Nitrogen Compounds Lab

I. **Author:** Abigail King
Date of Experiment: 11/13/23
Date Report Submitted: 11/20/23
Class: Chemistry

II. **Problem Statement:** The purpose of this lab is to demonstrate the properties of compounds containing nitrogen, specifically ammonia

III. **Materials and Method**:
Erlenmyer flask
Glass bowl
Clamp
One-hole stopper
Two-hole stopper
Straight glass tube
90° glass tube
Graduated cylinder
Dropper
Large apparatus x2
Water
Ammonium Hydroxide (NH_4OH)
Nitric acid (HNO_3)
Copper wire (Cu)
Hydrochloric acid (HCl)
Phenolphthalein

1) **Making Nitrogen dioxide (NO_2)**

We placed a piece of copper wire (Cu) in a glass bowl containing nitric acid (HNO_3) and let it sit for several minutes.

IV. Results: The solution in the glass bowl turned a strong bluish green color. It also fizzed around the copper wire. A strong odor was also produced.

V. Conclusion: The two reacted, forming copper nitrate ($Cu(NO_3)_2$) and releasing nitrogen dioxide (NO_2). The copper nitrate gave off the bluish green color and nitrogen dioxide was the source of odor. (see image 1 and 2)

Image 1:

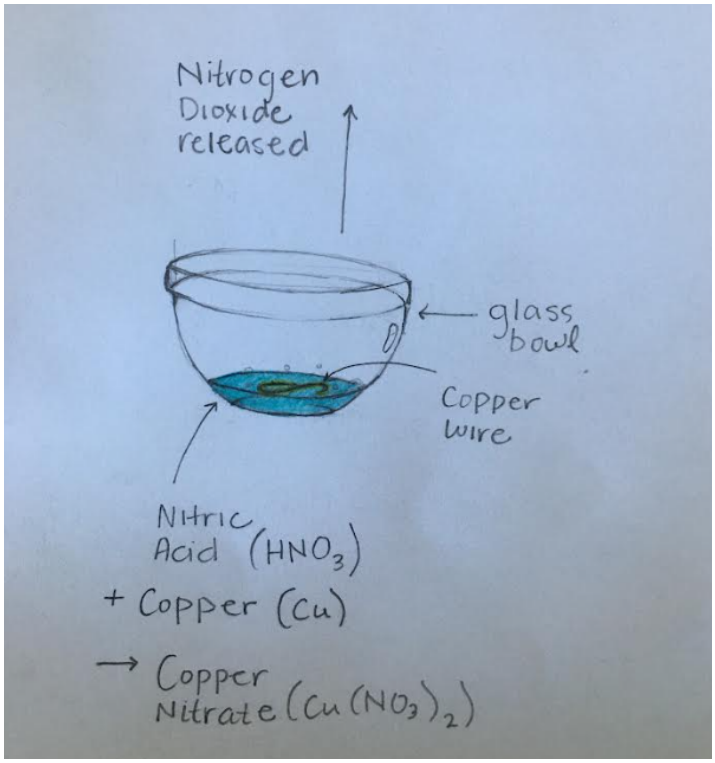
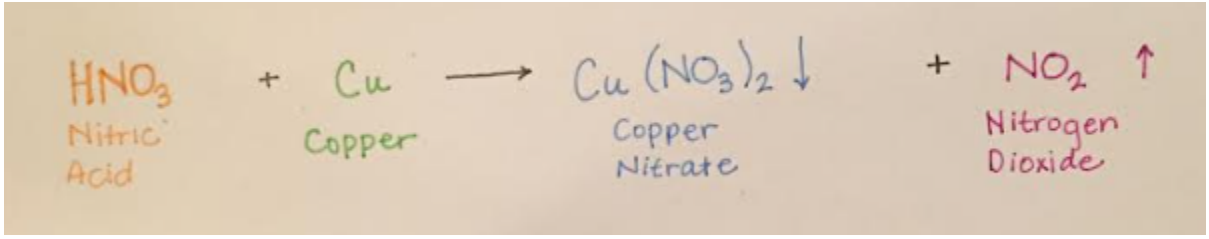


Image 2:



2) **Producing Ammonia**

We first placed ammonium hydroxide (NH_4OH) in an erlenmeyer flask with a one-hole rubber stopper, into which we inserted a glass tube. The flask was held in place by a clamp. A graduated cylinder was placed over the glass tube. We then used a butane torch to heat the base of the flask until it bubbled. After several seconds the cylinder was taken off of the glass tube, placing a thumb to cover the mouth of the cylinder. It was then brought over to a plastic tub filled halfway with water. The mouth of the cylinder was brought under the surface and uncovered.

IV. Results: When heated, the ammonium hydroxide (NH_4OH) bubbled. When brought under the surface of the water, a violent popping sound occurred and water was instantly sucked into the cylinder, filling it.

V. Conclusion: When heated, ammonium hydroxide (NH_4OH) releases ammonia gas (NH_3) which fills the cylinder. Ammonia gas is extremely soluble. Thus, when brought under the water's surface, the ammonia dissolved in the water very fast, due to this and pressure, the water replaced the ammonia in the cylinder very fast, causing the harsh suction. (see image 3 and 4)

Image 3:

