Serious Stoichiometry

Summary

Students will perform a lab to observe a chemical reaction. One reactant is weighed and one product is isolated, allowing students to determine both a theoretical mole ratio (using stoichiometry) and an experimental mole ratio.

Time Frame

1 class periods of 90 minutes each

Group Size

Small Groups

Materials

- student sheet
  (attached)
  3 M HCl (about 20 mL per lab group)
  baking soda (NaHCO3) (about 4 g per group)
  scale (must measure to two decimal places)

Each group needs:

  dropper
  2 test tubes
  Bunsen burners (one per group)
  tongs

Background for Teachers

This lab could be easily extended to have students calculate a theoretical yield and compare to their actual yield to obtain a percent yield. I chose to make this a simple introduction and leave these steps out.

Safety considerations:

Use safety goggles and aprons. Be careful with the HCl, obviously. Ideally, the product left in the test tube will be salt water…perhaps slightly acidic if students overshoot the stoichiometric point. The huge safety consideration with this lab is that when heating the products, the salt water mixture frequently "bumps" out of the test tube. Remind students about heating test tubes pointing AWAY from people, and have the exercise caution in pulling the tube away from the flame as soon as it starts to boil, then carefully putting it back in again. If this is a huge concern, you can have students set aside their test tubes to evaporate for the next class period, and measure the salt produced then.

Student Prior Knowledge

Students need to know some basic stoichiometry, especially mole ratios. They should also be familiar with the terms: products and reactants, exo- and endothermic.

Instructional Procedures

Before class, set out scale(s) and containers of baking soda and HCl. Have at least one Erlenmeyer flask of HCl for every 2 groups, as students will be adding HCl drop-wise to their baking soda.

In class, pass out the student sheet. Read the background together, concentrating on the equation. Explain that they will be adding HCl to baking soda. Have them look at the equation

and try to tell you what they will see in their test tubes. (They should recognize that CO2 is a gas, so they should probably see bubbles.) Have them tell you what will be left in their test tube when they are done. (The CO2 will dissipate, leaving salt water.) Can we measure that as a product? (No…two chemicals…get rid of the water by heating or evaporating, leaving just the salt.)
Explain to students the difference between an experimental yield (measured in an experiment) and a theoretical yield (calculated). Explain that you will measure your baking soda initially, and that will be your "given" for both the experimental and theoretical yields.
Discuss possible errors (test tube not dry initially, so mass inflated; adding excess HCl so mass of product inflated; salt water bumping out when heating so mass of product decreased, etc.)
Point out that if they use more than a couple of grams of baking soda that they will be here all week adding HCl and waiting for the resulting water to boil off.

Bibliography

Lesson Design by Jordan School District Teachers and Staff.

Authors

Utah LessonPlans