



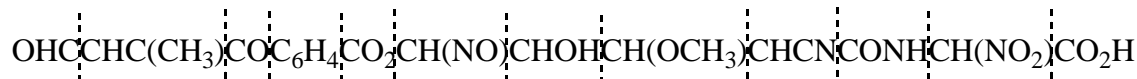
2D Problems

a.

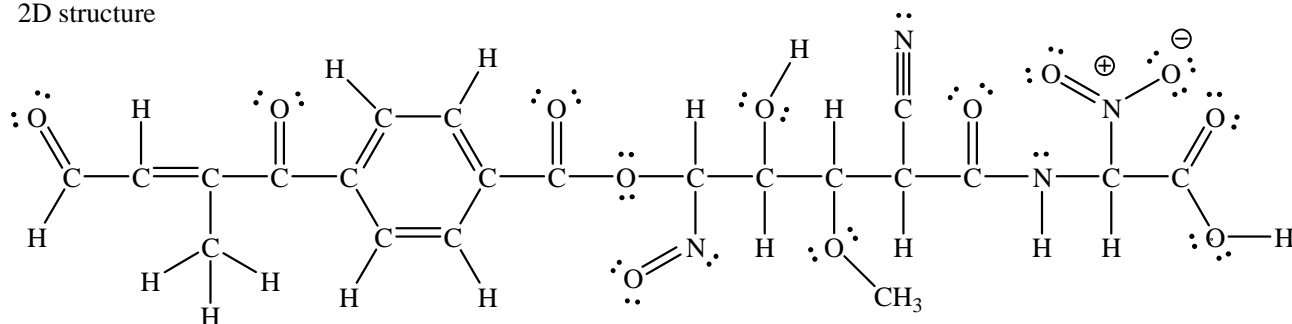
Condensed line formula



Functional group breaks

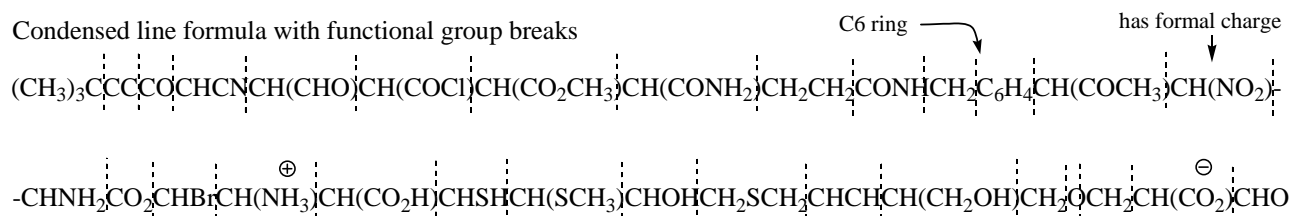


2D structure

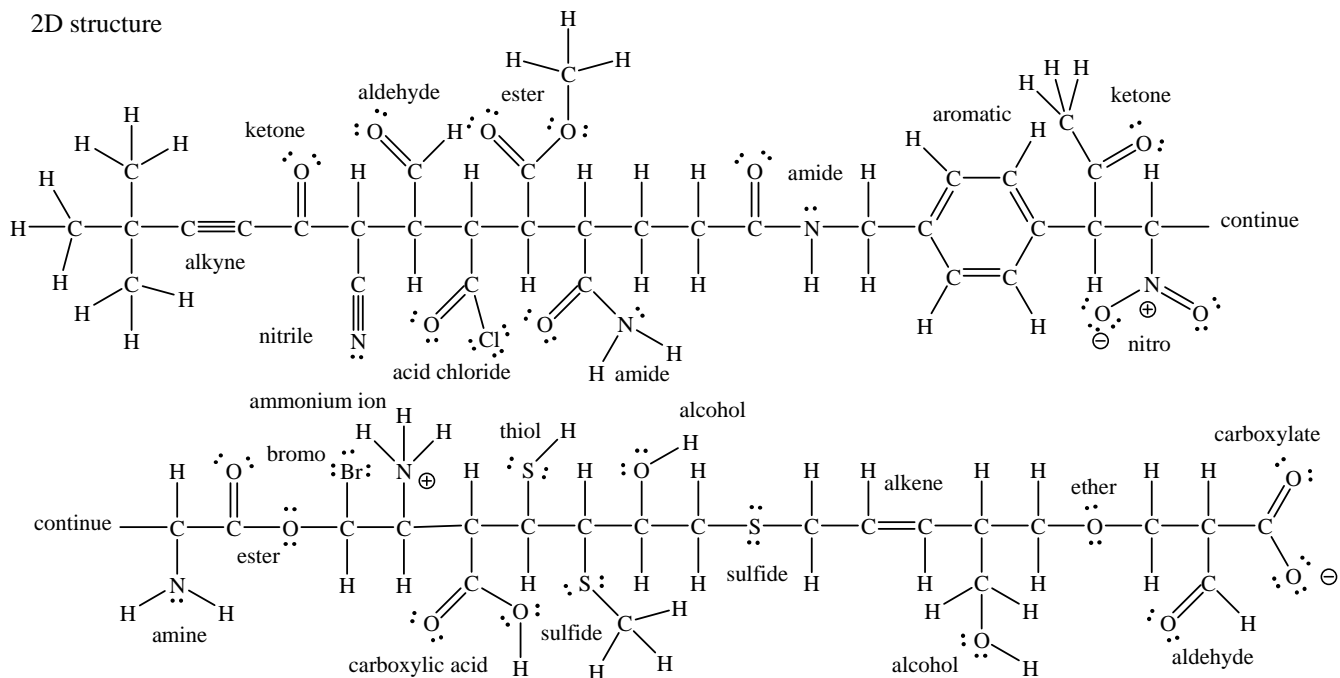


b.

Condensed line formula with functional group breaks



2D structure



Common, Possible Patterns of Resonance

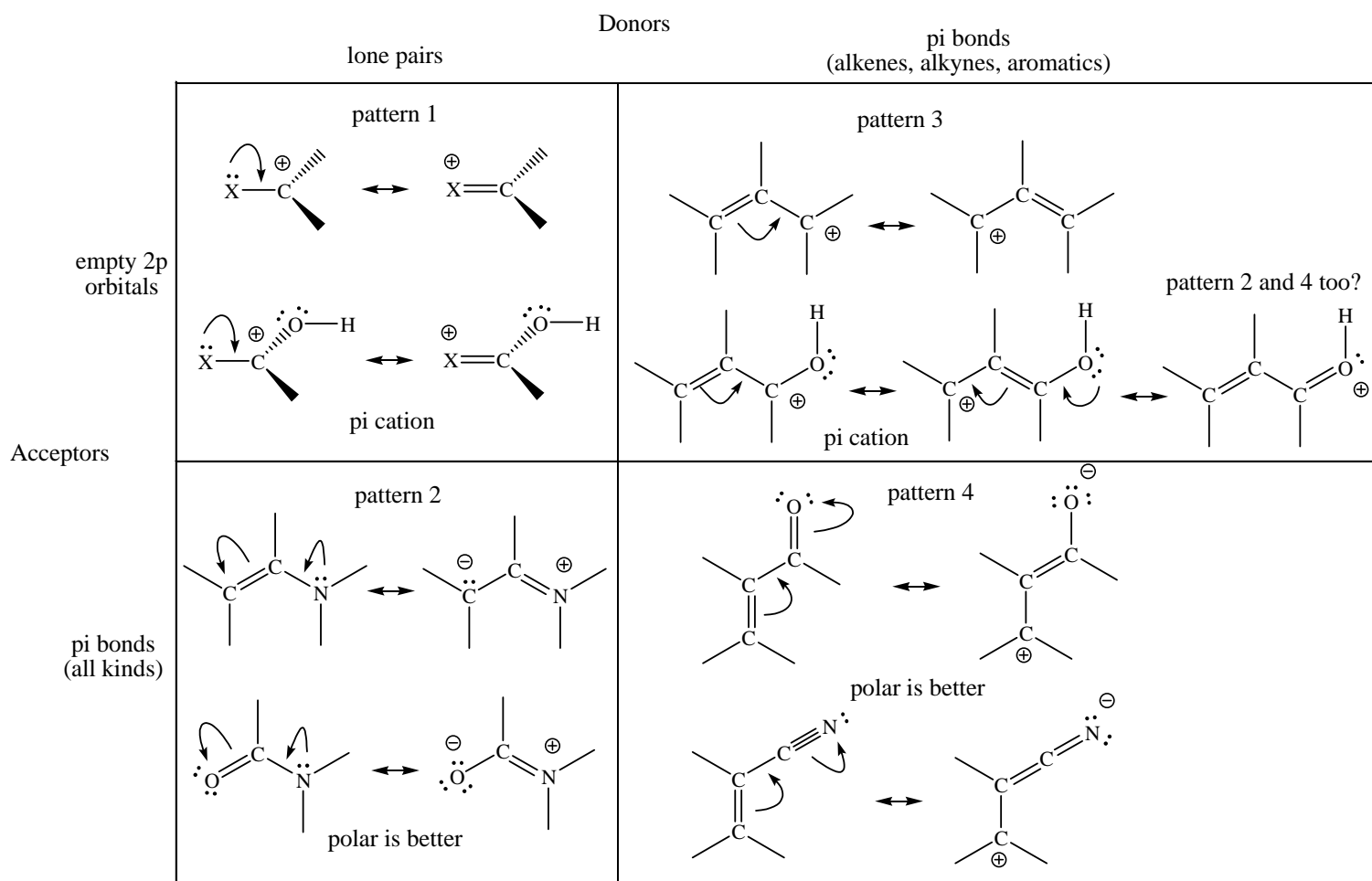
There are four common resonance patterns that we encounter, using two donor sites and two acceptor sites. Donor electrons can come from lone pairs and pi bonds. Acceptor sites include an empty 2p orbital (almost always carbon in our course = carbocations) and pi bonds (polar is best). Notice that pi bonds can donate and accept electrons. In our course resonance systems will always occur through p orbitals. There is another brand of resonance that can use sigma bonds with p orbitals, called hyperconjugation. We will not emphasize this resonance.