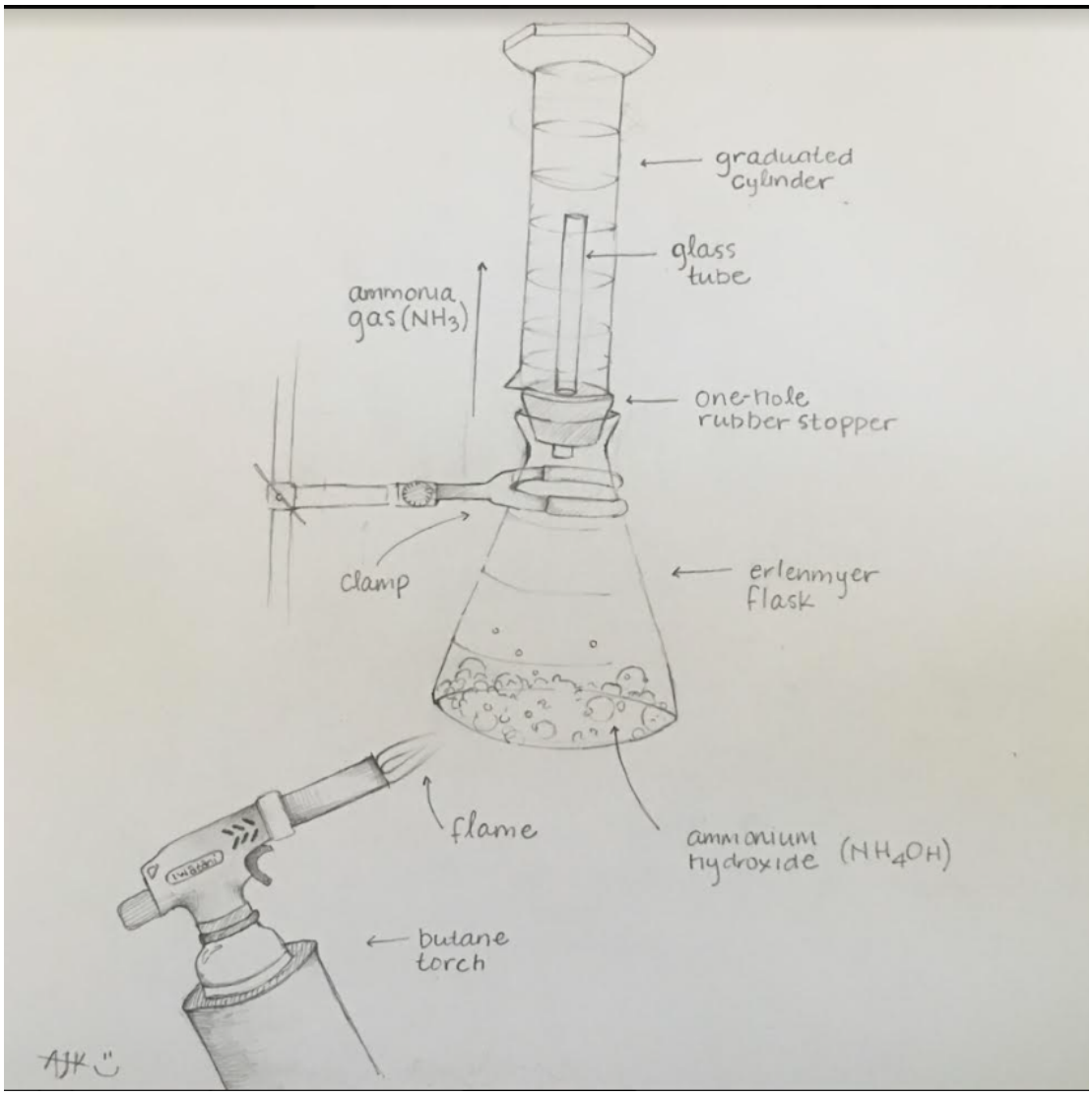
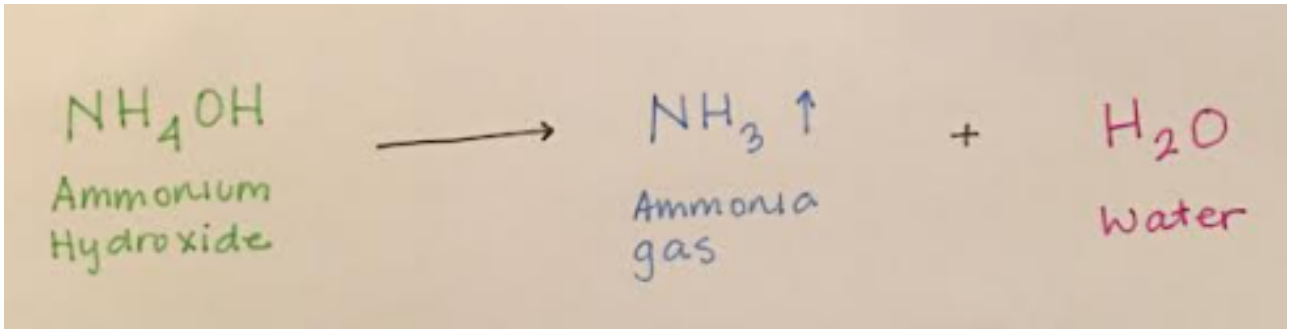


Image 4:



3) White smoke

The inside of one beaker was wiped with hydrochloric acid (HCl). The other was filled with ammonia (NH_3) (using the same method in the previous experiment) and slipped on top using paper to keep the ammonia inside. Once placed on top, the two beakers were taped to keep all chemicals in.

IV. Results: With the two beakers attached, a "white smoke" filled the bottom beaker. After some time, the smoke dissipated and white flakes were left behind on the bottom of the flask.

