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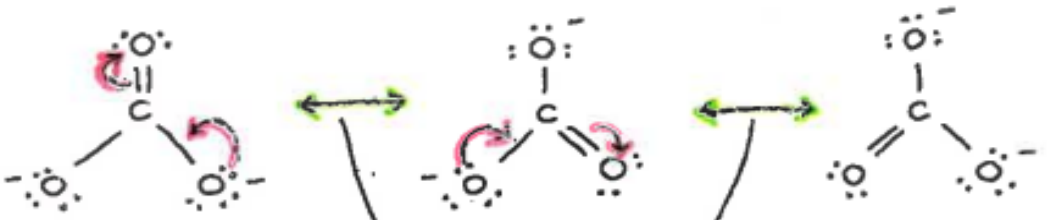
Resonance structures: Lewis structures that differ from one another only in the position of their electrons

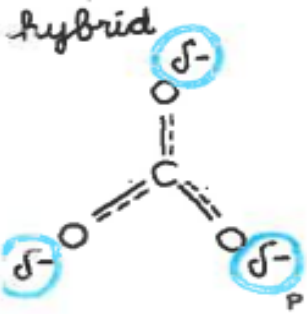
★ a single resonance structure will not adequately represent a molecule, rather the molecule is represented by the hybrid of all resonance structures ★

Ex: carbonate ion (CO_3^{2-})



structure 1 structure 2 structure 3

(not real structure for the actual molecule or ion they only exist on paper)



partial negative charge

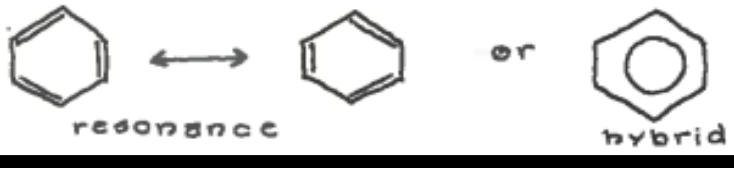
double-headed arrows indicate that these are three hypothetical structures (carbonate ion isn't a fluctuation of these; it is a hybrid of them)

Rules for writing resonance structures

- write 2 or more Lewis structures
- indicate resonance using ⟷ double-headed arrows
- only allowed to move ELECTRONS in writing resonance structures
- move only those of multiple bonds & those of nonbonding e⁻ pairs
- the energy of the resonance hybrid is *lower* than the energy of any contributing structure.

If resonance structures are equivalent, then resonance stabilization is large.

Ex: benzene is highly resonance stabilized b/c it is a hybrid of two equivalent forms.



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1) The more stable a structure is, the greater its contribution to the hybrid.

How do we know which resonance structure is more stable?

2) the more covalent bonds a structure has, the more stable it is.

3) charge separation decreases stability
(b/c it takes energy to separate opposite charges)

4) when all atoms have a complete valence shell of e^-, it is more stable

Ex: consider the resonance structures for formaldehyde

structure 1

- has 4 covalent bonds
- does NOT have separated charges
- carbon completed the octet w/ 8 electrons around it

structure 2

- has 3 covalent bonds
- has separated plus & minus charges
- carbon does not satisfy the octet rule, only has 6 electrons around it