

Lab Investigation 6 – Exploration of Chemical Reactions and Using Chemical Reactions

INTRODUCTION - PART I

Chemical reactions can be recognized by color change, the formation of a solid, formation of bubbles, or a change in temperature. Chemists describe these reactions using chemical formulas. You have learned how to write and balance chemical reactions. But if we mix two or more reagents together, how can we determine what products are formed? In this investigation, you will determine the identity of the products that are formed as a result of a chemical reaction.

EXPLORATION OF CHEMICAL REACTIONS

Carry out each of the reactions below. Note what physical states of matter are present in each reaction? Once your team has finished making the initial observations, use the solubility rules and splint tests for gases (see below) to confirm the identity of the various products formed. Write balanced chemical reactions for the six reactions. Identify each reaction as **Oxidation-Reduction, Precipitation or Acid/Base**.

REACTIONS



MATERIALS AVAILABLE FOR USE

Test tubes & Rack

Spatulas

Rubber stoppers w/ vent

Wood sticks

Blue Litmus paper

3 M HCl

0.5 M CaCl₂

0.5 M KNO₃

0.5 M AgNO₃

0.5 M Na₃PO₄

3% H₂O₂

NaHCO₃(s)

Copper metal

Zinc pieces

Test tube with catalyst

SAFETY PRECAUTIONS

CAUTION: Always wear **goggles**.

CAUTION: Handle acid, HCl, with great care.

CAUTION: AgNO₃ (silver nitrate) will stain your skin and clothes brown.

GLOWING SPLINT TEST FOR GASES

Prepare gas testing splint by holding it with tongs in a burner flame; then blowing out the flame to leave a glowing ember at the tip of the splint.

- 1 If the gas is oxygen, insert and quickly remove the glowing splint into the test tube in which the gas was collected. The glowing splint will glow brighter or flame up.

Explanation: Oxygen supports combustion.

- 2 If the gas is hydrogen, a slight explosive popping sound will be heard. This test works best with the splint actually lit and held up to the mouth of the test tube.

Explanation: When hydrogen gas mixes with oxygen in the air, an explosive mixture is formed and is ignited by the burning splint.

- 3 If the gas is carbon dioxide, insert and quickly remove the glowing splint into the test tube in which the gas was collected. The splint will be extinguished.

Explanation: Carbon dioxide does not support combustion.

SOLUBILITY RULES

Mainly water soluble compounds

- Compounds that contain Group 1A cation or NH_4^{1+}
- Compounds that contain NO_3^{1-} , $\text{C}_2\text{H}_3\text{O}_2^{1-}$, ClO_4^{1-} , ClO_3^{1-}
- Compounds that contain Cl^{1-} , Br^{1-} or I^{1-} except for Ag^{1+} , Hg_2^{2+} , Pb^{2+}
- Compounds that contain F^{1-} except for Mg^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Pb^{2+}
- Compounds that contain SO_4^{2-} except Ca^{2+} , Ba^{2+} , Sr^{2+} , Ag^{1+} , Hg_2^{2+} , Pb^{2+}

Mainly water insoluble compounds

- Compounds that contain S^{2-} except those that contain Group 1A or 2A cation or NH_4^{1+}
- Compounds that contain CO_3^{2-} , PO_4^{3-} , CrO_4^{2-} , $\text{C}_2\text{O}_4^{2-}$ except those that contain Group 1A cation or NH_4^{1+}
- Compounds that contain OH^{1-} except those that contain a Group 1A cation or Ba^{2+} , Sr^{2+} , Ca^{2+}

PART II - USING CHEMICAL REACTIONS

Guiding Question

What is the best way to recover silver from aqueous silver nitrate?

INTRODUCTION - PART II

Last week you explored a variety of chemical reactions. It is valuable to know how chemicals react for many reasons; precipitation reactions are used to remove heavy metals from wastewater; and oxidation-reduction reactions are used to recover or plate metals. In both instances, we might want to recover or isolate the precipitate or the metal either for further use or disposal. This week's lab provides the opportunity for you to use many of the skills learned in lab and lecture this semester. You will use your knowledge of chemical reactions and stoichiometry to prepare a specific amount of material.

THE PROBLEM

The second part of this investigation requires you to use your knowledge of chemical reactions from last week to design a procedure to recover silver from an aqueous silver nitrate. You will either use precipitation or oxidation/reduction.

ADDITIONAL MATERIALS AVAILABLE FOR USE

Side-arm filtration flask

Büchner Funnel

Filter paper

50 mL beaker

25 mL & 10 mL graduated cylinders

Tweezers

Tongs

Micro spatula

Watch glass

Stirring rod w/ rubber tip

INTERACTIVE POSTER SESSION

Once your group has completed your work, prepare a whiteboard that you can use to share and justify your ideas. See the handout provided for details on this process.

REPORT

Once you have completed your research, you will need to prepare an *investigation report* that consists of three sections. Your report should answer these questions in 2 pages or less. This report must be typed and any diagrams, figures, or tables should be embedded into the document. Generally, you need one page for the first two sections and the second page for the third section. Each section should provide an answer for the following questions.

Section 1: What concept were you investigating, and how does it relate to the guiding question?

Section 2: How did you go about your work, and why did you conduct your investigation in this way? **Discuss your reaction design and show your calculations.**

Section 3: What is your argument? Compare percent recovery for the two methods of silver recovery as well as percent recovery of different teams.

The third section is where you not only present your data, but **use** the values you obtain as evidence in your reasoning. Be sure to write in a persuasive style; you are trying to convince others that your explanation is acceptable or valid! Statements like, “see data table for values” are not acceptable!

EXPERIMENTAL DESIGN

Please print the worksheet for this experimental design phase of the investigation.

You will be given 5.0 mL of 0.500 M AgNO₃ solution. Design an experiment to recover all of the silver from the solution.

- Assigned Chemical Reaction
- Calculations for each reactant
- Outline of the procedure you plan to follow