V. Conclusion: Here, the ammonia (NH_3) reacted with the hydrochloric acid (HCl) to form ammonium chloride (NH_4Cl). This ammonium chloride "smoke" is actually millions of inorganic salt particles, which is why we observed the white flakes. These are salt crystals which have settled to the bottom of the flask. (see image 5 and 6)

Image 5:

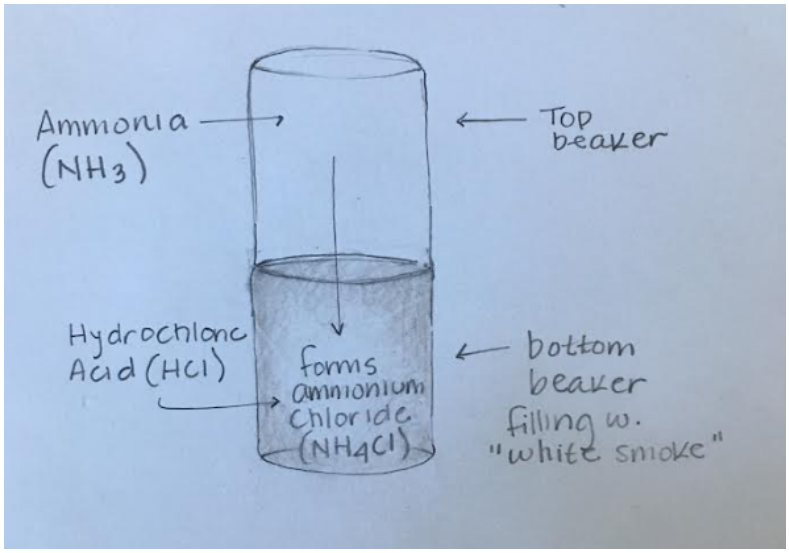
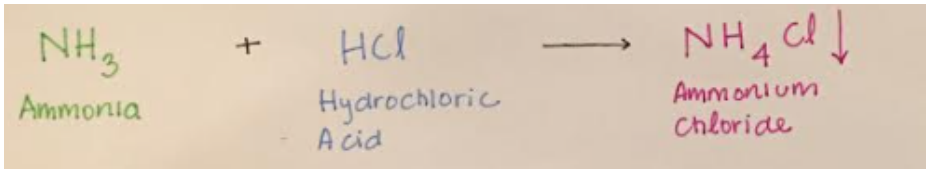


Image 6:



4) Ammonia fountain/solubility

We filled the first apparatus with water and 5 drops of phenolphthalein ($C_{20}H_{14}O_4$). This was set up with a two hole stopper and two glass tubes (one straight and one 90°). A one-hole stopper was also slid onto the glass tube upside down. The second apparatus was filled with ammonia gas (NH_3) (using the method from the first experiment). This apparatus was pushed onto the one-hole stopper upside down. We then blew air into the 90° glass tube.

IV. Results: The water/phenolphthalein solution was sent up the straight glass tube clear, but changed to a bright pink color when exiting the tube.

V. Conclusion: When phenolphthalein ($C_{20}H_{14}O_4$) and ammonia gas (NH_3) combine they form metallic ammonium (NH_4). This is what colors the solution pink. (see image 7 and 8)

Image 7:

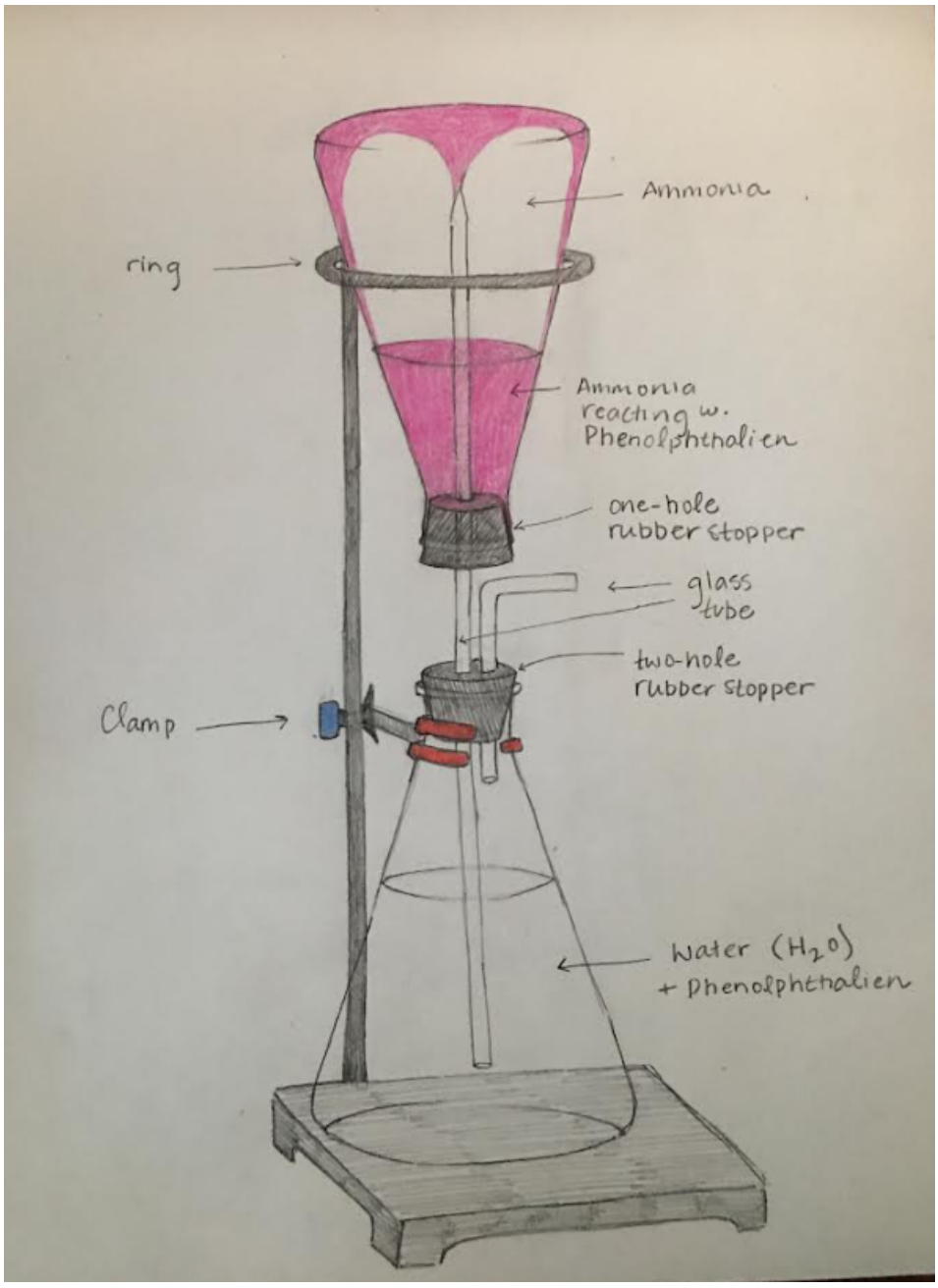
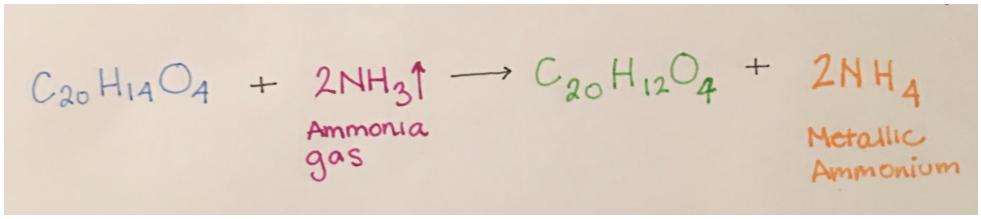


