Science: Chemistry

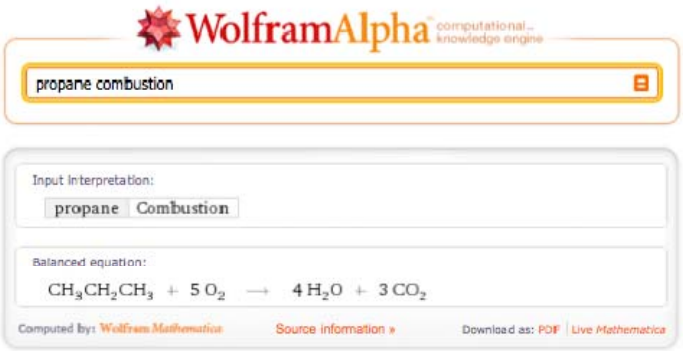
Stoichiometry

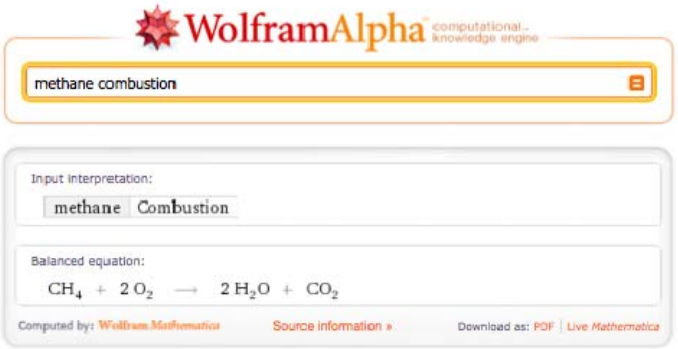
Objectives

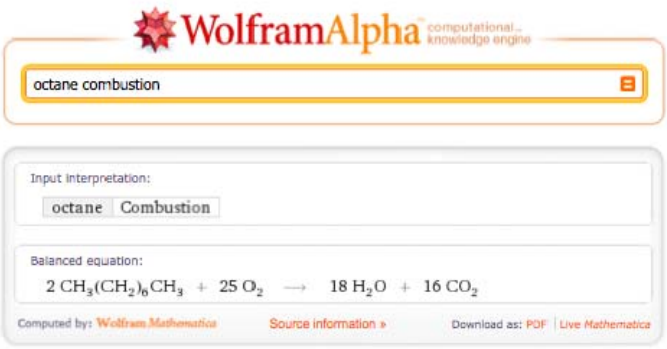
Students will be able to:
- Research the chemical formulas for various compounds.
- Balance equations of chemical reactions.
- Determine limiting reactants and calculate theoretical yield of a reaction.

Warm-Up

Ask students to identify some everyday chemical reactions and the reactants and products involved in each. After discussing a few examples (acids neutralizing bases, etc.), ask students what is consumed and produced by the burning of propane for cooking or heating homes. Check W|A to confirm their answers, and look up several more combustion reactions.



