

## Section 4.3 Balancing Chemical Equations

Pages 203 to 211

# + Chemical Reactions

- Result in chemical changes
- New substances are created
- No new matter is created or destroyed; atoms are just rearranged.
- Reactants  $\rightarrow$  Products

## + The law of conservation of mass:

- In chemical reactions, atoms are neither created nor destroyed.
- Mass of reactants = mass of products
- This is why the equation for every chemical reaction needs to be balanced

# +How are Chemical Reactions Written

- A word equation:
- The simplest form of a chemical equation
  - Examples:
    - Nitrogen monoxide + oxygen → nitrogen dioxide
    - Potassium metal + oxygen gas → potassium oxide

Reactants appear on left side of arrow.



Plus sign on left side means "reacts with."

Arrow means "produces."

Plus sign on right side means "plus."

Products appear on right side of arrow.

# + Word Equations Continued

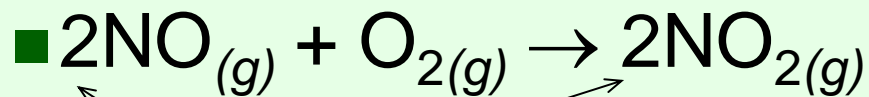
- Require careful examination
  - Be careful of polyatomic elements
    - For Example:  $P_4$  and  $S_8$
  - Be careful of diatomic elements (“special seven”)
    - $H_2$ ,  $O_2$ ,  $F_2$ ,  $Br_2$ ,  $I_2$ ,  $N_2$ ,  $Cl_2$
    - Acronym: HOFBrINCl
  
- Common names for molecules containing hydrogen
  - Examples
    - methane =  $CH_4$
    - glucose =  $C_6H_{12}O_6$
    - ethane =  $C_2H_6$
    - ammonia =  $NH_3$

1				
+				
1				
H Hydrogen 1.0				
				18
0				
2				
He Helium 4.0				
14      15      16      17				
-				
6	7	8	9	10
C	N	O	F	Ne
Carbon	Nitrogen	Oxygen	Fluorine	Neon
12.0	14.0	16.0	19.0	20.2
-				
14	15	16	17	18
Si	P	S	Cl	Ar
Silicon	Phosphorus	Sulphur	Chlorine	Argon
28.1	31.0	32.1	35.5	39.9
-				
32	33	34	35	36
Ge	As	Se	Br	Kr
Germanium	Arsenic	Selenium	Bromine	Krypton
72.6	74.9	79.0	79.9	83.8
-				
50	51	52	53	54
Sn	Sb	Te	I	Xe
Tin	Antimony	Tellurium	Iodine	Xenon
118.7	121.8	127.6	126.9	131.3
-				
82	83	84	85	86
Pb	Bi	Po	At	Rn
Lead	Bismuth	Polonium	Astatine	Radon
207.2	209.0	(209)	(210)	(222)

# +How are Chemical Reactions Written

## ■ A symbolic equation:

### ■ Example



*Coefficients*

*State of matter*

- *Indicate the ratio of compounds in the reaction.*

*(aq) = aqueous/dissolved in water*

*(s) = solid*

*(l) = liquid*

*(g) = gas*

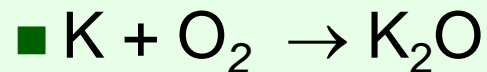


# + Symbolic Equations Continued

## ■ Skeleton equation

- shows the formulas of the elements/compounds, but not quantities

### ■ Example:

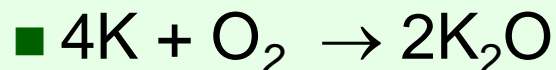


# + Symbolic Equations Continued

## ■ Balanced chemical equation

- shows the formulas of the elements/compounds including quantities
- Always use the smallest whole-number ratio.

■ Example:





# + Steps for Balancing Chemical Equation

1. Count the number of atoms for the reactants and products
2. Balance compounds first and elements last.
3. Balance one compound at a time.
4. Only add coefficients; NEVER change subscripts.
5. If H and O appear in more than one place, attempt to balance them LAST.
6. Polyatomic ions (such as  $\text{SO}_4^{2-}$ ) can often be balanced as a whole group.
7. Always double-check after you think you are finished.

# + Practice Problems

- $\text{Fe} + \text{Br}_2 \rightarrow \text{FeBr}_3$
- $\text{Sn}(\text{NO}_2)_4 + \text{K}_3\text{PO}_4 \rightarrow \text{KNO}_2 + \text{Sn}_3(\text{PO}_4)_4$
- $\text{C}_2\text{H}_6 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$