Image 8:



Unit 6: Nitrogen Compounds Lab

Author:	Jessica Nottoli
Date of Experiment:	November 14, 2023
Date of Report Submitted:	November 20, 2023
Seminar:	Chemistry

Purpose: To make and test various nitrogen compounds.

Materials:

- Two 1000mL erlenmeyer flasks
- 2 beakers
- Pink post-it notes group
- Straight and bent glass tubes
- A small clear bowl
- 1-hole rubber stoppers
- One 2-hole rubber stopper
- Yellow litmus paper
- A large plastic rectangular container
- A graduated cylinder
- Support stand
- Large steel ring
- 3 prong finger clamp
- Butane torch
- 1 erlenmeyer flask
- Water (H_2O)
- Hydrochloric acid (HCl)
- Ammonia (NH_3)
- Ammonium hydroxide (NH_4OH)
- Copper (Cu)
- Nitric acid (HNO_3)
- Phenolphthalein ($C_{20}H_{14}O_4$)
- Plastic eye dropper

Procedure:

We began our 'Producing Ammonia' experiment by filling a large plastic container with warm water. An erlenmeyer flask with a dash of ammonium hydroxide (NH_4OH) was then placed upon a support stand, held by a clamp. A glass tube poked through the 1-hole rubber stopper in the flask and a graduated cylinder was placed over the opening of the tube. The flask was then heated by a low flame until the graduated cylinder was filled with ammonia (NH_3).

Quickly sticking his thumb over the mouth of the graduated cylinder, Mr. J. submerged the opening in the container full of water. Immediately after removing his thumb, the cylinder instantly let go of the ammonia, which dissolved, and filled with water with an audible pop. We cleaned up, and started the next experiment.

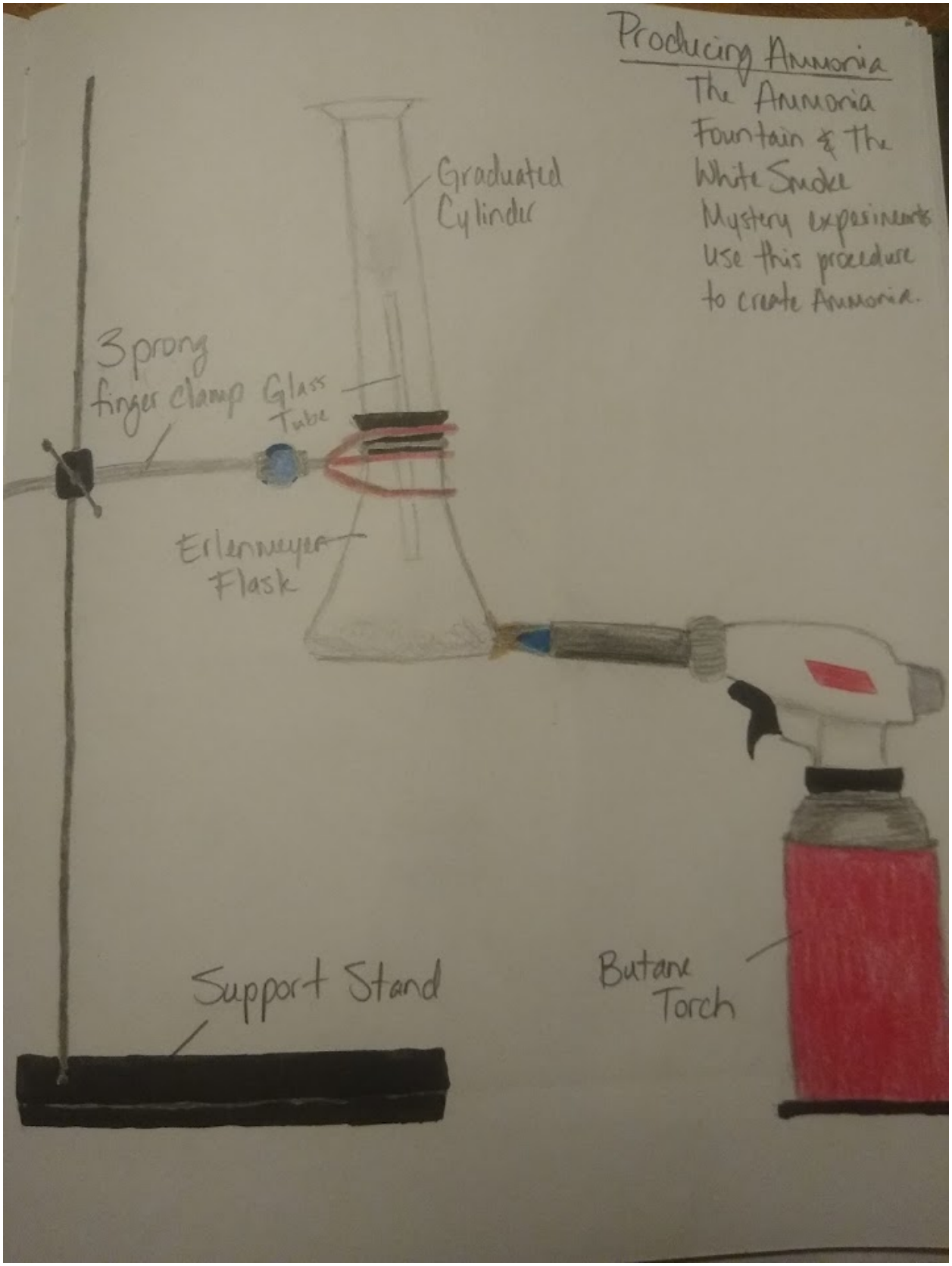
Our 'White Smoke Mystery' experiment began with us grabbing two beakers, pouring in a drizzle of hydrochloric acid (HCl) in the bottom beaker and filling the other with ammonia via the 'Producing Ammonia' procedure. To be sure the ammonia filled jar would not lose the easily loseable ammonia, a set of post-it notes was quickly moved over the beaker's opening, and set upon the bottom beaker. The post-it notes were taken away and the openings touched each other where the solutions combined to instantaneously create a white gas similar to fog or smoke. This white smoke is actually ammonium chloride crystals forming. Ultimately, at the end of the lab, the salt-like crystals descended to the bottom jar, visible crystals.

