Stoichiometry

A balanced chemical equation provides the same kind of quantitative information that a recipe or materials list does.

For example, the components to a tricycle would be the frame [F], the seat [S], the wheels [W], the handlebars [H], and the pedals [P]. From materials to production would be like going from reactants to products.

$$F + S + 3W + H + 2P \longrightarrow FSW_3HP_2$$

Using Balanced Chemical Equations

Chemists use balanced chemical equations as a basis to calculate how much reactant is needed or product is formed in a reaction.

This can be done to save time and money depending on what is being produced.

The calculation of quantities in chemical reactions is a subject of chemistry called **stoichiometry**. Calculations using balanced equations are called stoichiometric calculations.

Example

In a 5 day work week, Tiny Tyke is scheduled to make 640 tricycles. How many wheels should be in the plant on Monday morning to make these tricycles?

Interpreting Chemical Change

Ammonia is widely used in fertilizers. The formation of ammonia is

$$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$$

A balanced chemical equation can be interpreted in terms of different quantities, including numbers of atoms, molecules, or moles; mass; and volume.

Number of Atoms : At the atomic level, the number and type of atoms before the reaction are accounted for after the reaction.

Number of Molecules : The ratio's formed by the balanced chemical equations can be scaled to a larger number while still making the same compound. Because these numbers are quite small, Avogadro's number can be used to scale them to larger values.

Moles : The number of moles in a reaction are the coefficients. The total number of moles in the reactants *do not* equal the total number of moles in the products.

Mass : A balanced chemical equation obeys the law of conservation of mass. The number of grams in the reactants equals the number of grams in the products.

Volume : If we can assume standard temperature and pressure (STP), then we can use 22.4L as the volume of 1 mol of any gas.

Mass Conservation in Chemical Relationships

Mass and atoms are conserved in every chemical reaction.

However, molecules, formula units, moles, and volumes are not always conserved (although they can be)

Example

Hydrogen sulfide, which smells like rotten eggs, is found in volcanic gases. The balanced equation for the burning of hydrogen sulfide is:

$$2H_2S(g) + 3O_2(g) \longrightarrow 2SO_2(g) + 2H_2O(g)$$

Interpret this equation in terms of

a) numbers of representative particles and moles.

b) masses of reactants and products.

Try questions 1-10 on pages 355-358