Announcements

Niagra Falls

To join clicker to class today (Clickers with LCD display joins 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).

Review

- Molar Mass
  - To get correct significant figures do in two steps.
  - (2 mol H/mol H_2O)(1.00794 g H/mol H) = 2.01588 g H/mol H_2O

+(1 mol O/mol H_2O)(15.9994 gO/mol O)=15.9995 g O/mol H_2O

18.0153 g H_2O/mol H_2O

- $$\% \text{ Composition} = \frac{100\% * (\text{mass of X in molecule})}{molar\ mass}$$

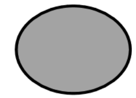
- $$\%\ yield = \frac{amount\ collected}{amount\ expected} \cdot 100\%$$

Stoichiometry/Mole Map

Model Reaction: aA + bB ⟶ cC

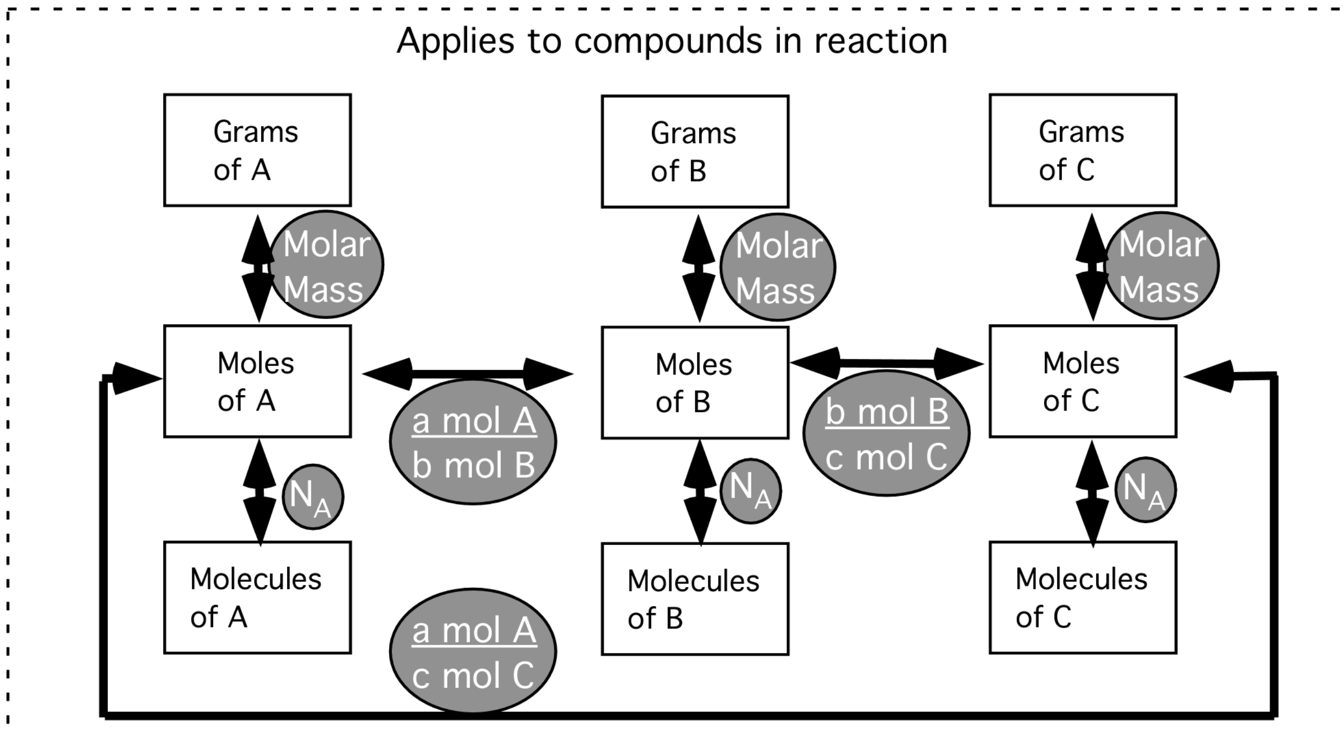
A, B and C represent molecular formulas

a, b and c represent the stoichiometric coefficients



= conversion factor

$N_A = 6.022 \times 10^{23} \frac{\text{things}}{\text{mole}}$



Experimental determination of % Composition

- unknown + O_2 (excess) → oxides (H_2O, CO_2, NO_2, SO_2, etc.)
- Burn 100% of unknown and weigh amount of each oxide.
- Example: ethylene: $C_2H_4 + O_2$(excess) → $CO_2 + H_2O$
  - 1.000 g ethylene yields 1.284 g H_2O and 3.137 g CO_2
  - Calculate moles of H and C in sample to get empirical formula:
  - $$mol\ H = (1.284\, g\, H_2O)\left(\frac{1\, mol\, H_2O}{18.0153\, g\, H_2O}\right)\left(\frac{\mathbf{2\, mol\, H}}{1\, mol\, H_2O}\right) = 0.1426\, mol\, H$$
  - $$mol\ C = (3.137\, g\, CO_2)\left(\frac{1\, mol\, CO_2}{44.010\, g\, CO_2}\right)\left(\frac{1\, mol\, C}{1\, mol\, CO_2}\right) = 7.128\, x\, 10^{-2}\, mol\, C$$
  - n_H/n_C = 0.1426/0.07128 = 2 as we found before.
  - Can go from that to % composition by mass.

Chemical Bonds

- Valence Electrons
- Review of Ionic Bonding
- Covalent Bonding
  - octet rule
  - electronegativity
  - electron affinity
  - bond polarity
- More complex examples:
  - Ozone and CFCs
  - resonance
  - formal charge
  - octet exceptions
  - bond order
  - bond length

Valence Electrons (Chang Fig 9.1)

Bond Lengths

Chang Table 9.2

- Chang Table 9.2

Electronegativities
(Chang Figs. 9.5 & 9.6)

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.

Ozone, O_3

- Allotrope of oxygen (allotropes are differently bound forms of the same element)
- O_3 is one of the irritants in smog.
- O_3 in the stratosphere (ozone layer) is good.
  - It protects us from UV radiation by absorbing radiation between 242 nm and 320 nm.

$$O_3 + h\upsilon(\leq 320 \text{ nm}) \rightarrow O_2 + O$$

  - O_2 only absorbs radiation with $\lambda \leq 242$ nm (higher energy)

$$O_2 + h\upsilon(\leq 242 \text{ nm}) \rightarrow O + O$$