In the 'Making NO_2' experiment we used a small translucent bowl and poured nitric acid (HNO_3) into it. A copper (Cu) wire was added into the acid and suddenly a reddish brown gas with an overpowering smell arose; this gas was nitrogen dioxide (NO_2). The copper nitrate ($Cu(NO_3)_2$) liquid that was left became a bluish turquoise color. At the end of the lab, the copper solution took so much from the copper wire that it left only a thin strand. If we had had the time, we may have tried to reverse the experiment and create pure copper again by adding aluminum which can cleanse copper.

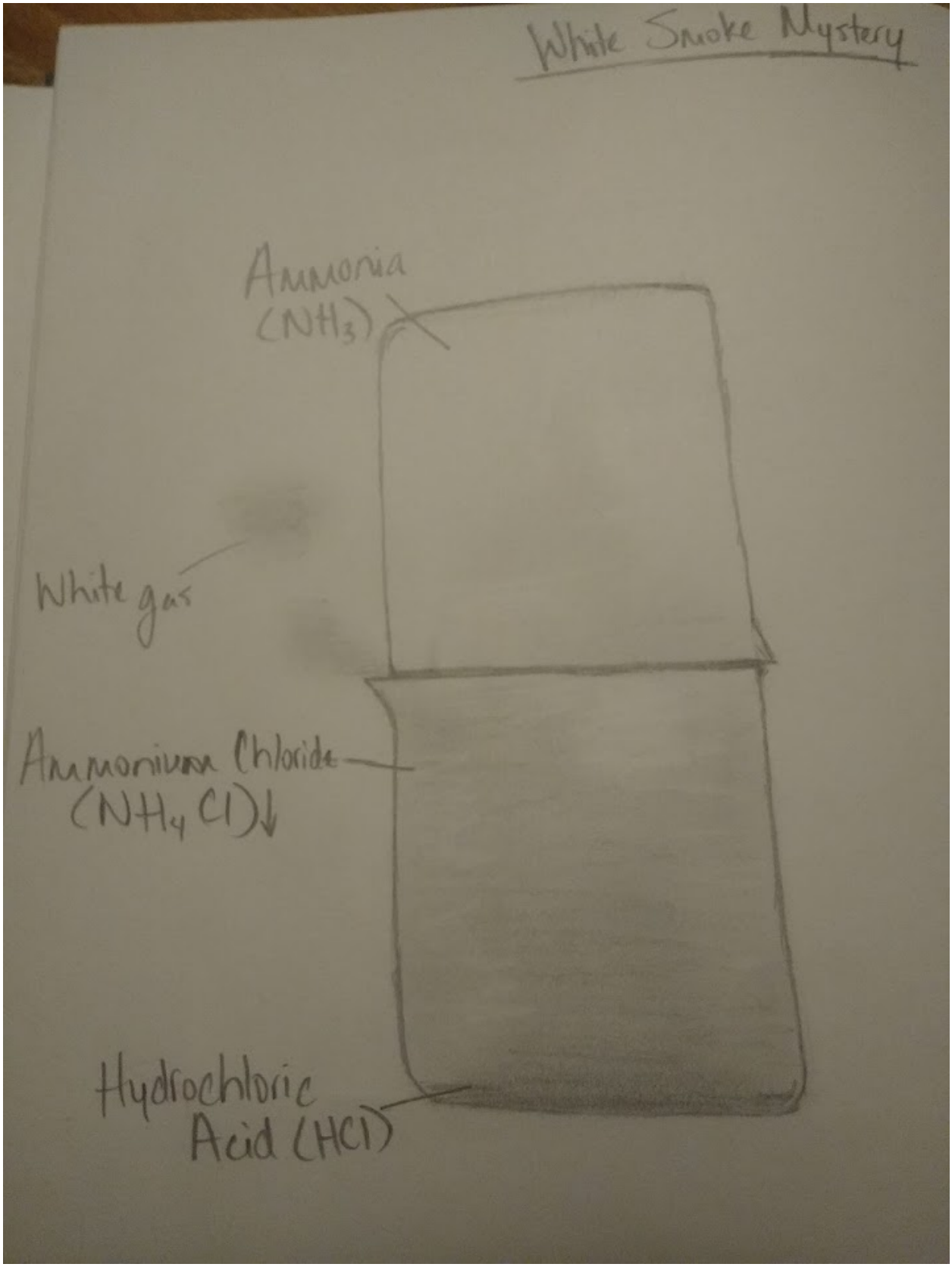
The 'Ammonia Fountain' experiment commenced by strapping two 1000mL erlenmeyer flasks onto a support stand by setting the bottom flask upon the platform and holding the other upside down by a large steel ring. Before these two erlenmeyer flasks were set up together, the bottom one was filled with water with 20 drops of phenolphthalein ($C_{20}H_{14}O_4$) and the top was filled with ammonia by the 'Producing Ammonia' procedure. The two flasks were then connected by a glass tube. The bottom flask had a two-hole stopper and another tube was set in it which Mr. J. blew in to coax the solution up the connecting glass tube. When the water blew into the top upside-down flask, the ammonia was pulled into the water and reacted to it and the phenolphthalein by turning the solution a dark pink. The solution spouted into the flask like a fountain, until the top flask was filled and the bottom flask was empty. We cleaned up and put away materials and concluded our experiments.

