ChemisTree: Silver Plated Ornaments

I. **Author:** Abigail King
Date of Experiment: 12/5/23
Date Report Submitted: 12/11 /23
Class: Chemistry

II. **Problem Statement:** The purpose of this lab is to observe the physical properties of silver in both its ionic and metallic form.

III. **Materials and Method**:

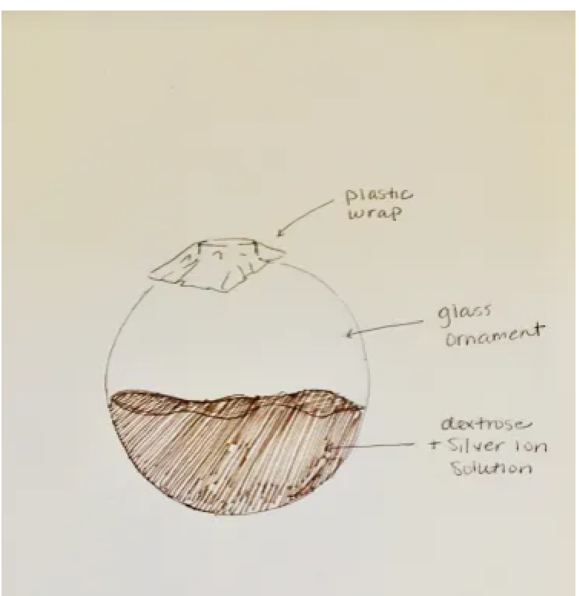
- Glass ornament bulb
- 0.25M dextrose ($CH_2OH(CHOH)_4CHO$) (24.78 g dextrose dissolved in 500mL distilled water)
- 0.80M potassium hydroxide (KOH) (22.44g of KOH dissolved in 500 mL distilled water)
- 0.10M silver nitrate ($AgNO_3$) solution
- Concentrated ammonia (NH_4OH) solution
- Isopropyl alcohol
- 1 M hydrochloric acid (HCl) solution
- Nitrile gloves
- Lab coat
- Goggles
- Parafilm
- 10 mL Graduated cylinder
- 25 mL graduated cylinder x2
- 1 mL disposable volumetric plastic micropipette
- Small beakers
- 1 L beaker (for waste)

First, we removed the metal ornament hanger and cleaned the ornament with distilled water to remove any excess ions. The ornament was set aside on a 250 mL beaker. 15 mL of potassium hydroxide (KOH) solution was added to a 25 mL graduated cylinder and set aside. Next, we added 20 mL of the silver nitrate solution ($AgNO_3$) into a 250 mL beaker, which we first cleaned with distilled water. Then, using the pipette, ammonia solution (NH_4OH) was added one drop at a time while simultaneously, gently swirling the beaker. The ammonia was added until it turned black, then clear. As soon as the solution turned clear, the addition of ammonia was immediately ceased. The potassium nitrate, which was previously mixed and set aside, was then added to the beaker containing silver nitrate and ammonia solution. The solution returned to its black color, which was when we then added more ammonia solution until the solution became clear again (avoiding an excess of ammonia solution). Lastly, we poured this final solution into the glass ornament and added the 35mL of dextrose solution. Then, we covered the opening of the ornament with a piece of plastic wrap and shook/swirled the ornament for approximately 3 minutes. Finally, we poured off the excess liquid which was grayish in color.

IV. Results:

When the dextrose and solution containing the silver ions combined, it turned a brownish/black color. When the solution was swirled around, the ornament gradually then suddenly became extremely shiny and metallic. The inside of the ornament was coated in a thin layer of silver deposits. See image 1

Image1:



V. Conclusion:

When the silver nitrate and ammonia combine to form the new, clear solution, silver diamine complex is formed. This is a reagent, more specifically, "Tollens' reagent". This reagent contains silver diamine ion ($Ag(NH_3)^{2+}$). This oxidizes with the dextrose to form carboxylate ions ($CH_2OH(CHOH)_4CHO$). During this reaction, the dextrose is oxidized which means it loses electrons. Those electrons are then pushed onto the positive silver nitrate ions. The silver changes from a positive ion to its neutral, solid form. This metallic silver then sticks to the ornament. After the metallic silver forms to the ornament wall, dextrose carboxylate ions, ammonia and water are left behind and poured off. And the result: a beautiful, shiny christmas ornament made using some amazing chemistry. See image 2 and 3 (on last page)

