Lewis Symbols

- Be able to use the periodic table to determine the number of valence electrons
- Know the preferred valence of an atom (first row main group atoms)
- Be able to draw the Lewis symbol for an atom
- Know the octet rule and why we use it
- Know how to calculate formal charge
  - \( FC = VE - LSE \)
  - Can help determine best L.S.
  - Following octet rule is more important than formal charge if possible

Rules for Drawing Lewis Structures

- Count number of valence electrons
- Write the atoms and connect with single bonds
- Determine how many electrons remain to be distributed; distribute them
- If not enough \( e^- \), make multiple bonds to complete octets
- If too many \( e^- \), put them on the central atom (period 3 and below on the periodic table)
**Resonance**

- Which molecules have resonance structures?
- Which one is the best picture of the bonding?
- Know that these molecules are more stable
- How does resonance affect bond length and strength?
- How is the resonance in an aromatic molecule illustrated?
- What does delocalized mean?

**Exceptions to the Octet Rule**

- Odd number of electrons (rare)
  - Where does the single electron go?
  - What is a free radical?
- Incomplete octet (rare, Be, B)
- Expanded octet (common for period 3 and below in the periodic table)
  - NEVER occurs with period 2 atoms
  - Larger central atoms have more space around them; less repulsions between outer atoms
  - Larger central atoms have available empty d orbitals to use to accommodate extra electrons
  - Outer atoms must be SMALL, HIGHLY ELECTRONEGATIVE atoms (F, Cl, O)
Bond Lengths and Energies

- What is the definition of bond length?
- What is the definition of bond energy? (E needed to break one mole of bonds)
- How do the bond length and bond strength of a single bond compare to a double and triple bond?
- How do the bond length and bond strength vary with the size of the atoms?
- What is the bond dissociation energy defined as?
- What is the sign of D?
- Is a molecule with strong bonds likely to be more easily decomposed?

Concept of Valence works best for first row only

- N has a valence of 3
- Does P have a valence of 3?
  - PCl$_3$
  - PCl$_5$
- O has a valence of 2
- Does S have a valence of 2?
  - O$_3$
  - SO$_2$
  - SO$_3$
  - SO$_3^{2-}$
  - SO$_4^{2-}$
Lewis Structures: Practice

- CS₂
- CO
- SF₂

Lewis Structures: Practice

- H₂SO₄
- ClO₂⁻
- NH₂OH
Lewis Structures: Practice

- $\text{H}_2\text{CO}$
- $\text{H}_2\text{O}_2$
- $\text{H}_2\text{SO}_3$

Lewis Structures: Practice

- $\text{N}_3^-$
- $\text{CO}_2$
- $\text{ClO}_2$
 Atom and Ion Sizes

Across a period
Which is smaller?  Na  Al  Cl

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Atom and Ion Sizes

Down a Group or Family
Which is smaller?

Sc  Y  Lu

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Atom and Ion Sizes

**Ions of the same element**
Which is smaller?
- $\text{Sc}^{3+}$
- $\text{Sc}^{2+}$
- $\text{Sc}^+$
- $\text{Sc}$
- $\text{Sc}^-$

**Isoelectronic Series**
Which is smaller?
- $\text{Ca}^{2+}$
- $\text{S}^2-$
- $\text{K}^+$
- $\text{Cl}^-$

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Chem 110 Exam I Review
Atom and Ion Sizes

Isoelectronic Series

Which is smaller?

\[ O^{2-} \quad F^- \quad Na^+ \quad Al^{3+} \]

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Atom and Ion Sizes