Chemical Equations: NH_4OH (ammonium hydroxide) —> NH_3 (ammonia) + H_2O (water)
NH_3 + HCl (hydrochloric acid) —> NH_4Cl (ammonium chloride)
HNO_3 (nitric acid) + Cu (copper) —> $Cu(NO_3)_2$ (copper nitrate) + NO_2 (nitrogen dioxide)

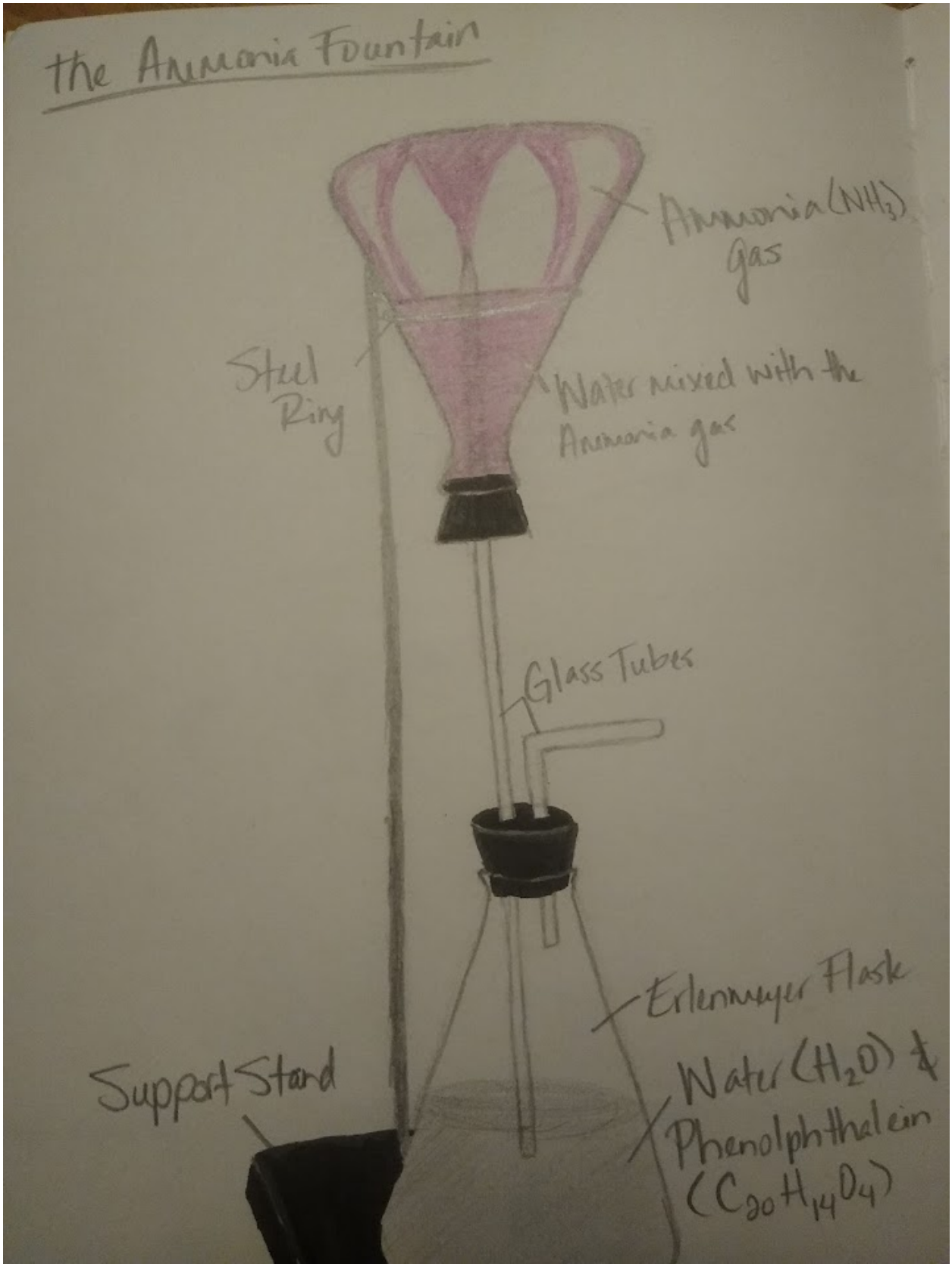
Sketches:


Producing Ammonia
The Ammonia Fountain & The White Smoke Mystery experiments use this procedure to create Ammonia.
Graduated Cylinder
3 prong finger clamp
Glass Tube
Erlenmeyer Flask
Support Stand
Butane Torch

White Smoke Mystery



the Ammonia Fountain



Conclusion: Through these experiments we have created ammonia for our future experiments, tested ammonia with hydrochloric acid, shown the acidity of a nitrogen based acid with copper, and the reactions ammonia has. We had previously tested the pH of ammonia hydroxide with a yellow litmus paper which comes between 12 and 13 with a bluish purple color. If a pH of a liquid is less then it will be colorless and the paper will be lighter, but if the pH is higher then the liquid and/or paper will turn a darker color. This is because if a pH is lesser it is more acidic but if higher it is a basic solution and not acidic. In the 'Ammonia Fountain' experiment the phenolphthalein, abbreviated Ph., turned pink because the ammonia solution that reacted to the Ph. had a high pH and was therefore a basic solution. It is because ammonia is a compound of nitrogen that it is basic or non acidic, since nitrogen is not reactive to most elements except hydrogen, oxygen, magnesium, calcium carbide, and itself. It's of these few elements that most of Nitrogen's compounds are made of. This concludes my lab on nitrogen compounds.