Image 2:

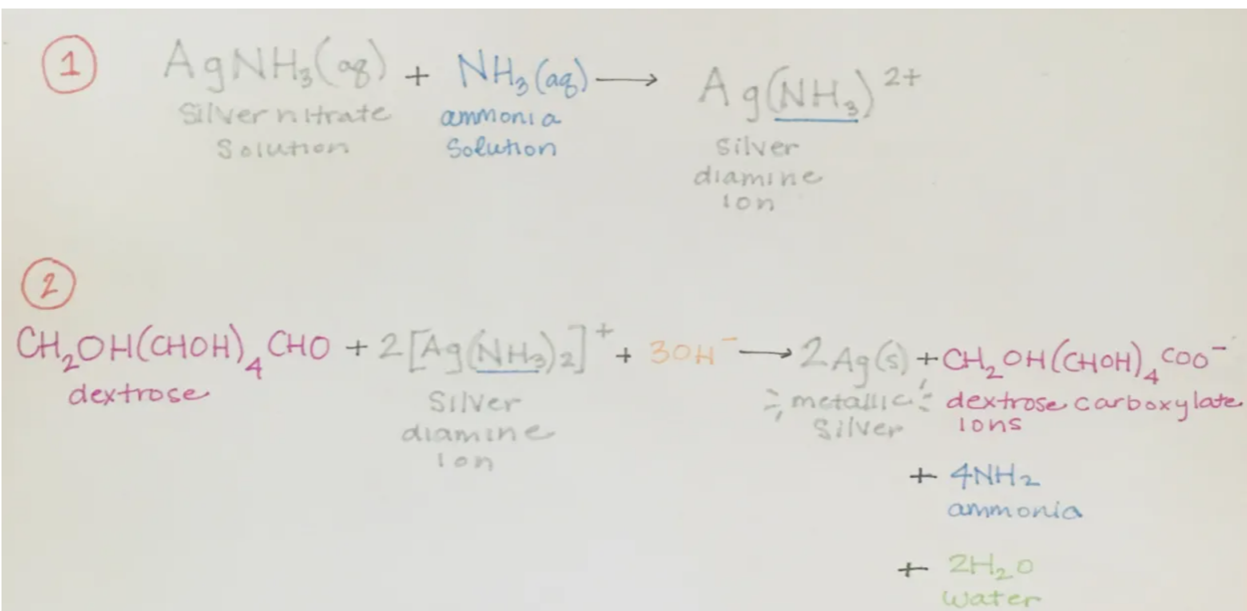
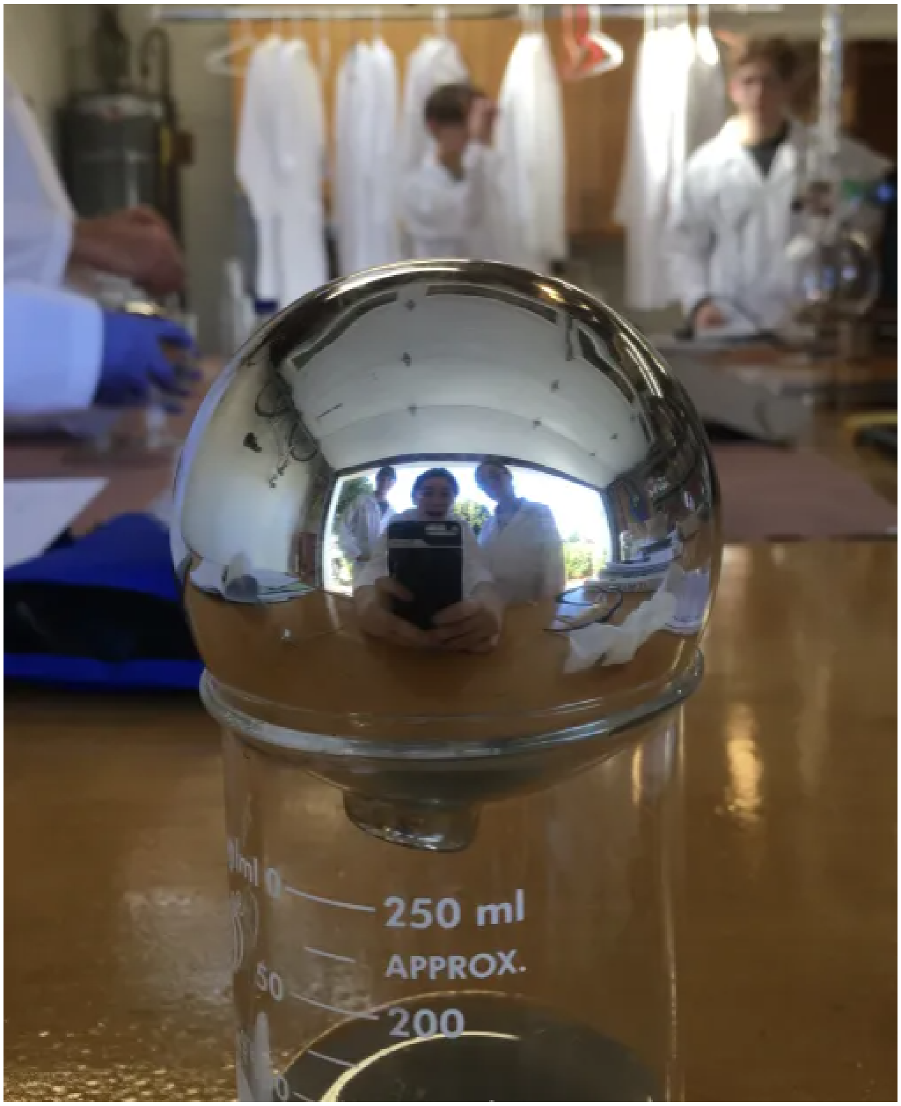


