NS J1 (pg 1 of 2) The Balanced Equation is a Recipe
Stoichiometry (Stoy-key-aw-met-tree)

Name________________________Per____

Chemists spend a lot of time and energy making things. Just like a chef spends lots of time and effort making food, a chemist spend lots of time making chemicals. Chefs use recipes to make food, and chemists use recipes to make chemicals.

Just like a cookie recipe you make at home with eggs / sugar / cookies ratios, chemists do these same kinds of manipulations when making chemicals. Of course their recipes are balanced equations. When you balance an equation, you now have a recipe of how many atoms or molecules of each chemical reactant is required to make the particular amounts of chemical products.

Consider the following recipe for making water:

2 molecules of hydrogen combine with 1 molecule of oxygen to produce 2 molecules of water

$$2\ H_2 + O_2 \rightarrow 2\ H_2O$$

The coefficients of this balanced equation tell us "how many" whether we are dealing with individual particles or large groups. Consider the following relationships.

$2\ H_2$	+	O_2	→	$2\ H_2O$
2 molecules		1 molecule		2 molecules
200 molecules		100 molecules		200 molecules
12,000 molecules		6,000 molecules		12,000 molecules
4 million molecules		2 million molecules		4 million molecules
1.2×10^{24} molecules		6.0×10^{23} molecules		1.2×10^{24} molecules
2 moles of molecules		1 moles of molecules		2 moles of molecules
0.042 mole of molecules		0.021 mole of molecules		0.042 mole of molecules
10 moles of molecules		5 moles of molecules		10 moles of molecules

All of these relationships are correct – they all follow the same recipe !

Coefficients only give you relationships in "how many" (# of items) not "how much" (mass) because the molecules do not all "weigh" the same − different chemicals have different molar masses.

$2\ H_2$	+	O_2	→	$2\ H_2O$
4.0 g		32.0 g		36.0 g

- Notice that mass is conserved – the reactants total 36.0 g and the products total 36.0 g.
- The mass does NOT follow the same ratio as the coefficients, but mass is conserved.

The balanced chemical equation becomes a powerful tool because it ***provides the quantitative relationships among all the reactants and products in a chemical reaction.*** Therefore we can use the balanced equation to quickly solve a variety of problems that appear to be to be very complex. By knowing the amount of a reactant we start with in a chemical reaction, we can use the balanced equation for that particular reaction to predict how much of the products can be *expected* to be produced (*theoretical* mass) or how much of the other reactant will be needed. Anytime you have information about one substance (given) and want to predict another substance (desired), you can use a balanced chemical equation to relate them.

The map on the next page demonstrates that you can use a balanced equation recipe to determine quantities. Pay close attention to whether you are given the information in mass or moles, and whether your answer is requested in mass or moles. You MUST watch the units on your numbers. The "stoichiometric link" lets you convert from moles to moles (NOT mass to mass directly).

Use the steps and map on the next page to help solve problems in this Unit J

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Steps in a Stoichiometry Problem:

1. First and foremost, you need a balanced equation.

Using dimensional analysis you will write one dimensional analysis that will have several steps (or parts) to it.

2. determine moles of the given substance
3. convert moles of substance given to moles of substance desired by multiplying by the "stoichiometric **LINK**"
4. convert moles of the desired substance to units requested in the problem.

A "Map" to Help with the Steps Above:

mass of A	*convert to*	moles of A	**LINK from A to B**	moles of B	*convert to*	mass of B
"how much"		**"how many"**	use coefficients from the balanced equation	**"how many"**		"how much"

the **LINK** is a ratio using the coefficients from the balanced equation.

$$\frac{\textit{coefficient of desired substance}}{\textit{coefficient of given substance}}$$

When working stoichiometry problems: When in doubt, change to moles.

Where does this weird word "stoichiometry" come from??

Stoichiometry – using quantitative relationships represented by chemical reactions

From Greek : → stoicheion = element → stoichiometry = "element measure"
metron = measure