Resonance Pattern 1 – Lone pair donation (2p orbital) into an empty 2p orbital (carbocation or pi cation).

Resonance Pattern 2 – Lone pair (2p orbital) donation into pi bonds (many kinds).

Resonance Pattern 3 – Pi bond donation (from alkene, alkyne or aromatic) into an empty 2p orbital (carbocation or pi cation).

Resonance Pattern 4 – Pi bond donation (from alkene, alkyne or aromatic) into a pi bond acceptor (alkene, alkyne, aromatic, carbonyl, imine, nitrile, etc. Polar is better.)

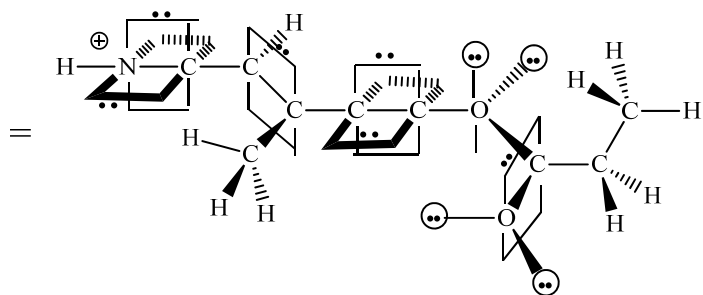
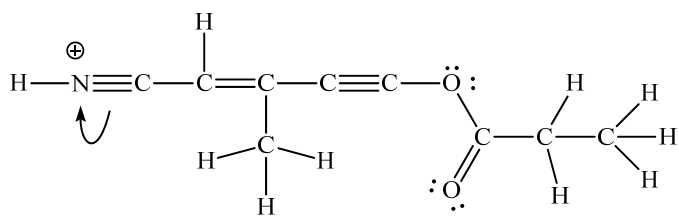




