Lab: Silver Test Tube Holiday Ornament

FOR THE STUDENT

Summary
In this lab, students will carry out a reduction reaction in order to create a silver-plated test tube that can be used as a holiday ornament.

Grade Level
High school

Objectives
By the end of this lab, students should be able to

- Carry out a reduction reaction in order to produce a silver-plated test tube using proper lab techniques.
- Explain the process of reduction of silver nitrate.

Chemistry Topics
This lab supports students’ understanding of

- Chemical Reactions
- Reduction
- Classification of Reactions
- Organic Chemistry

Time
Teacher Preparation: 45 minutes
Lesson: 50 minutes

Materials (per group)

- 50mL beaker
- 0.1M silver nitrate (AgNO₃)
- 15M ammonium hydroxide (NH₄OH)
- 0.8M potassium hydroxide (KOH)
- Test tube
- Test tube stopper
- 0.5M dextrose (C₆H₁₂O₆)
- 10 ml graduated cylinder
- Distilled water
- Dropper vial/bottle

Safety

- Wear an apron, gloves and safety goggles when conducting this investigation.
- Take extreme care when handling concentrated ammonium hydroxide, as it will cause severe burns if it is spilled on your skin. Gloves must be worn at all times.
- Ammonium hydroxide (NH₄OH) should only be handled while working inside the fume hood. Ensure that the fume hood sash is closed as much as possible, as the fumes are extremely dangerous.
- Be sure to explicitly inform students to exercise extreme caution when using 15M ammonium hydroxide. See Teacher Notes for recommended preparation.
- When working with bases, if any solution gets on your skin, alert your teacher and thoroughly flush your skin with water immediately.
• Students should wash their hands thoroughly before leaving the lab.
• When students complete the lab, instruct them how to clean up their materials and dispose of any chemicals.
• Refer to Safety Data Sheets listed in the Materials section for additional safety precautions for each chemical used in this lab.

Teacher Notes
• Students should read through all procedures before beginning the lab. Timing is an important part of getting favorable results.
• It is essential that the test tubes used are clean. Rinse with tap water and then distilled water prior to using in the lab.
• Grouping students in pairs or small groups is recommended for this lab.
• It would be helpful for teachers to prepare small volume samples of the 15M ammonium hydroxide in secure glass screw cap dropper vials, for student use in a fume hood. Ensure that students only use this in a working fume hood as vapors are extremely dangerous, and be certain that students are also wearing gloves. This is associated with procedure step 2.
• If your classroom only has one fume hood, allow enough time for each group to safely use the NH₄OH solution in the fume hood. Make sure these droppers do not leave the fume hood during the lab.
• Teachers may need to demonstrate proper use of the fume hood prior to the lab, with specific emphasis on keeping the sash lowered while completing necessary procedural steps.

FOR THE STUDENT

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Background
In this lab, a silver mirror will form on the inside of a test tube when a thin film of metallic silver deposits on the inner surface of the tube. The silver metal is formed by the reduction of silver nitrate by an aldehyde (dextrose). When an aldehyde is combined with an ammonia complex of silver in a basic aqueous solution, the aldehyde slowly reduces the complex to silver metal. When the surface of the glass is clean and wet, the silver will adhere to the glass, forming a mirror.

Purpose
You will complete a reduction reaction in order to make a silver-plated test tube that can be used as a holiday ornament.

Materials
• 50mL beaker
• 0.1M silver nitrate (AgNO₃)
• 15M ammonium hydroxide (NH₄OH)
• 0.8M potassium hydroxide (KOH)
• Test tube
• Test tube stopper
• 0.5M dextrose (C₆H₁₂O₆)
• Distilled water
• 10 ml graduated cylinder

Safety
• Wear an apron, gloves and safety goggles when conducting this investigation.
• Take extreme care when handling concentrated ammonium hydroxide (NH₄OH), as
it will cause severe burns if it is spilled on your skin. Gloves must be worn.
• You must wear gloves and only handle the ammonium hydroxide (NH₄OH) while working inside the fume hood. Ensure that the fume hood sash is closed as much as possible, as the fumes are extremely dangerous.
• When working with bases, if any solution gets on your skin, alert your teacher and thoroughly flush your skin with water immediately.
• Wash your hands thoroughly before leaving the lab.
• Clean up your materials and dispose of any chemicals according to your teacher’s instructions.

Procedure
Part 1:
1. Obtain a 50ml beaker. Using a graduated cylinder, measure and add 6 mL of silver nitrate (AgNO₃).
2. Take the beaker to the fume hood. You will find a dropper bottle containing 15M NH₄OH. You must put on gloves before handling the NH₄OH solution. Carefully add drops of concentrated ammonium hydroxide, NH₄OH, until a cloudy precipitate appears. Continue adding drops of the ammonium hydroxide until the precipitate disappears.
3. Return the dropper to the bottle and secure it before moving on to the next step.
4. Using a graduated cylinder, measure 3 mL of potassium hydroxide (KOH) and add it to the solution. A brown precipitate may form.
5. If a brown precipitate forms, return to the fume hood, following the same safety precautions outlined in step 2, and slowly add additional drops of ammonium hydroxide until the brown precipitate disappears.
6. At this point you should have about 10 mL of clear liquid in your 50ml beaker. This contains your silver in the form of [Ag(NH₃)₂]⁺. Set this aside and continue to part two.

Part 2:
1. Obtain a clean test tube for silver plating.
2. Read this section completely before proceeding further. Quickness and accuracy is crucial for success.
3. Obtain 2 mL of dextrose in a graduated cylinder
4. Fill your test tube for plating three-quarters full with hot water.
5. The next two steps need to be done in quick succession. Pour the hot water out of the test tube and pour 2 mL of dextrose into the hot test tube; swirl to coat evenly.
6. While the test tube is hot and the dextrose is covering the inside of the test tube, quickly pour the solution from your beaker created in part 1 (the silver mixture) into the hot dextrose test tube. Fill to about three-quarters full. Stopper and immediately agitate the test tube using a gentle rolling/shaking motion.
7. A silver mirror should coat the inside of the test tube. Pour the contents of the test tube down the drain.
8. Gently rinse your test tube with 3 mL of distilled water.
9. Decorate with ribbons to use as a holiday ornament and give it to a loved one if you wish.

Analysis
1. In your own words explain the process of reduction.
2. Explain the process of reduction of silver nitrate during this lab.