Image 3:



Unit 7: Chemist-TREE Silver Ornament Lab

Author:	Jessica Nottoli
Date of Experiment:	December 5, 2023
Date of Report Submitted:	December 11, 2023
Seminar:	Chemistry

Purpose: To reduce silver ions to metallic silver and deposit it on the sides of an ornament, creating a mirror-like coating.

Materials:

- Dextrose ($C_6H_{12}O_6$)
- Potassium Hydroxide (KOH)
- Silver Nitrate ($AgNO_3$)
- Ammonium Hydroxide (NH_4OH)
- Nitrile gloves
- Lab Coat
- Plastic wrap
- Beakers
- 25 mL graduated cylinder
- 1 L beaker
- One 1-mL disposable volumetric plastic micropipette
- Clean glass ornament bulbs
- 250 mL beakers
- Glass rod
- Scale

Procedure:

We began our Chemist-TREE Silver Ornament Lab by each grabbing a 250 mL beaker to hold the glass ornament bulbs in. 25 mL of dextrose solution was poured into the ornament bulbs. We had to stop the bulb openings with our thumbs and shake the contents over all surfaces to coat the inside of the bulb thoroughly. However, before shaking up the solution, we mixed 3.7 grams of silver nitrate in 217 mL of H_2O in a beaker. We used a micropipette to drop about 6 mL of ammonium hydroxide into the silver nitrate solution and mixed it with a glass rod. The solution began to turn brown then black where all the silver sank to the bottom and after more drops, the solution returned to its colorless form again but with a new silver diamine ionic complex formation [$Ag(NH_3)_2^+$]. The micropipette was switched for a newer one in the middle of the mixing, but this did not have any connection to what happened.

After this test, we grabbed a scale and measured out 22.5 grams of potassium hydroxide and mixed it in 500 mL of water. Then it was added to a silver solution, creating the black AgOH precipitate form. The ammonium hydroxide solution was added with gentle mixing until the solution became clear; no more drops were added than were needed. Ammonium hydroxide is a base, which is a substance that can neutralize the acid by reacting with hydrogen ions like it does in the potassium hydroxide and water. This solution would be used for the bulb after the ornament was sufficiently coated inside by the dextrose solution and the leftover dextrose was disposed of.

35 mL of the silver solution was measured by a graduated cylinder and quickly poured into the glass ornament. Immediately after, plastic wrap was laid over the opening and held down tightly by the thumb and pointer finger. We began mixing immediately. The color change was almost instant, changing from a urine yellow to a clay red to brown to brackish brown/black. After mixing the solution around over all surfaces of the bulb, the solution became reflective and almost instantly turned a mirror-like silver color. After continually mixing for about 5 minutes, the leftover chemicals were disposed of into a beaker. The inside was then lightly sprayed and cleansed in water. The silver ornaments were then laid upside down on their respective beakers to dry until the end of the class.