Nitrogen Compounds Lab Report

I. Author: Judy Zhu
Date of Lab: 11/14/2023
Date Due: 11/21/2023

II. Exploring the Different Properties of Nitrogen Compounds

Experiment A: Attempting to produce ammonia gas and demonstrating its solubility in water

Experiment B: Attempting to produce ammonium chloride.

Experiment C: Attempting to produce copper nitrates and nitrogen dioxide.

Experiment D: Attempting to produce an ammonia fountain

III. Materials & Methods:

Experiment A: 1 ring stand
1 metal clamp
1 erlenmeyer flask
1 1-hole rubber stopper
1 test tube
1 gas burner
1 tray filled w/water
Ammonium hydroxide

Experiment B: 2 glass jars
Hydrochloric acid
1 piece of cardboard
Masking tape

Experiment C: Nitric acid
Copper
Small glass bowl

Experiment D: 2 ring stands
2 metal clamps
1 250 ml erlenmeyer flask
2 1-liter erlenmeyer flasks
1 1-hole rubber stopper
1 2-holed rubber stopper for 1 liter erlenmeyer flasks
1 piece of bent glass
Water
Ammonia gas
phenolphthalein

Experiment A (construction below): First, fill the erlenmeyer flask with about half an inch of ammonium hydroxide. Then, connect the erlenmeyer flask to the ring stand with the metal clamp, lifting the erlenmeyer flask around 6 inches into the air. Put a

one-hole rubber stopper with a straight glass tube into the flask and a tray filled with water next to the ring stand. Hold the test tube with its opening on the glass tube while gently heating the ammonium hydroxide, and collect the ammonia gas until the test tube is full. Quickly put the test tube into the tray of water.

$$\text{Equation: } NH_4OH \xrightarrow{\triangle} NH_3\uparrow + H_2O$$

(ammonium hydroxide) (ammonia gas) (water)

Experiment B (construction below): Coat the inside of a glass jar with hydrochloric acid, and put a piece of cardboard on top. Using the set up from Experiment A, collect ammonia gas with the other glass jar. Then, put the jar filled with ammonia on top of the jar with hydrochloric acid, and quickly pull away the piece of cardboard. Tape the two glass jars together with masking tape.

$$\text{Equation: } NH_3 + HCl \rightarrow NH_4Cl\downarrow$$

(ammonia gas) (hydrochloric acid) (ammonium chloride)

Experiment C (construction below): Put some nitric acid into a small glass bowl. Then, put some copper into the acid.

$$\text{Equation: } HNO_3 + Cu \rightarrow Cu(NO_3)_2\downarrow + NO_2\uparrow$$

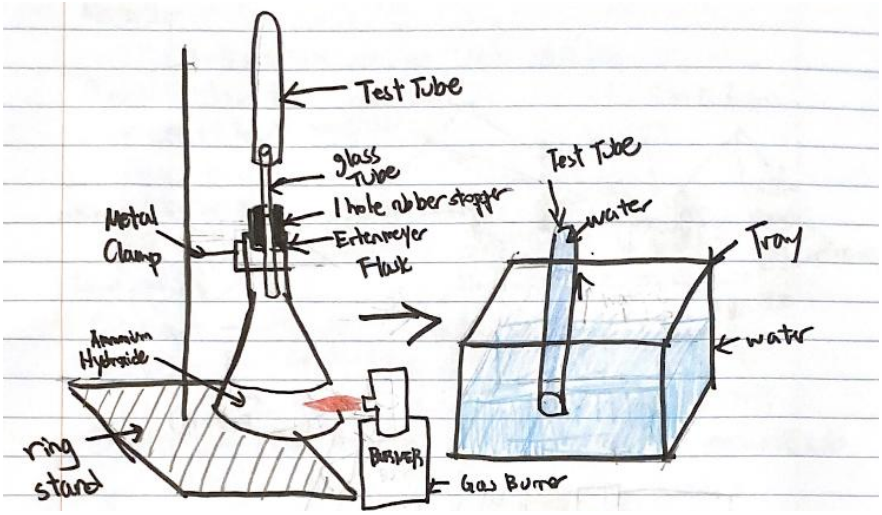
(Nitric acid) (copper) (copper nitrate) (nitrogen dioxide)

Experiment D (construction below): Clamp the 250 ml erlenmeyer flask with about 1/2 inch of ammonium hydroxide to a ring stand. Clamp a 1-liter erlenmeyer flask to the second ring stand filled with water and 20 drops of phenolphthalein solution. Put a 2-holed rubber stopper with a straight glass tube and a bent glass tube into the erlenmeyer flask. Then, heat up the erlenmeyer flask with ammonium hydroxide and collect ammonia gas using the other 1-liter erlenmeyer flask, and put a 1-hole rubber stopper into the flask. Attach to the flask with water using the glass tube and the ring on the ring stand.

