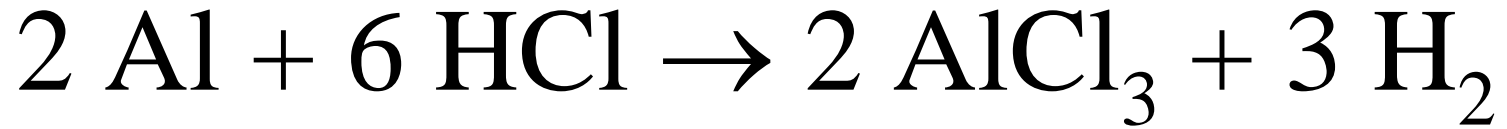


Calculations from Chemical Equations

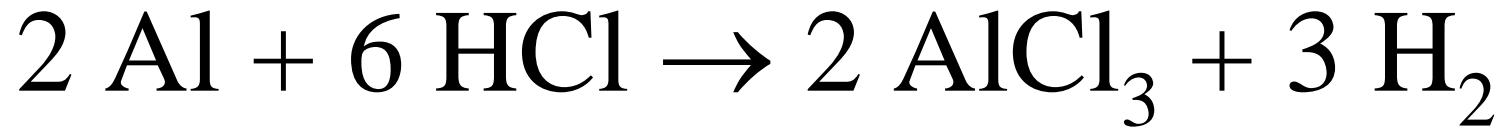
Chapter 9

Stoichiometry

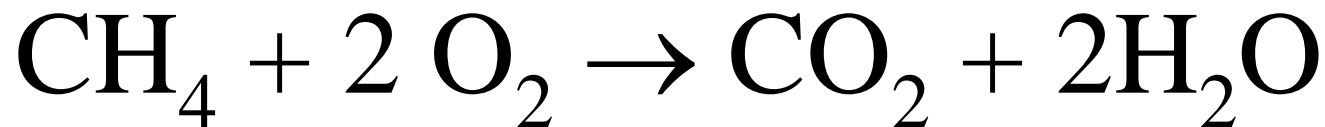
- ❖ Calculations involving chemical equations
- ❖ Chemical equations tell us exactly how much of one reactant will react (combine) with a second reactant and how much of the product we should expect.



- 2 atom Al + 6 molecule HCl
- \rightarrow 2 formula unit AlCl_3 + 3 molecule H_2
- 2 mol Al + 6 mol HCl
- \rightarrow 2 mol AlCl_3 + 3 mol H_2
- 2 (26.98 g) Al + 6 (36.46 g) HCl
- \rightarrow 2 (133.3 g) AlCl_3 + 3 (2.016 g) H_2

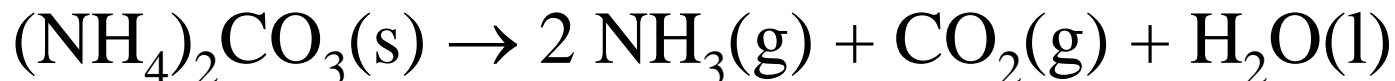


- How many molecules of HCl will react with 4 atoms of Al?
- How many atoms of Al are required to make 1 molecule of AlCl₃?
- How many moles of H₂ are made from 3 mole of HCl?
- If 4 moles of AlCl₃ are produced, how much H₂ is produced?
- How much HCl is required to react with 1 mole of Al?



- How many moles of oxygen are required to react completely with 50.0 g CH_4 ?
- What mass of CH_4 , in grams, is required to react with 96.0 g of O_2 ?
- Calculate the mass of CO_2 that can be produced by burning 6.0 moles of CH_4 in excess O_2 ?
- What mass of CH_4 produces 3.01×10^{23} water molecules when burned in excess oxygen?

- Smelling salts contain ammonium carbonate, which can decompose to form ammonia, which acts as a mild heart stimulant. Ammonium carbonate decomposes by the reaction



- How many g of NH_3 will be formed from 0.500 g of $(\text{NH}_4)_2\text{CO}_3$?

- Calculate the number of moles of calcium chloride needed to react with excess silver nitrate to produce 6.60 g of silver chloride.
-
- 1st - write the equation (a double displacement reaction)
-
- 2nd -do stoichiometry

Reactions and Energy

- Reactions will often generate energy (heat) or produce (give off) energy. We can use stoichiometry to calculate energy consumption or production.

- Exothermic reaction -- A reaction that liberates heat.
- $\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2 \text{C}_2\text{H}_5\text{OH} + 2 \text{CO}_2 + \text{heat}$
- Endothermic reaction -- A reaction that absorbs heat.
- $\text{CO}_2 + \text{heat} \rightarrow \text{C} + \text{O}_2$

- Consider the combustion of methane (used in our bunsen burners)
-
- $\text{CH}_4(\text{g}) + 2 \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{l}) + 890 \text{ kJ}$
-
- Calculate the amount of heat produced when 1.00 g of methane is burned in excess oxygen.

- Copper(I)sulfide reacts upon heating in oxygen gas to produce copper metal and sulfur dioxide. How many grams of copper can be obtained from 500.0 g of cuprous sulfide using this process?
- If 382.6 g of copper were obtained from the reaction above, what would be the percent yield?
- What mass of sulfur dioxide would be produced from 500.0 grams of cuprous sulfide?

Percent Yield

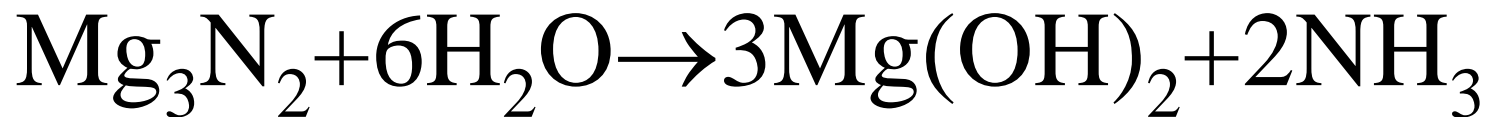
- $\% \text{ Yield} = (\text{mass product} / \text{mass expected}) * 100(\%)$
- What could cause the yield to be $< 100\%$?
- impurities in the sample
- incomplete reaction
-
- What could cause the yield to be $> 100\%$?
- unexpected reactions
- Impure product
- incorrect weighing etc.

Limiting reactant

- Chez Ronald is making Big Macs. The formula for a Big Mac is B_3M_2 , and is made according to the following fast food formula.
- $2 M + 3 B \rightarrow B_3M_2$
- If Chez Ronald buys 28 meats and 36 buns how many Big Macs (B_3M_2) can he make?
- We only got 11 Big Macs - What is the percent yield?

- How much potassium chloride is produced from the reaction of 2.00 g potassium and 3.00 g chlorine gas? Which is the limiting reagent?
- We only recovered 3.66 g KCl. What is the percent yield?

- When solutions containing 4.28 g Na_2SO_4 and 7.16 g BaCl_2 are mixed, what mass of BaSO_4 is produced?



- How many moles of $\text{Mg}(\text{OH})_2$ would be produced from the reaction of 0.10 mole of Mg_3N_2 ?
- How many moles of NH_3 would be produced from the reaction of 500 g of Mg_3N_2 ?
- How many molecules of water would be required to react with 3.64 g of Mg_3N_2 ?
- What is the maximum number of grams of $\text{Mg}(\text{OH})_2$ that can be produced by the reaction of 10.0 g of Mg_3N_2 and 14.4 g of H_2O ?
- What is the percent yield if 9.4 g of $\text{Mg}(\text{OH})_2$ are produced?