Announcements

To join clicker to class today (Clickers with LCD display join automatically):

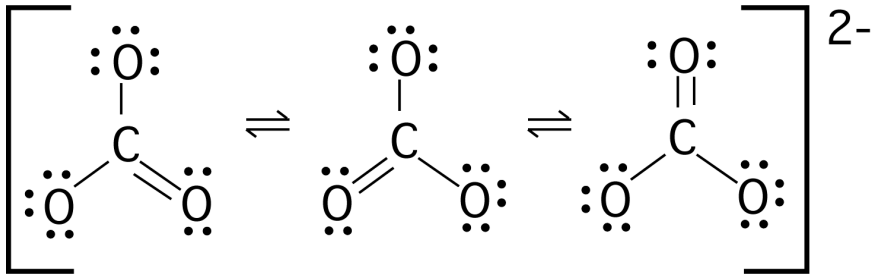
- Turn on the Clicker (the red LED comes on).
- Push "Join" button followed by "20" followed by the "Send" button (switches to flashing green LED if successful).

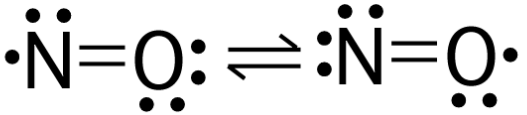
- Exam 3 next Monday.
- As usual, please do not enter room until I let you in.
- Don't forget: calculator, pencils, something to drink and a bathroom stop.

- Section 9.7 was inadvertently left off of the reading assignment.
- No shorts, sandals or skirts allowed in Lab!!
- Volunteer to help with Earth Day Science Fun

Review

- Resonance structures:



- Formal Charge
  - Formal Charge = # valence e^- -[# non-bonding e^- + (1/2)•(# bonding e^-)]
  - Electroneutrality Principle: best structure has FCs nearest zero.
  - Most electronegative atoms most negative.
- Odd electron species: 
- Expanded octets for to get better formal charges allowed for period 3 and beyond.
- Bond order between 2 atoms = # shared electrons/2.
  - In resonance structures bond order = weighted average of bond order in each resonance structure.

Bond Lengths and Energies

Combines Chang Figures 9.1 & 9.2

Bond Type Triangle

Section 5 Review

- Limiting Reagents (on reactant is used up first)
  - Calculate moles of product from each reagent.
  - Smaller one is most you can get.
- % yield=amount collected/amount expected.
- Concentration Units:
  - Molarity (M) = moles /L
  - Fraction by mass in %, ppm, ppb, ppt
  - Molality (*m*) = moles/kg solvent

Section 5 Review con't

- Unit interconversions
  - M —>*m*:
    - Calculate mass of 1 L solution using density
    - Subtract mass of solute from mass of solution
    - Divide moles by mass of solvent calculated above
  - *m*—> M:
    - Add mass of solute to 1 kg of solvent
    - Calculate volume of total mass of solution using density
    - Divide moles by volume calculated above.
- Electrolytes vs. non-electrolytes
- Colligative properties depend on # of solute particles

Section 5 Review con't

- Colligative properties:
  - Osmotic Pressure: $\Pi = iMRT$
  - Boiling Point Elevation: $\Delta T_b = imK_b = iK_bm$
  - Freezing Point Depression: $\Delta T_f = imK_f = iK_fm$
  - Molar mass from measurements of these.
- Solubility (only NO_3^- and Group I salts all soluble)
- Identifying Acid-base reactions.

Section 6 Review

- Lewis structures:
  - Octet rule
  - electron affinity
  - Resonance
  - Odd electron species (radicals)
  - Expanded octets
  - Bond order, lengths and strengths
  - electronegativity
  - bond polarity
  - Formal charge
- Catalysts, ex: Chemistry of ozone depletion.
- Bond triangle for classifying bond types as ionic, covalent, metallic or semi-metallic(semiconductor)

Systematic Lewis Structures

1. Octet rule: all main group (s and p block) elements except B (6) and H (2) will share electrons to get 8 valence electrons.
2. Count the total number of valence electrons on all atoms. Add or subtract from this to account for the overall charge on the species.
3. Next draw single bonds from each of the outer atoms to the central atom. Subtract two electrons from the total number of electrons for each bond you have made = # electrons you have left to use elsewhere.
4. Put electrons on the outer atoms to give each atom a total of eight (an octet). (H) hydrogen only needs 2 electrons. (B) boron usually only 6 electrons. Keep track of how many electrons you are using. If you run out of electrons before filling the outer atoms' octets, stop.
5. Any electrons that were not used up in step 3 should be put on the central atom. You should now have no unused valence electrons.
6. If any atoms do not have octets, make multiple bonds (double and triple) by sharing electron pairs from atoms that do have octets.
7. Look for resonance structures. If you have made multiple bonds or have odd electron species where all the atoms cannot have octets, there may be more than one way to arrange the multiple bonds or place the odd electron. If so, the molecule is better modelled as an average of all the possible structures.
8. Use “Formal Charge” to pick best resonance structures.

Formal Charge

- Useful for determining most likely resonance structures.
- Formal charge = the charge an atom would have if all bonding electrons are shared equally.
- Calculation: Formal Charge = # valence e^-

  $-[\#\ \text{non-bonding}\ e^- + (1/2)\bullet(\#\ \text{bonding}\ e^-)]$
- Electroneutrality Principle: the resonance structure with formal charges closest to zero is the largest contributor.