Backyard Ballistics Teachers Guide

Lesson Plan: Stoichiometry and the Carbide Cannon

Objective:

The word stoichiometry derives from two Greek words: stoicheion (meaning "element") and metron (meaning "measure"). Stoichiometry deals with calculations about the masses (sometimes volumes) of reactants and products involved in a chemical reaction. It is a very mathematical part of chemistry. The objective of this lesson plan is to show the application of stoichiometry to real problems.

Concepts

Acetylene (ethyne) gas is commonly generated by reacting calcium carbide with water. The chemical equation for this reaction is:

$CaC2(s) + 2\ H2O(l) \rightarrow Ca(OH)2(aq) + C2H2(g)$

Stoichiometry is the study of the proportions in which elements combine into compounds. Stoichiometry problems are known as weight and balance problems because their solutions require figuring out simple ratios to determine the weights of the chemicals that are both used and left.

There are five steps involved in solving stoichiometry problems:
1. Write and balance the chemical equation.
2. Determine the molecular weight of each compound or element in the equation.
3. Multiply the molecular weights by their respective coefficients and write the products under the formulas.
4. Write the given weight data under the molecular weights calculated in step 3.
5. Use simple ratios to fill in missing information.

As an example of working with stoichiometry problems, you can calculate the amount of acetylene produced from 2.5 grams of Bangsite (powdered calcium carbide), and then check our results with the carbide cannon described in the book Backyard Ballistics, by William Gurstelle.

First write the balanced chemical reaction:

	CaC2 (bangsite)	+	2 H2O	-->	Ca(OH)2	+	C2H2 (acetylene)

Molecular weights: (from handbook)	(64)	(32)	(40)	(26)
Given information	2.5 grams			?

The ratio used is: C2H2/CaC2 = 26/64 = ?/2.5 grams so, ? = 1 gram of acetylene produced.

Field Work

Build the carbide cannon as described in chapter 10 of Backyard Ballistics (Chicago Review Press, 2001). Place one gram of bangsite in the loader arm of the Carbide Cannon and ignite. Enjoy the loud report!

Chemical handbooks show that the energy content of acetylene is 46 BTU's per gram. So, when the 2.5 grams of Bangsite reacts with water to produce a single gram of acetylene, the amount of energy produced in the combustion chamber of the carbide cannon when the gram of acetylene is burned is 46 BTU's. A rule of thumb is that one BTU is the equivalent of the energy released when a single match head is ignited. So, we are releasing the same amount of energy as 46 matches or just more than two match books at once!

Backyard Ballistics (ISBN: 1556523750) is available from most bookstores, online, and from the publisher
Sales: orders@ipgbook.com