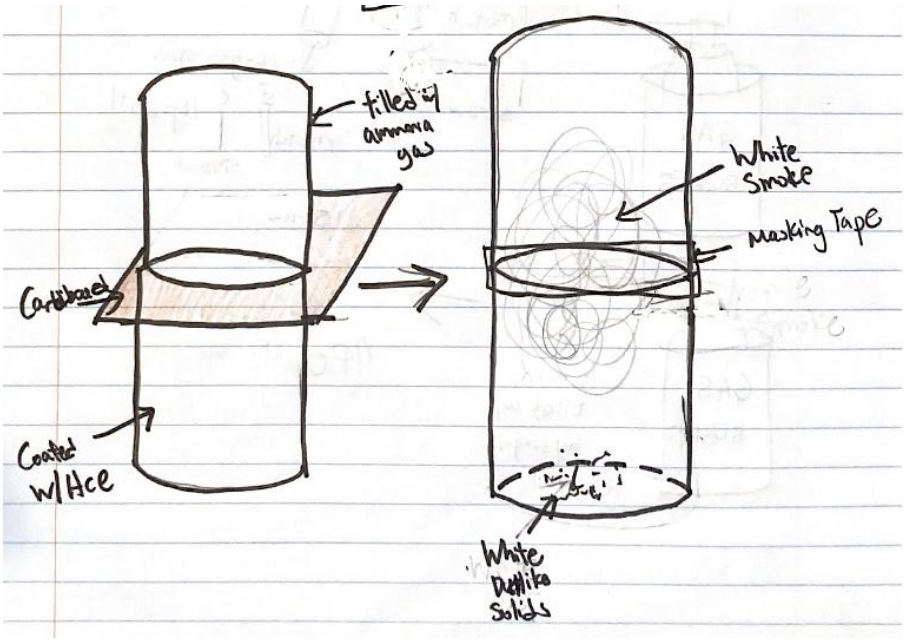
$$\text{Equation: } NH_3\uparrow + H_2O \rightarrow NH_4OH$$

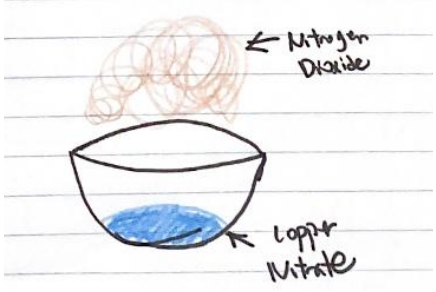
(ammonia gas) (water) (ammonium hydroxide)

Experiment A:



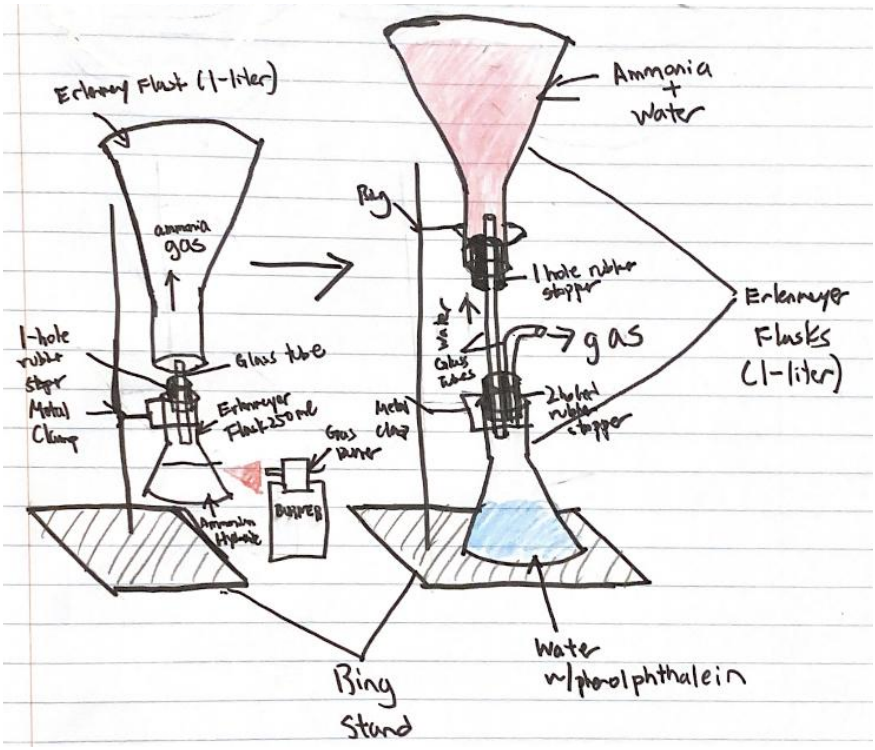
Experiment B:





Experiment C:

Experiment D:



IV. Results:

Experiment A: While we were heating up the ammonium hydroxide, it produced ammonia gas, which had a pungent smell. After we put the test tube filled with ammonia gas into the tray of water, water was immediately sucked up through the tube.

Experiment B: When the cardboard was removed separating the hydrochloric acid form the ammonia gas, a white smoke formed immediately. After a while, the white smoke settled at the bottom and formed small salts.

Experiment C:When the copper was put into the nitric acid, it produced a brownish red smoke with a pungent smell and the nitric acid reacting with copper turned bluish green. After the smoke stopped, little copper remained in the solution.

Experiment D: After the flask filled with ammonia gas was attached, water was sucked up through the glass tube, and the water in the top ammonia flask turned pink immediately. This is because the solution turned basic.

V. Conclusion:

Experiments A: In conclusion, we learned that when ammonium hydroxide is heated up, it turns into ammonia gas. We also found out that ammonia is a very soluble gas because water was sucked up into the test tube.

Experiment B: We found out that when ammonia gas reacts with hydrochloric acid, it forms a white mystery smoke, which is ammonium chloride. Although ammonium chloride may seem to be a gas at first, the compound is actually a solid as it settles to the bottom of the jar.

Experiment C: We discovered that when copper and nitric acid react, it forms copper nitrates, which is a beautiful bluish green crystal, and also emits a foul smelling brownish red smoke, nitrogen dioxide.

Experiment D: We found out that the ammonia gas is able to pull up water through the glass tube, and we learned that ammonium gas reacts with water by forming ammonium hydroxide. Because ammonium hydroxide is basic, it causes the solution to turn pink.