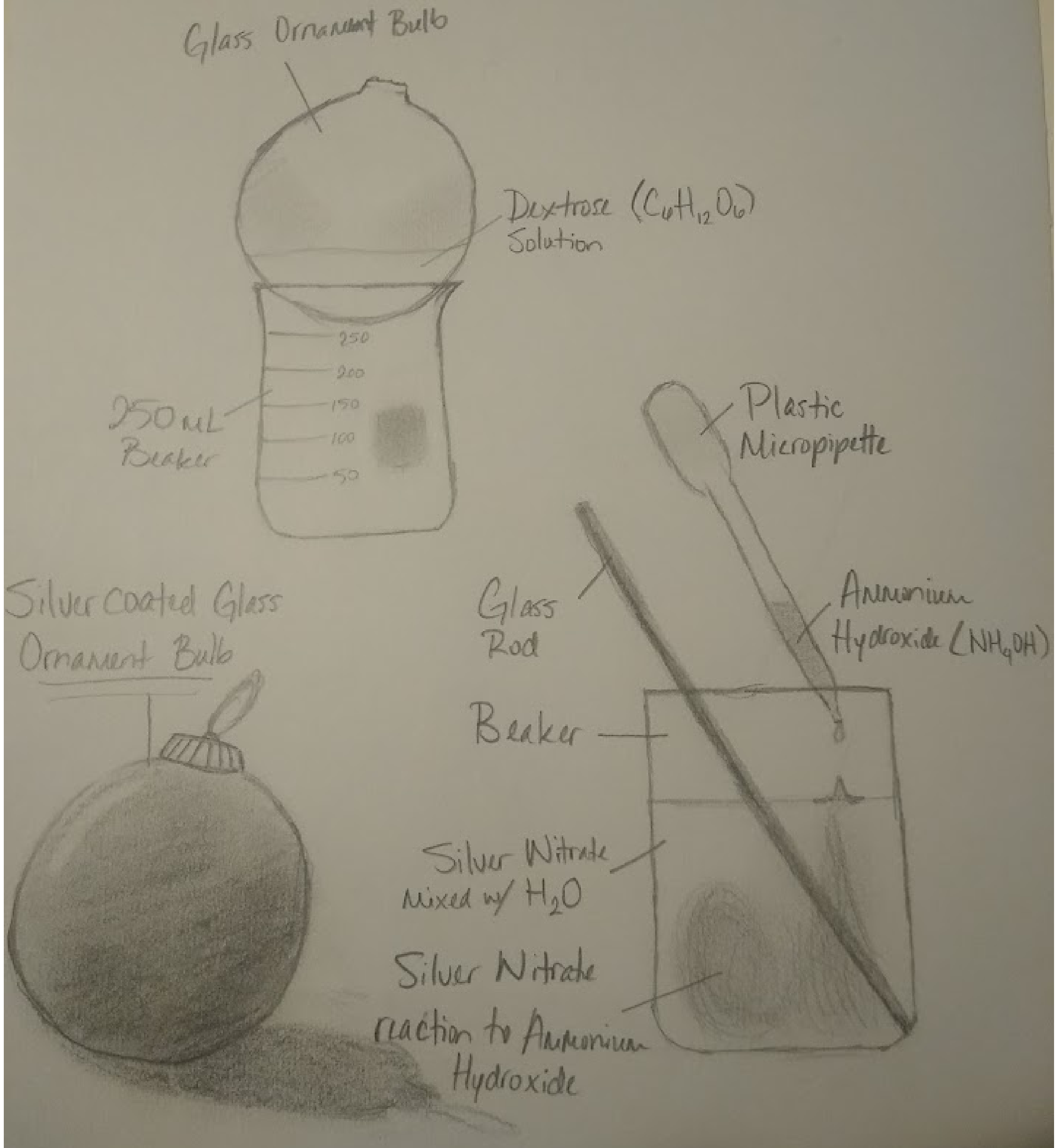
Chemical Equations:

$CH_2OH(CHOH)_4CHO$ + $2[Ag(NH_3)_2]^+$ + $3OH^-$ —>
(Dextrose) (Silver Diamine Ion) (Hydroxide Ion)

$2Ag(s)$ + $CH_2OH(CHOH)_4COO^-$ + $4NH_3$ + $2H_2O$
(Silver) (Dextrose Carboxylate Ion) (Ammonia) (Water)

Sketches:

Chemist-TREE Silver Ornament Lab



Conclusion: In this lab, we have created our own silver christmas tree ornaments by chemistry and its chemical reactions. How they chemically did this is thus explained. The silver diamine ion, a very weak oxidizing agent, oxidizing is to chemically combine with oxygen, is used to oxidize the aldehyde functional group (-CHO) of dextrose, a sugar, to a carboxylate ion (COO-). An aldehyde is an organic compound in which the carbonyl group is attached to a carbon atom at the end of a carbon atom. In the -CHO and COO- you can see the oxidation working by the gain of oxygen and loss of hydrogen. In the equation, all these chemical reactions produce the dextrose ion, and create water from the lost hydrogen in dextrose, and form ammonia because of the separation of the silver that coats the ornament. It is because of the first coating of dextrose solution that the silver was able to stick because when the surface of the glass is clean and wet, the silver metal adheres to the glass, forming a highly reflective surface. It is because dextrose is a form of glucose that it can reduce silver nitrate to form silver due to the fact glucose has a free -CHO group and hence has a reducing power. This concludes my lab on silver ornaments.

Silver Christmas Ornaments Lab Report

I. Author: Judy Zhu
Date of Lab: 12/5/2023
Date Due: 12/12/2023
Class: AP Chemistry

II. Attempting to Silverplate Christmas Tree Ornaments.

III. Materials & Methods:

22.5 g of dextrose in 500 mL of distilled water
22.5 g of KOH in 00 mL of distilled water
3.7 g of $AgNO_3$ in 217 mL of distilled water
12 mL of NH_4OH
1 glass Christmas Tree Ornament with volume of 250 mL
4 x 500 mL-erlenmeyer flasks
1 250 mL-erlenmeyer flask
1 stirring stick
1 magnetic mixture
1 pipette
1 graduated cylinder
Parafilm
HCl
Scale

First, calculate the amount of dextrose, KOH, and $AgNO_3$ needed to mix in the set amount of water (calculations below). Mix 22.5 g of dextrose into 500mL of water in a beaker, 22.5g of KOH in water using the magnetic stirrer in a beaker, and add 3.7g of $AgNO_3$ to 217 mL of water in a 500 mL beaker. Then, gently mix the $AgNO_3$ solution while adding in the NH_4OH solution using a pipette. Add until the solution turns from gray/back to clear. Add 163 mL of KOH to the $AgNO_3$ solution, and add NH_4OH using the pipette and stir until the solution becomes clear. Then, measure (using the graduated cylinder) 30 mL of dextrose mixed with water into the ornament, and cover the top with parafilm and shake the ornament to coat the inside with dextrose. Measure 35 mL of KOH and $AgNO_3$ solution and pour it into the ornament using the graduated cylinder.Cover the opening with parafilm and shake until the entire inside is covered with silver. Pour the remaining liquid out into a 500 mL beaker and wash the inside with water. Neutralize the waste liquid with HCl.

Equation:

$CH_2OH(CHOH)_4CHO=2[Ag(NH_3)2]+3OH^- \rightarrow 2Ag(s)+CH_2OH(CHOH)_4COO-+2H_2O$

Chemical Calculations:

Dextrose Calculations

moles = M (molarity) × V (volume)

$\Rightarrow m = 0.25\ m/L \times 0.5\ L$

$\Rightarrow m = 0.125$

$mol \times 180.156 = 0.125 \times 180.156 \approx \boxed{22.5\ grams}$ (every 0.5 L)

KOH Calculations

$mol = M \times V$

$\Rightarrow M \times V = 0.8\ mol/L \times 0.5\ L = 0.4\ mol$

$mol \times 56\ g/mol = 0.4\ mol \times 56\ g/mol = \boxed{22.4\ grams}$ (every 0.5 L)

(used 22.5 in experiment)

