ScholAR™ Chemistry

AP Chemistry

Mole Ratio of Reactants

Introduction

When a chemical equation for a reaction is balanced it provides the mole ratio of reactants and products. When the formulas of the reactants and products are known, the equation for the reaction can be readily balanced and the ratios calculated. When the formulas of the products are not known, the equation cannot be balanced and experimental measurements must be used to find the mole ratios.

Using the method of continuous variation, two solutions are combined in various volume ratios. In order to select the volume ratio that produces the most product or consumes the most reactants, we must find an empirical method which is proportional to the amount of reaction that occurs. This might be volume of gas produced, intensity of color of product produced, or the weight of a precipitate formed. The reaction selected for this experiment is exothermic and the optimum ratio produces the greatest temperature change.

In this experiment the total numbers of moles of reactants are kept constant while varying each reactant. The measurements are made on each different ratio until the optimum ratio, the stoichiometric ratio in the equation, is made which consumes the greatest amount of reactants, produces the greatest amount of product and produces the greatest amount of heat.

Objective

The experiments involve accurate volumetric measurements and monitoring reaction temperatures. The data is collected graphed and analyzed during the lab so that additional measurements may be taken if needed.

Chemicals and Equipment

Materials included in this kit:

5 X 1Lt	O.5M Sodium Hypochlorite solution
5 X 1Lt	0.5M Sodium Thiosulfate solution

1 set of Student study and analysis copy masters
1 Teacher guide

Materials needed but not supplied:

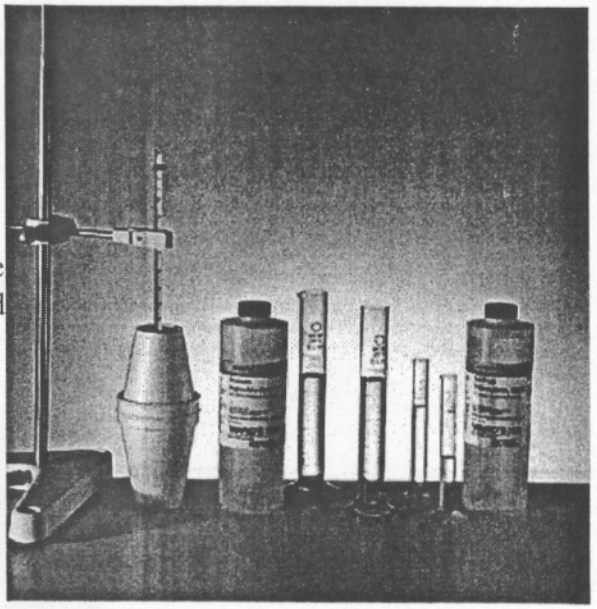
30 each	Styrofoam cups
15 each	50mL glass beakers
15 each	Thermometers
15 each	10 mL graduated cylinders
15 each	50 mL cylinders

Safety equipment required:

Rubber gloves
Apron
Safety goggles
Fume Hood

Safety notes: Sodium Hypochlorite is bleach. Keep off of clothing. All solutions are strong bases that are harmful to skin and eyes. Work under a hood to control fumes.

Procedure



1.) Take temperature measurements of each solution and record a temperature for time T_0.

2.) Pour 5mL of Sodium hypochlorite (NaClO) into a 50mL beaker nested in two Styrofoam cups. Add 45mL of the unknown solution to the beaker. Stir the mixture with a thermometer and record the highest temperature reached. Empty the beaker and rinse with DI water.

3.) Pour 10mL of NaClO and 40mL of the unknown into the beaker and record the highest temperature reached.

4.) Continue with the ratios of:

NaClO	Unknown
20mL	30mL
30mL	20mL
40mL	10mL
45mL	5mL

Chemical disposal: These dilute solutions can be safely flushed down the drain with copious amounts of water.

Discussion and Laboratory Report

1.) Plot the data collected ΔT (°C) versus reactant volumes. The exact mole ratio can be found at the intersection of the two lines.

2.) Explain the method of continuous variations and how you can find the optimum mole ratio of reactants.

3.) How do you correct the ratios if the initial temperatures are not the same for the two solutions?

4.) Calculate the theoretical mole ratios versus the observed` mole ratios. Suggest the sources of error.

5.) Write the net ionic equation for the reaction and calculate the enthalpy change.