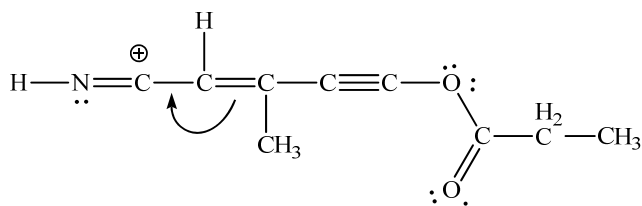
3D Problems



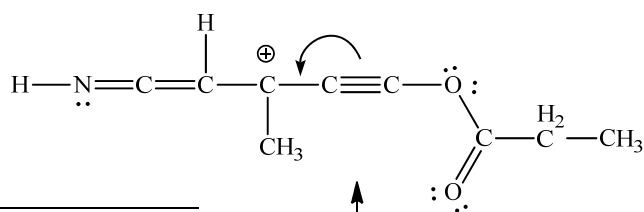
3D of first structure



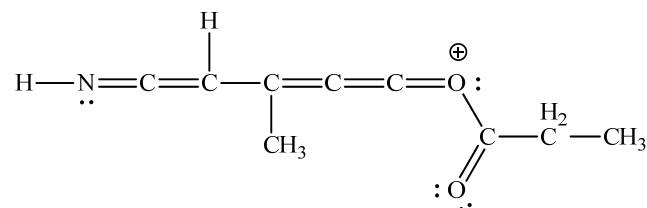
resonance \updownarrow



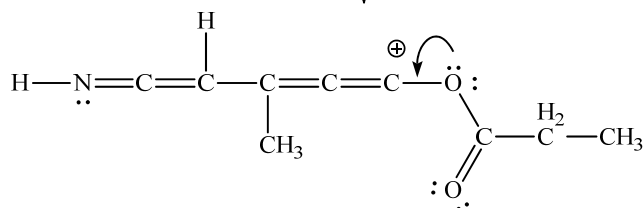
resonance \longleftrightarrow



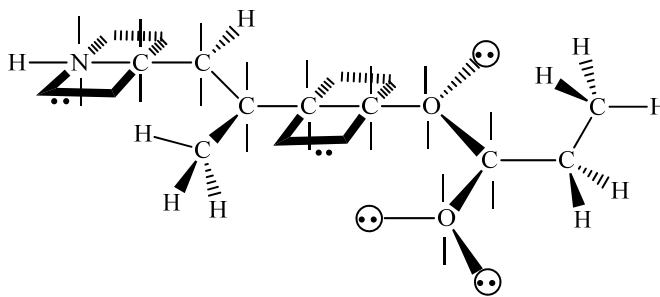
resonance \updownarrow



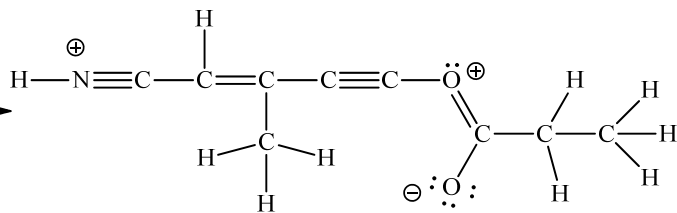
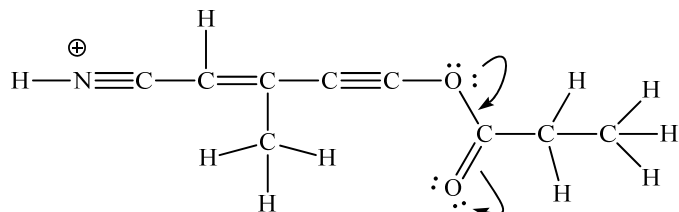
resonance \longleftrightarrow



Template structure can be used to draw all resonance structures above. On exam draw out all hydrogens.

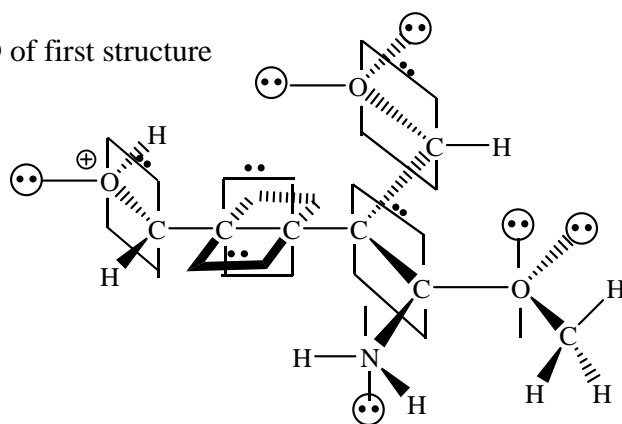
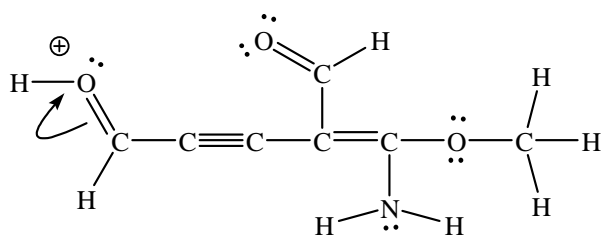


