

## Notes on Balancing Equations:

Abbreviation for Equation is Eqn

**Word Eqn** – words are given, but no formulas

**Formula Eqn** – formulas of each compound are written out, but no coefficients are listed

**Chemical Eqn** – balanced equation with correct formulas and coefficients

### Balancing Equations Example #1:

#### Word Equation

sodium + chlorine → sodium chloride

#### Formula Equation



Notice that there are 2 chlorines on the reactant side (left), but only one chlorine on the product side (right). That is okay for now. Formula equations do not have to be balanced. "Balanced" means that the same number of each element is on the right side and the left side. Also notice that chlorine is  $\text{Cl}_2$  and not  $\text{Cl}$  because it exists as a diatomic molecule.

#### Balanced Chemical Equation

To balance an equation, look at one element (or polyatomic ion) at a time and compare how many are on the left side to how many are on the right side.



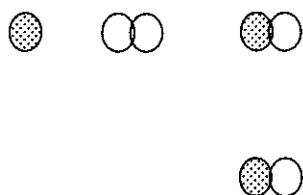
check Na: One Na on the left, one Na on the right OK



check Cl: Two Cl's on the left, only one Cl on the right;  
must have another Cl on the right side. Do NOT change formula to  $\text{NaCl}_2$  because that is not the formula for sodium chloride. You can only change the coefficient.

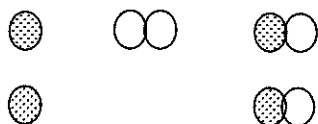


\* Diatomics  
Brine/Hof  
 $\text{Br}_2$   $\text{I}_2$   $\text{N}_2$   $\text{Cl}_2$   $\text{H}_2$   
 $\text{O}_2$   $\text{F}_2$



The 2 in front of the NaCl is a coefficient. It means that there are now 2 sodium chloride formula units on the right side. check Cl: 2 Cl's on the left, 2 Cl's on the right OKAY

check Na: One Na one the left, 2 Na's on the right. Change the coefficient in front of the Na to 2.



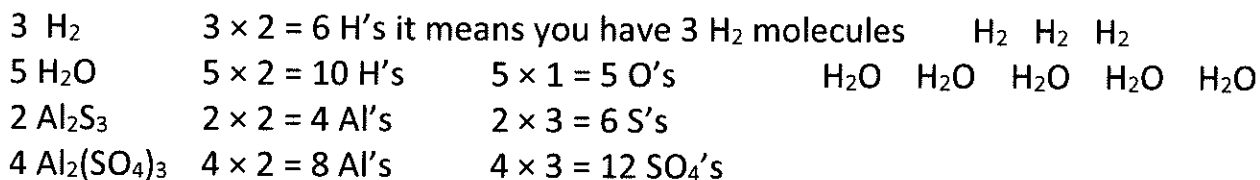
final check: 2 Na's on the left, 2 Na's on the right OKAY

2 Cl's on the left, 2 Cl's on the right OKAY

### Coefficients

When you put a coefficient in front of a formula, it means that you now have a multiple of that formula.

Examples with coefficients:



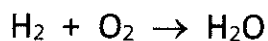
(notice that polyatomic ions like SO<sub>4</sub> can often be counted as a single unit)

### Balancing Equations Example #2:

#### Word Equation

hydrogen + oxygen → water

#### Formula Equation



Remember that the formula equations do not have to be balanced. It is very important to have the correct formulas before trying to balance the equation. Notice that hydrogen is H<sub>2</sub> (not H) and oxygen is O<sub>2</sub> (not O) because they are both on

the list of elements that exist as diatomic molecules.

### Balanced Chemical Equation

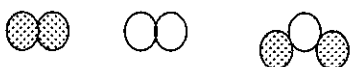
To balance an equation, look at one element (or polyatomic ion) at a time and compare how many are on the left side to how many are on the right side.



check H: Two H's on the left, two H's on the right OKAY



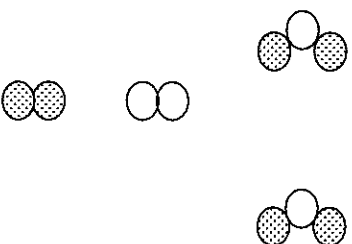
check O: Two O's on the left, one O on the right; you



must change the coefficient in front of  $\text{H}_2\text{O}$ . Do NOT change the formula to  $\text{H}_2\text{O}_2$  because that is not the formula for water! Formula cannot be changed – only the coefficient can change.



check O: Two O's on the left, two O's on the right OK

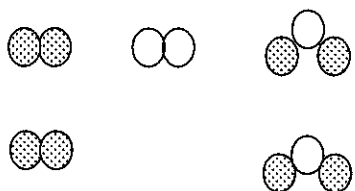


check H: Two H's on the left, four H's on the right;

need to change the coefficient in front of  $\text{H}_2$  to fix this.



final check: 4 H's on the left, 4 H's on the right OKAY  
2 O's on the left, two O's on the right OKAY



## Balancing Equations Notes #2:

Equations must be balanced because of the Law of Conservation of Mass which says:

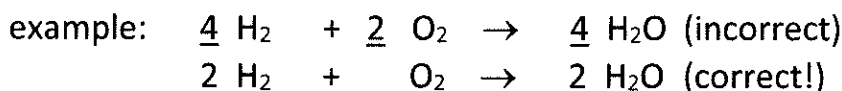
Mass is neither created nor destroyed in ordinary chemical reactions or physical changes.

This means that the mass of the reactants must equal the mass of the products  
and therefore

the number of atoms of each element must be the same on each side of the arrow.

When Balancing Equations:

- change coefficients only – do not change subscripts or formulas
- balance one element or polyatomic ion at a time
- start with leftmost element and work left to right (don't jump around)
- leave H and O for last (this usually helps)
- use trial and error (definitely use a pencil!)
- recheck everything when you think you are done
- if the last coefficient you need ends in .5 (like 1.5, 2.5, 3.5, etc.), go back and double all the coefficients. You can only have whole number coefficients.
- coefficients must be expressed as the simplest relationship



More Difficult Balancing: (usually for combustion reactions)

Example:



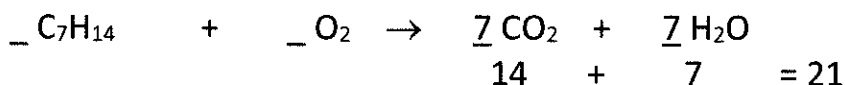
1) balance the C's



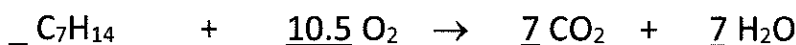
2) balance the H's



3) add up the O's on the product side



4) determine coefficient for O<sub>2</sub> on reactant side so that the # of O's on the reactant side equals the total number of O's on the product side



5) double all coefficients