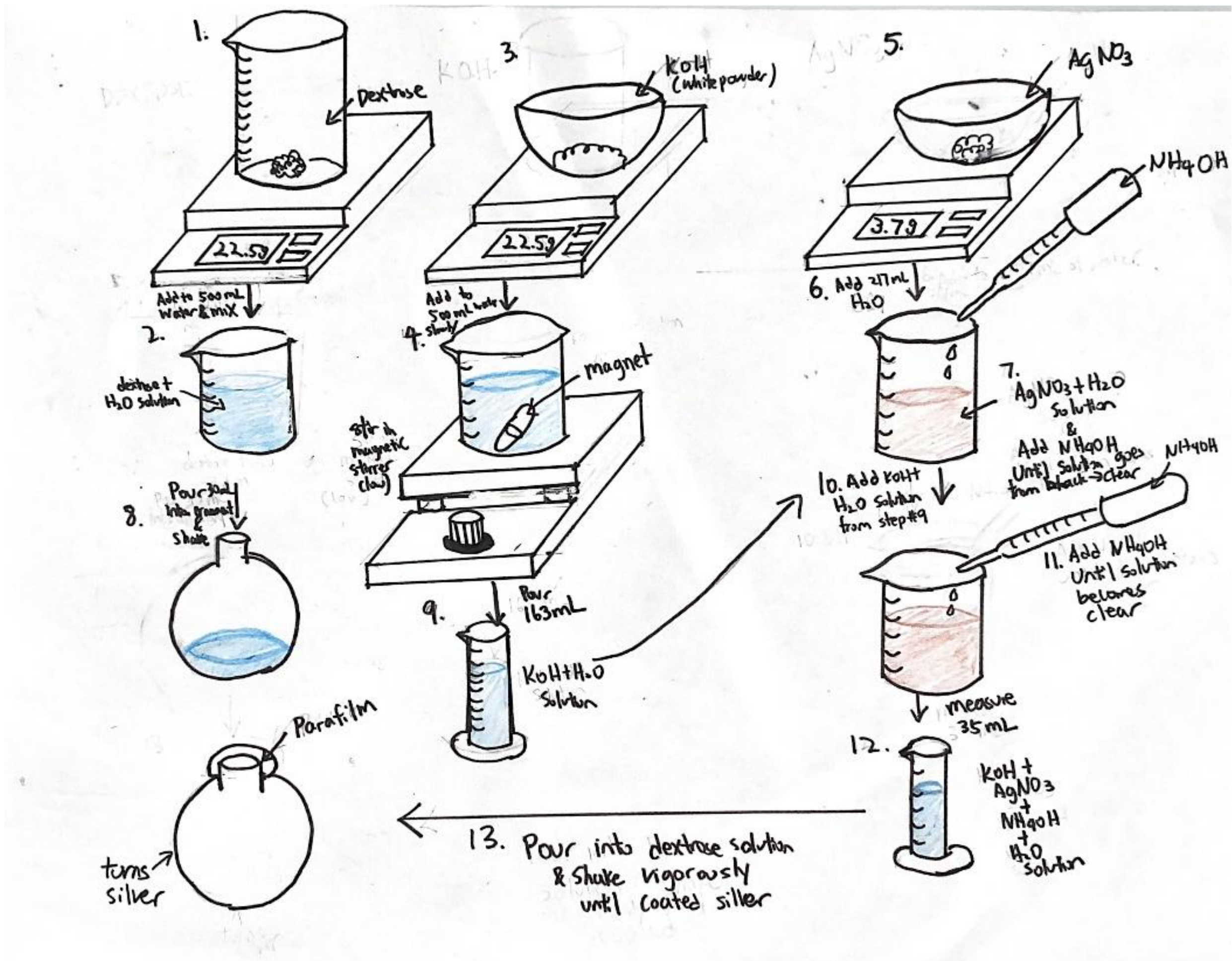
$AgNO_3$ Calculations

$mol = M \times V$

$\Rightarrow M \times V = 0.1\ mol/L \times 0.217\ L = 0.0217\ mol$

$mol \times 170\ g/mol \approx 0.0217 \times 170 \approx \boxed{3.7\ g}$

Lab Setup:



IV. Results

When the NH_4OH was added to the $AgNO_3$ solution, a black precipitate (AgOH) formed. After a while the solution turned clear because a silver diamine ionic complex formed. When the KOH and $AgNO_3$ solution was added to the dextrose solution, it immediately turns yellow then black. After shaking it for a while, the inside of the bulb was coated in silver. The remaining solution (which was not turned into silver) had a gray color and some black precipitates within it. When mixed with HCl (to neutralize the solution), silver chloride formed and sank to the bottom of the solution.

V. Conclusion

In conclusion, I learned that it is possible to silverplate ornaments using chemistry. I also learned that NH_4OH makes the solution basic and turns a solution black then clear, and that KOH is a highly corrosive molecule and generates heat when mixed with water. I discovered that dextrose reduces and spreads the solution, and we were also able to observe the reactions between the different solutions.