Separate resonance

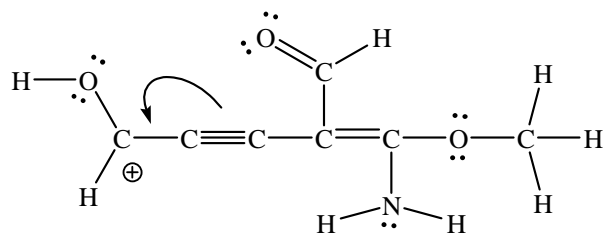




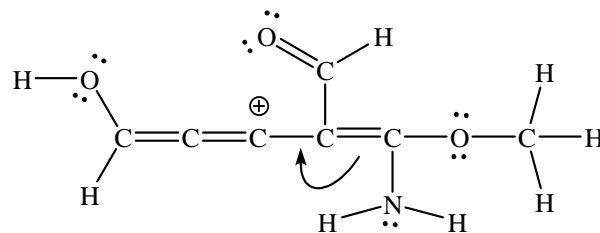
3D of first structure



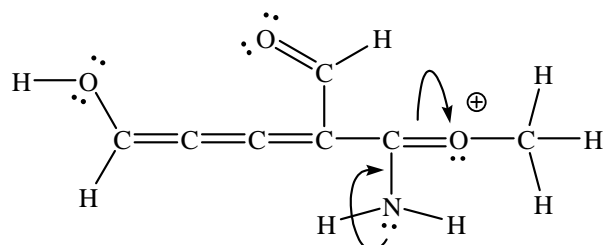
resonance



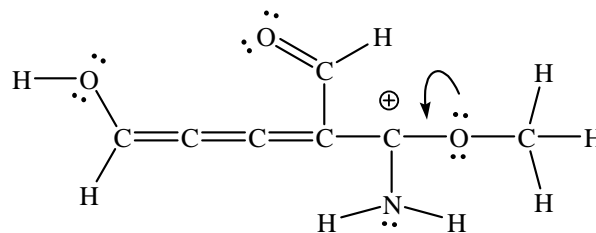
resonance



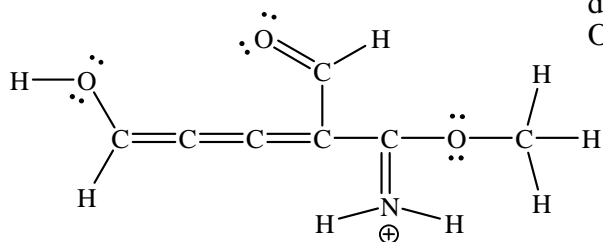
resonance



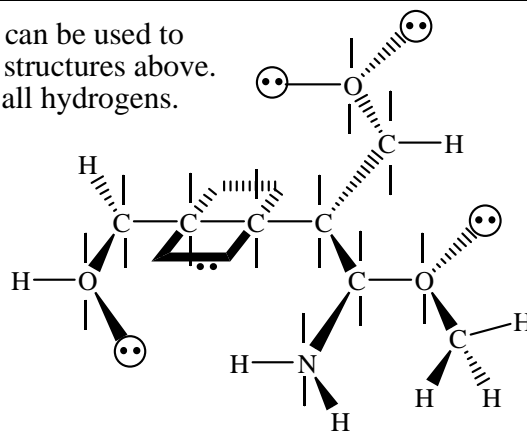
resonance

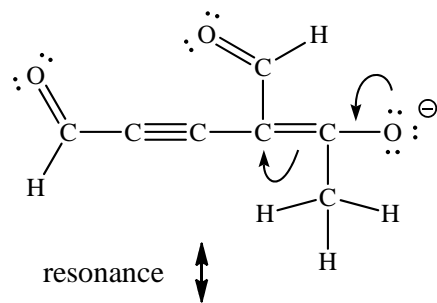


resonance

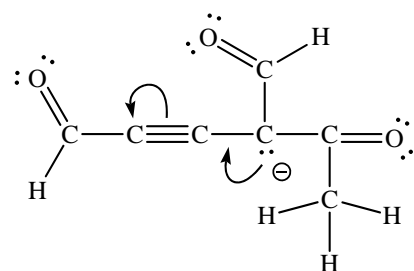


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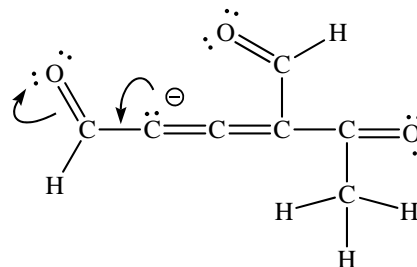




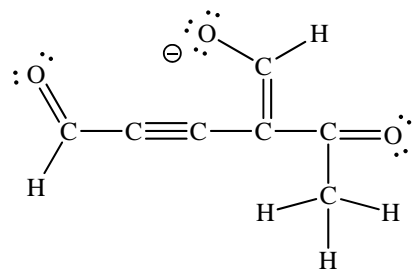
resonance



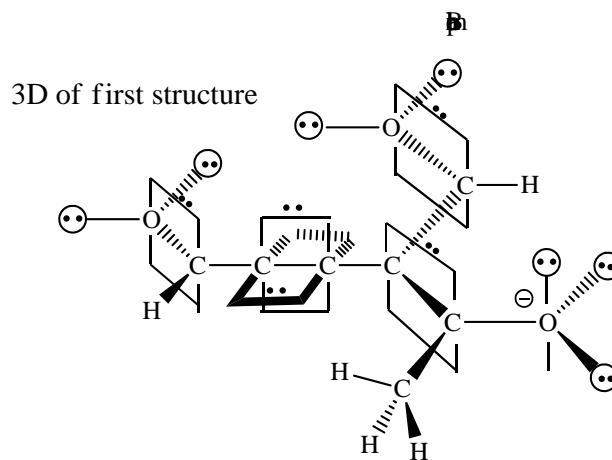
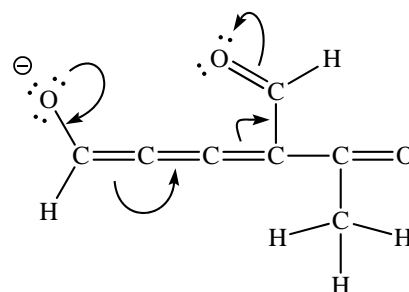
resonance



