Formation of Barium Iodate

Concepts:

Balancing equations, stoichiometry, limiting reagents

Use the following recommendations to increase the challenge difficulty for your students

Short-on-time Inquiry Lab:

In this lab students are evaluating limiting and excess reactants. They are mixing barium chloride and potassium iodate together to produce barium iodate, a white solid. Different amounts of barium chloride are added while the volume of potassium iodate is held constant. Once the precipitate settles, students test the supernatant of each mixture for excess. They will then determine which reactant is limiting, and which is in excess for each of the five mixtures. (30 min.)

Guided Inquiry Lab:

The first part of this lab is experimentally the same as the short version. The second part holds the barium chloride volume constant and varies the amount of potassium iodate. The same series of experiments are carried out. Students use the molar ratio of the components to compare the two parts and make their determination of which reactant is limiting and which is in excess. (50 min.)

Open Inquiry Lab:

For this version students are asked to come up with their own method to empirically prove the stoichiometric ratio of barium chloride to potassium iodate. The first part of the lab is the same experiment described in the short-on-time version. In the second part of this lab students should design a procedure that is very similar, if not the same, as what is presented in the second part of the guided version. They will hold the barium chloride volume constant and vary the volume of potassium iodate. (50–90 min.)

Advanced Inquiry Lab:

The first two parts of this lab are experimentally the same as the guided version. For the third portion of this lab, students are no longer holding either reactant constant. The final volume remains the same at 10 mL, but the volume of barium chloride and potassium iodate are both varied. Students will use stoichiometry calculations to determine which reactant is limiting and which is in excess. (60–90 min.)

Outcomes:

The importance of stoichiometry calculations is the primary focus of this lab. Students will use different reactant volumes to evaluate limiting and excess reagents. They will see that one single reactant is not always limiting. The molar ratio between the reactants is what determines whether one is limiting and the other is in excess. This lab will also help students understand the difficulty in achieving perfect molar equality between the reactants. There is generally always an excess and limiting reactant. But with careful calculations that excess can be minimized.

Associated Phenomena:

What can make a recipe fail?

Standards

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations and designing solutions	HS-PS1.B: Chemical Reactions	Energy and matter

Performance Expectations

HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.