

Warm-Up

Write the chemical equation and balance

Cu^{2+} N^{3-}
copper (II) nitride reacts with Ca^{2+} PO_4^{3-}
calcium phosphate



Chapter 12

Stoichiometry



What is the purpose of a recipe?



A recipe is like a balanced equation

Stoichiometry

Greek for "measuring elements"

Defined as: calculations of the quantities in chemical reactions, based on a balanced equation.

There are 4 ways to interpret a balanced equation

1. **Representative particles (atoms, molecules, formula units]**
2. **Moles**
3. **Mass**
4. **Volume**

1. In terms of [representative] particles

A. An element is made of **ATOMS**. Ca

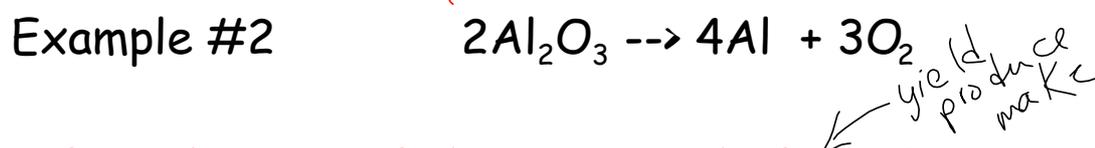
B. A molecular compound [made of only nonmetals] is made up of **MOLECULES** CO_2
[don't forget the diatomics] O_2 ←

C. Ionic Compounds [[+] cation + [-] anion] are made up of **FORMULA UNITS** CaCl_2
 NaOH



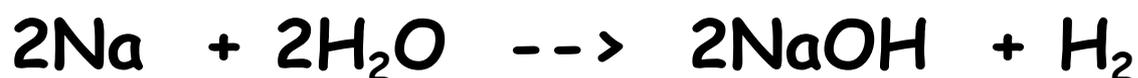
*Two molecules of hydrogen and one molecule of oxygen form two molecules of water.

coefficient



2 formula units of aluminum oxide form 4 atoms of aluminum and 3 molecules of oxygen

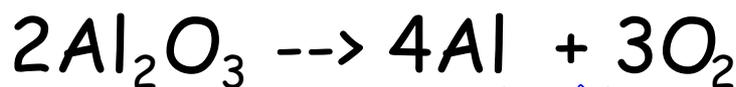
Now write this



2 **atoms** of sodium react with 2 **molecules** of water to produce 2 **formula units** of sodium hydroxide and 1 **molecule** of hydrogen

2. In terms of MOLES

* The coefficients tell us how many moles of each substance



2 moles Al₂O₃ → 4 moles Al plus 3 moles oxygen

*the balanced equation gives us the **MOLAR RATIO**

What is the ratio of Al to O₂ in products?

4 : 3

3. In terms of MASS

*The Law of Conservation of Mass applies

Prove:

↳ Mass Reactants = Mass product



$$\begin{array}{r} 101.96 \text{ g/mol} \Rightarrow \\ \times 2 \\ \hline 203.92 \text{ g/mol} \end{array}$$

$$\begin{array}{r} 26.98 \text{ g/mol} + 32 \text{ g/mol} \\ \times 4 \qquad \qquad \times 3 \\ \hline 107.92 + \qquad \qquad \qquad \\ \hline 203.92 \text{ g/mol} \end{array}$$

4. In terms of VOLUME *[applies with gases]*

* At STP, 1 mol of any gas = 22.4 L



- a) Write the following in terms of representative particles
[remember- atoms, molecules, formula units]

2 formula units of sodium phosphate react with 3 formula units of barium sulfate to produce 1 formula unit of barium phosphate and 3 formula units sodium sulfate

- b) Prove the law of conservation of mass.



3(22.99)	137.33	3(137.33)	2(22.99)
30.97	32.07	2(30.97)	32.07
64	64	8(16)	64
163.94	233.4	601.93	142.05
<u>x 2</u>	<u>x 3</u>		<u>x 3</u>
327.88	700.2		426.15

$$1628.08 \text{ g/mol}$$

$$\rightarrow 1028.08 \text{ g/mol}$$

Section 12.2

Chemical Calculations

Mole to Mole conversions



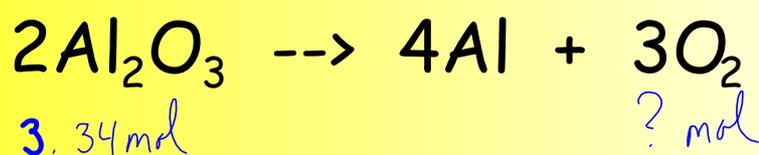
*Each time we use 2 moles of Al_2O_3 we will make 3 moles of O_2

Mole to mole ratio

$$\frac{2 \text{ moles of } \text{Al}_2\text{O}_3}{3 \text{ moles of } \text{O}_2} \text{ or } \frac{3 \text{ moles of } \text{O}_2}{2 \text{ moles of } \text{Al}_2\text{O}_3}$$

Mole to Mole conversions

How many moles of O_2 are produced when 3.34 moles of Al_2O_3 decompose?

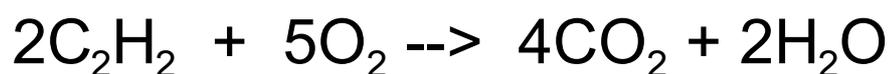


$$3.34 \text{ mol } Al_2O_3 \times \frac{3 \text{ mol } O_2}{2 \text{ mol } Al_2O_3} = 5.01 \text{ mol } O_2$$

b) How many moles of Al can be produced given 12 moles of Al_2O_3 ?



$$12 \text{ mol } Al_2O_3 \times \frac{4 \text{ mol } Al}{2 \text{ mol } Al_2O_3} = 24 \text{ mol } Al$$



- a. Given 3.84 moles of C_2H_2 are burned, how many moles of O_2 are needed?

9.6 mol O_2

- b. How many moles of C_2H_2 are needed to produce 8.95 mole of H_2O

8.95 mol C_2H_2

Read page 356-358, 7, 8, 9, 10

- c. If 2.47 moles of C_2H_2 are burned, how many moles of CO_2 are formed?

Attachments

percent composition2.doc

mole to mole answers.notebook