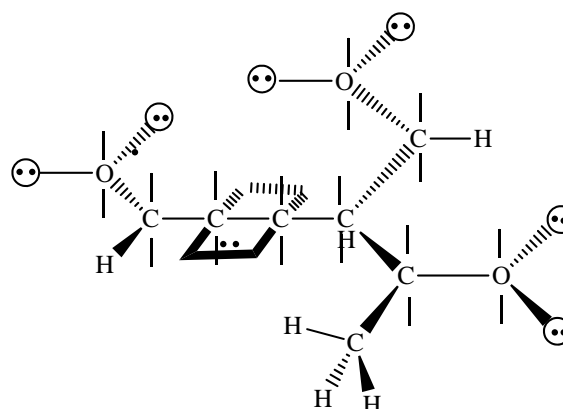
resonance



resonance



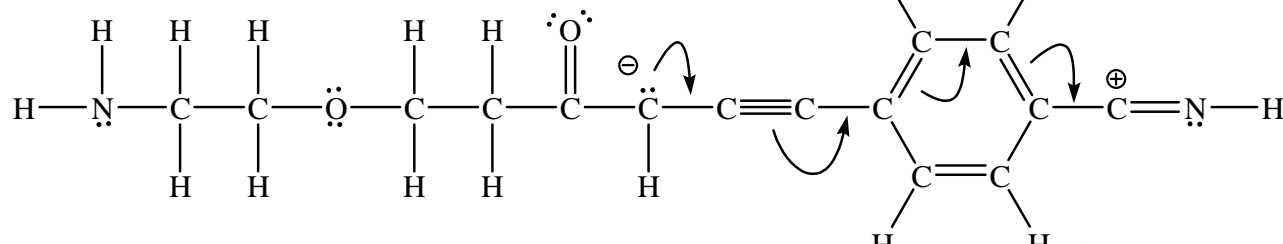
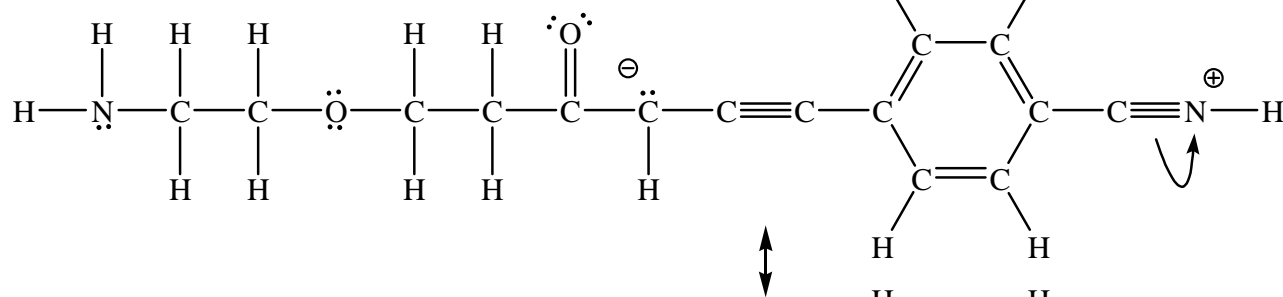
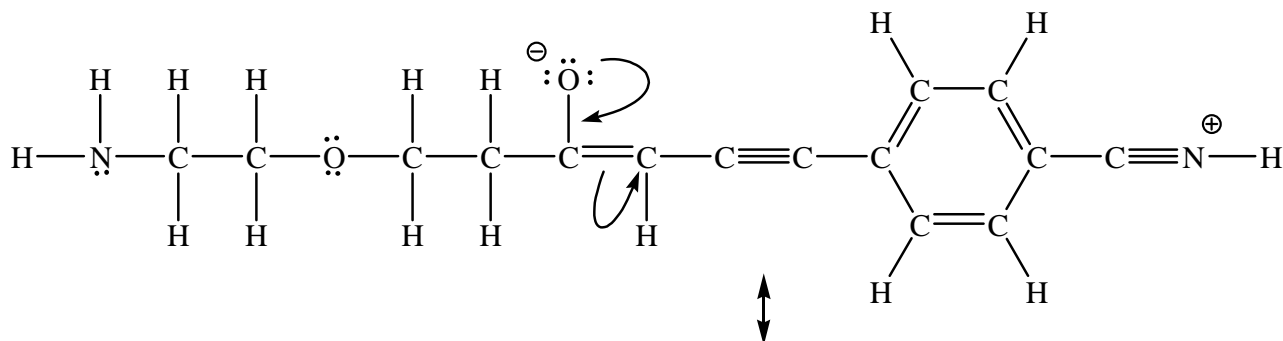
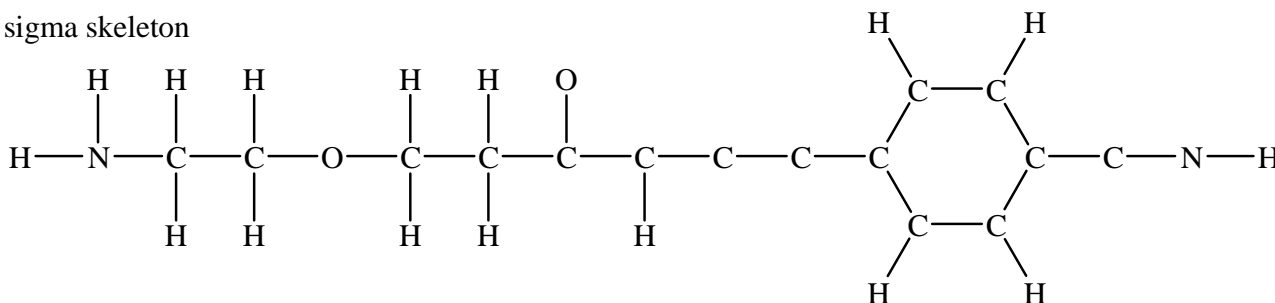
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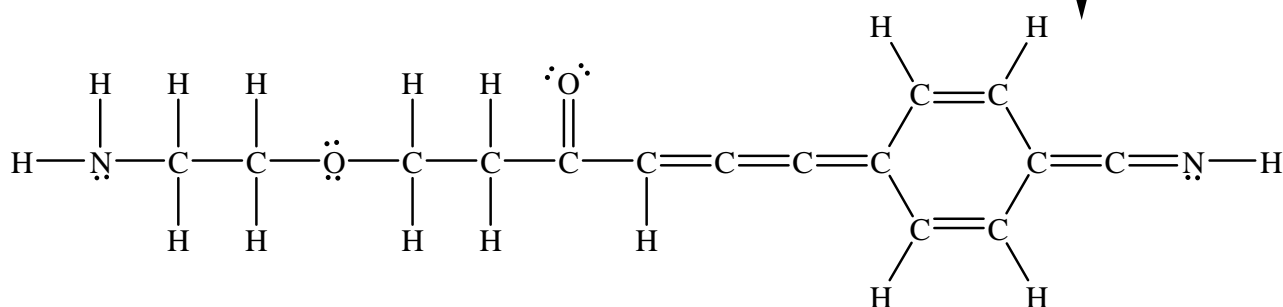
2D / 3D resonance structures with formal charge



