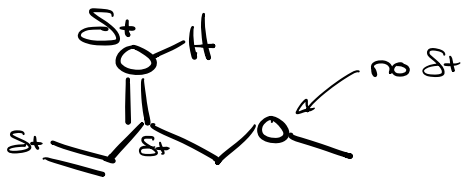
sp^3 ⇒ Wall blocking resonance



⇒ 2 | 1 | 1

+ on oxygen | + on C | + on C

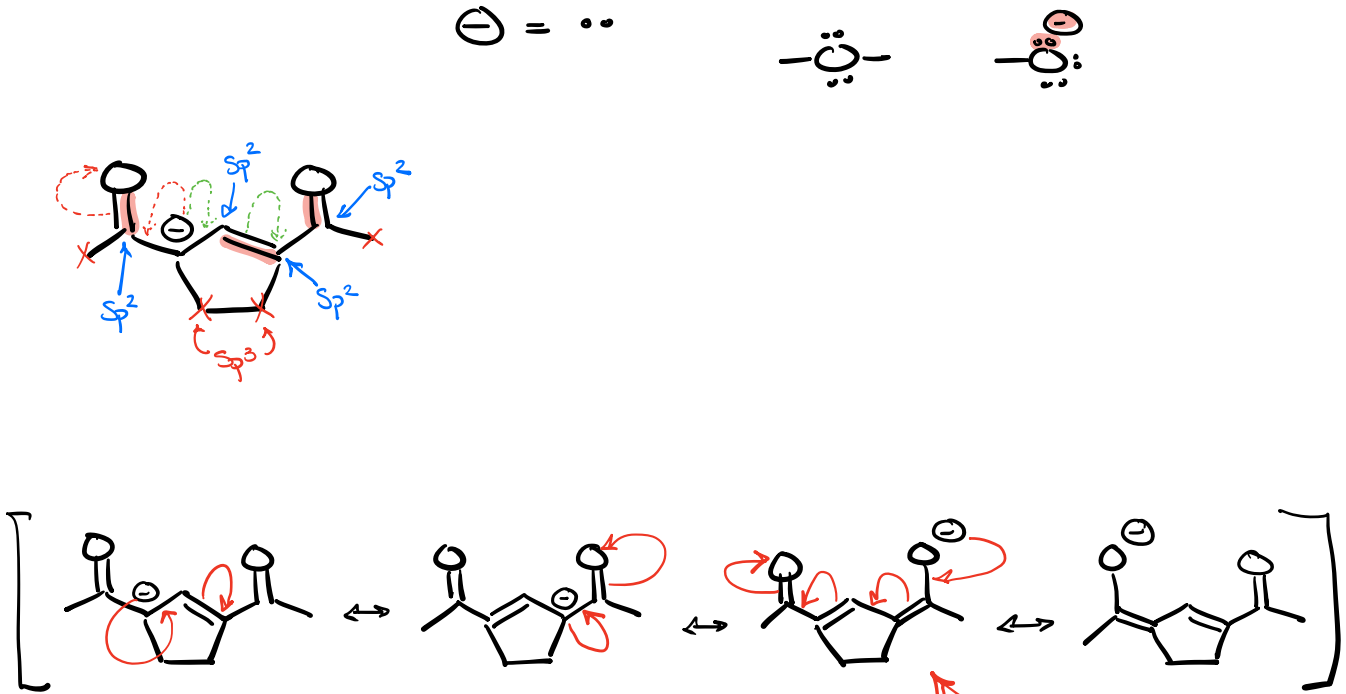
Major

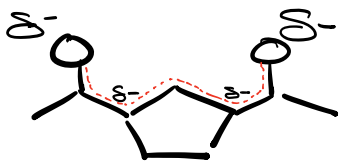


Resonance equals Conjugation

Conjugation is a connected π system of π electrons & lone pair e⁻ that are all sp^2 ⇒ no sp^3

 break Conjugation & isolate parts of the molecule from resonance


⊖ = ••
sp2
sp2
sp2
sp2
sp3
Error
The e⁻ do not need to go back onto the carbon, they should flow into the bond as in the Scheme above
#π 3 3 3 3
⊖ on C C Oxygen Oxygen
Both minor
Both major



Conjugated system
with delocalized charge