Class #3
Introduction to Chemical Reactions

CHEM 107
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Chemical Reactions

• Transformation of one or more chemical species into new substances
• Reactants $\rightarrow$ Products
Chemical Equations

- Written description of a reaction
- Varying information: physical states, conditions
- Doesn’t necessarily mean it really happens!

C (diamond) + O$_2$ (g) $\rightarrow$ CO$_2$ (g)

Types of Reactions (unbalanced eqs.)

- “addition” or “combination”
  C$_2$H$_4$ + H$_2$ $\rightarrow$ C$_2$H$_6$
- “decomposition”
  NH$_4$NO$_3$ $\rightarrow$ N$_2$ + O$_2$ + H$_2$O
- “substitution” or “displacement”
  Mg + HCl $\rightarrow$ MgCl$_2$ + H$_2$
- “combustion” (burning in O$_2$)
  C$_3$H$_8$ + O$_2$ $\rightarrow$ CO$_2$ + H$_2$O
Balancing Equations: Conservation Laws

These properties are conserved, and can be “accounted for.”

- number of atoms of each element
- mass
- electric charge
- energy

Balanced Equations

- $2 \text{CO} + \text{O}_2 \rightarrow 2 \text{CO}_2$
- Coefficients: “reaction ratio”
  How many ...
  - Molecules react with molecules
  - Moles react with moles
  - NOT how many grams react with grams!!!
Balancing Equations

• Find **smallest whole number coefficients** that satisfy conservation rules
• For many reactions, do this by trial and error
• For some reactions, use more systematic methods

Try balancing these ...

• Burning of acetylene (C$_2$H$_2$) in a welder’s torch:

\[ C_2H_2 + O_2 \rightarrow CO_2 + H_2O \]

• Combustion of TNT (C$_7$H$_5$N$_3$O$_6$).
Products are CO$_2$, H$_2$O, and N$_2$
Stoichiometric ratios

- Once you have a balanced equation, it tells you the relative amounts of the various substances.

\[ \text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O} \]

This reaction has mole:mole ratios of 1:2:1:2