sigma skeleton

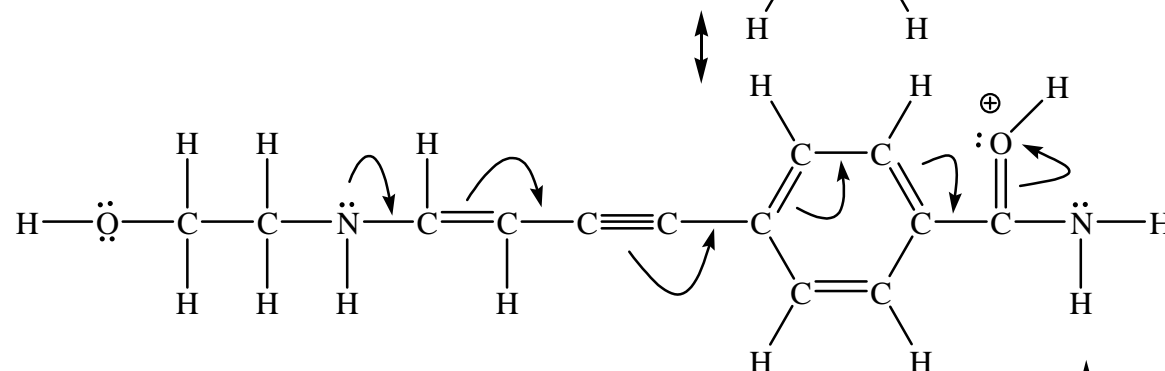
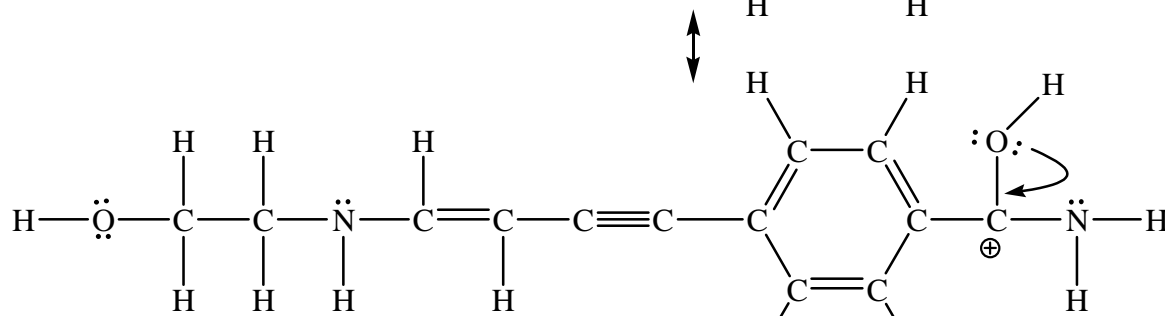
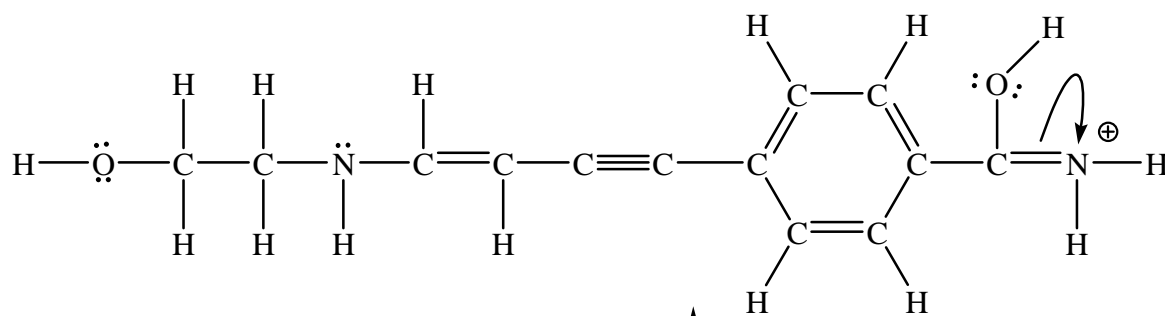
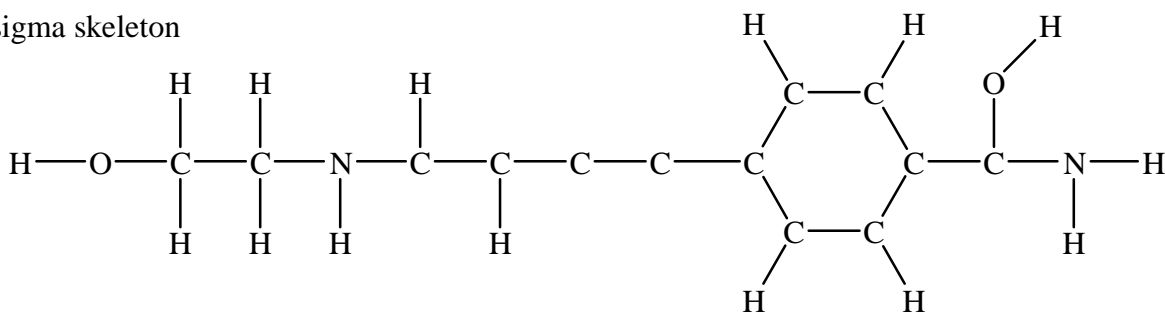


