Lab: Observing Chemical Change

Integrated Science

Chemistry includes the study of the interactions of atoms. At the molecular level, chemical change means that atomic bonds are being made and/or broken, and the atoms of the reactants are being reorganized into new products. Chemical formulas are the summary of the changes in matter taking place in the reaction. (This is different than a physical change, which is simply a change in state.) Chemical changes are often indicated by observable changes. Note the change that indicates a chemical reaction took place in each.

**Goggles at all times!**

1. **Acetic acid + sodium bicarbonate -> sodium acetate**

 *CH3COOH + NaHCO3→ CO2 + H2O+ CH3COONa*

1. Pour 3 mL of acetic acid solution into a test tube. Use a thermometer to determine the initial temperature. Record.

2. Weigh out 2 g baking soda. Stir into the acetic acid solution. Monitor the temperature of the solution. Record the final (stable) temperature.

1. **Decomposition of hydrogen peroxide**

 *H2O2 -> H2O + O2*

 3. Measure 3mL of hydrogen peroxide into a test tube.

 4. Add 1 mL (?) peroxidase enzyme solution, to speed up the reaction.

5. Bring a glowing splint near the gas bubbles. Oxygen gas is flammable; if present, the splint will re-ignite. Record your observation.

**C. Carbon dioxide in solution is indicated by bromthymol blue**

 *CO2 + H2O --> H2CO3 (carbonic acid)*

6. Fill 2 flasks with 50 mL tap water and add about 10 drops of Bromothymol blue indicator or until both flasks are noticeably colored.

7. Add a piece of dry ice (frozen CO2) to one flask, it will sublimate (change from solid to gas) creating carbonic acid as it reacts with water. Record any color differences.

1. **Formation of barium carbonate solids**

 Na2CO3(aq) + BaCl2(aq) -> BaCO3(s) + NaCl (aq)

 Washing soda + salt Barium carbonate + salt

 8. Measure out 3 mL of washing soda solution into a test tube. Measure out 3mL of BaCl

 salt solution into a second test tube.

 9. Carefully pour the salt solution into the washing soda. Observe and record.

Data Table

|  |  |  |  |
| --- | --- | --- | --- |
|  | Chemical Reaction(label the reactants and the products) | Directions/Amounts | Observed Change-Evidence Reaction Occurred |
| A |  |  |  |
| B |  |  |  |
| C |  |  |  |
| D |  |  |  |

**Teacher Notes**

1. **Temperature Change**
2. **Gas production**
3. **Color Change** (old method: straw, exhale CO2 for a few minutes into the water of one flask)
4. **Precipitation of a solid**

**Blue Bottle Experiment Introduction to Reaction Rates**

**Introduction**

The “blue bottle” reaction is a classic chemistry demonstration. It is often used in general science classes to introduce the roles of observation and hypothesis in the scientific method. The demonstration is used in chemistry classes to illustrate oxidation and reduction reactions, and also to study the rates of chemical reactions.

**Materials**

Dextrose, C6H12O6, 8 g Methylene blue solution, 1% aqueous Potassium hydroxide, KOH, 8 g Water, distilled or deionized

***Safety Precautions***

• Oxidation–reduction

Flask, 500-mL, with cap or stopper to fit Graduated cylinder, 500-mL Weighing dishes, 2

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*Potassium hydroxide is a corrosive solid; it is especially dangerous to eyes and may blister and burn skin. Avoid contact with eyes and skin and clean up all spills immediately. Methylene blue solution is slightly toxic by ingestion. Wear chemical splash goggles and chemical-resistant gloves and apron. Wash hands thoroughly with soap and water before leaving the laboratory. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.*

**Preparation**

To prepare the “blue bottle” solution, add 8 g of potassium hydroxide to 300 mL of water in a 500-mL flask. Stir until the solid is dissolved. Add 10 g of dextrose and a few drops of methylene blue indicator solution. Fill to the 500-mL mark, stopper or cap the flask, and mix thoroughly.

**Procedure**

1. Allow the “blue bottle” solution to stand undisturbed in the stoppered flask until the solution is colorless. This may take a few minutes.

2. Show students the colorless solution, then *gently* shake the flask to obtain the blue color. 3. Wait patiently as the solution turns colorless again. See the *Tips* section for the effect of shaking on the time required for the blue color to disappear.

4. Repeat steps 2 and 3 and ask students to record observations and propose possible tests to explain the colorless–blue– colorless sequence of color changes. The process can be repeated several times over a 10–15 minute period. Periodically remove the stopper to introduce more air (oxygen) into the reaction flask.

5. Discuss factors that might affect the time needed for the blue color to fade. This demonstration can be used as the basis of student-designed kinetics experiments to study the effect of temperature or concentration on the rate of the reaction graduated cylinder

PROCEDURE: 1. Dissolve 4g of KOH into 40mL of water in the beaker 2. Dissolve 4g of glucose into 40mL of water in the flask 3. Add 2-4 drops of methylene blue to the flask 4. Pour the KOH solution into the flask 5. Stopper and wrap parafilm around the stopper 6. Wait for the solution to go clear, then shake

ADDITIONAL COMMENTS: This is a great one to prep ahead of time, then take to lecture. The flask should last for a few shakes. SAFETY: Safety goggles should be worn at all times. KOH can cause burns if handled.

**Part 6: Citric Acid (H3C6H5O7 ) and Baking Soda (NaHCO3)**

The "water" in the first glass is really a solution of sodium carbonate (Na2CO3), also known as washing soda. The carbonate ion causes the solution to be alkaline, that is, it is a weak base that produces hydroxide ions (OH-).

The second glass contains several drops of phenolphthalein indicator. An indicator is a substance that is a different color in acidic solution than it is in basic solution. Phenolphthalein is colorless by itself, but when the alkaline "water" is poured into the glass, it turns pink, giving a solution that looks like a light red wine.

The third glass contains a saturated solution of barium chloride (BaCl2). When the "wine" is poured into the glass, the carbonate ions in the solution react with the barium ions to form barium carbonate (BaCO3), a white solid precipitate. The suspension of white solid in the solution makes it look like milk.

|  |  |  |
| --- | --- | --- |
| “water” | Na2CO3(aq) | CO32-http://www.coolscience.org/CoolScience/KidScientists/arrow_equil.gifHCO3- + OH- |
| “wine” | phenolphthalein indicator | HIn + OH-http://www.coolscience.org/CoolScience/KidScientists/arrow_right.gifIn- + H2O |
| “milk” | BaCl2(aq) | Ba2+ + CO32-http://www.coolscience.org/CoolScience/KidScientists/arrow_right.gifBaCO3(s) |

Washing soda + BaCl2 makes a precipiatate.