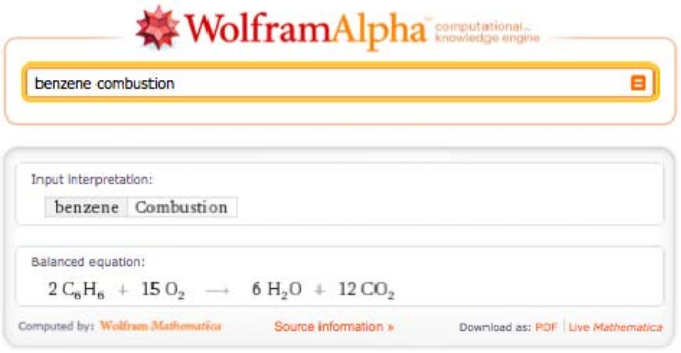




Lesson

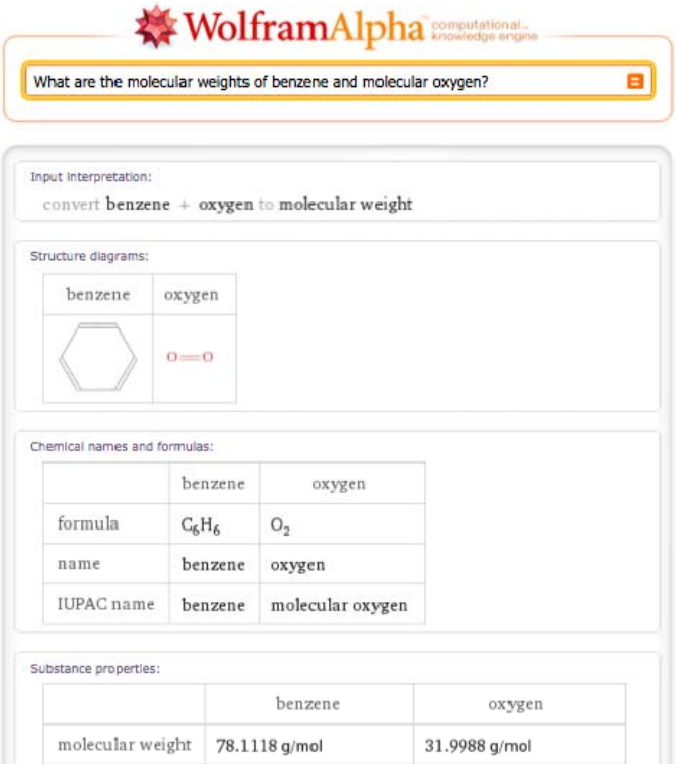
• In each of the combustion reactions shown above, it should have been easy for students to identify the reactants (diatomic oxygen and some form of hydrocarbon) and products (water and carbon dioxide). Now ask students why there are different coefficients in front of each compound in each reaction; write the equation for the propane reaction without these coefficients and ask students if they can spot any problems. Remind students of the law of conservation of matter. Are the same numbers of atoms present before and after the chemical reaction?

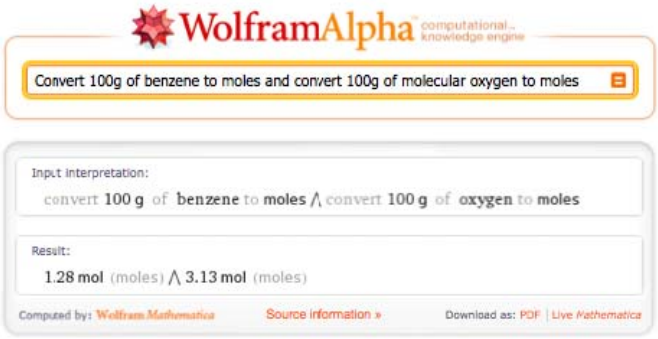
• Explain the concept of a balanced equation, and ask students to write and balance the equation for the combustion of benzene, C_6H_6. Check solution with W|A.



• Ask students how much water and carbon dioxide would be produced by burning 100 grams of propane in a furnace containing 100 grams of oxygen. Discuss the ratios between molecules of different compounds in the balanced equation. Introduce the concepts of molar or molecular masses and Avogadro's number.

• Ask students to look up and calculate the molar or molecular masses of benzene, oxygen, water, and carbon dioxide, and determine the number of moles of benzene and oxygen present within the furnace. Check answers with W|A (be sure to note the distinction between atomic oxygen, O, and molecular oxygen, O_2).





• Ask: If benzene and oxygen molecules are supposed to combine in a ratio of 2 to 15 as our balanced equation indicated, but the actual ratio of benzene to oxygen molecules in our furnace is 1.28 to 3.13, will all the benzene be consumed? Will all the oxygen be consumed? Explain the concept of a limiting reagent to students, and show how W|A can calculate limiting reactants and the expected yield of a reaction.

Closing

• Ask students to try answering the following chemistry inputs with W|A: "How many moles are in 20 gallons of octane?" "3D structure of benzene vs. octane" "What is the molecular weight of acetaminophen?" After allowing students to explore these and other possibilities, assign students to think up a real-world stoichiometry problem and solve it using W|A.

Demonstrations

Junk Food Molecules

Formulas and Structures for Some Simple Molecules

Chemical Compound Class Browser