(many additional resonance structures could be drawn, only the "best other" is shown)

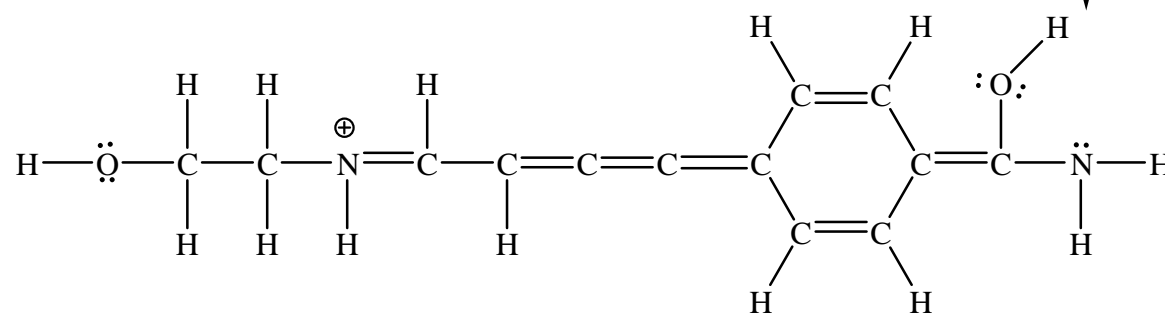




sigma skeleton



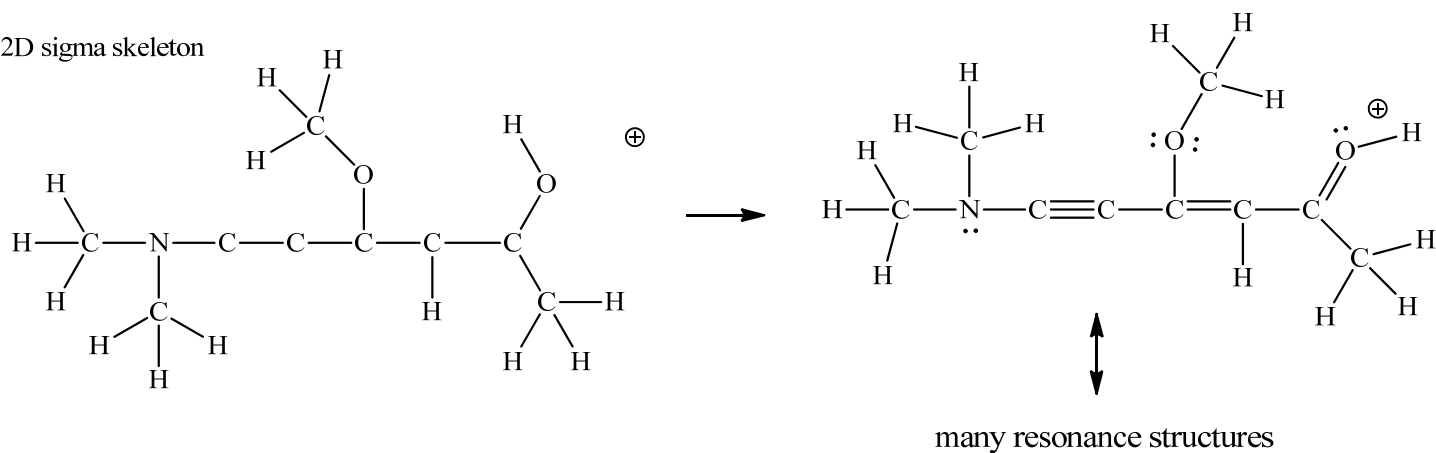
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Additional structure



2D sigma skeleton



3D sigma skeleton

