Reactions of Copper

Prelab
Create a data table similar to the one shown below. Complete the names of all reactants and products. (You will fill in the descriptions during the lab.)

<table>
<thead>
<tr>
<th>Copper Reactant</th>
<th>Added Reactant</th>
<th>Copper Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Description</td>
<td></td>
</tr>
</tbody>
</table>

Purpose
In this lab, you will observe different reactions of copper. Copper metal will be converted into several different chemical forms and then converted back to the metal.

Safety
- Use caution with sodium hydroxide, as it will cause severe burns if it is spilled on your skin.
- Do not inhale any chemicals as odors are unpleasant and some of the chemicals will burn or irritate your respiratory tract.
- Be extremely cautious when working with 6-M nitric acid and 6-M sodium hydroxide.
- Safety goggles must be worn at all times during this investigation.

Materials
- Copper wire or copper shot
- 6-M nitric acid
- 6-M sodium hydroxide
- 3-M hydrochloric acid
- Aluminum wire
- Distilled water
- Ethanol
- Ice water
- Glass stirring rod
- Graduated cylinder
- Balance
- Weighing paper
- Beakers (50 mL, 100 mL, and 250 mL)
- Watch glass
- pH paper
- Bunsen burner
- Ring stand
- Ring
- Wire gauze
- Tongs
- Filter paper
- Funnel
- Flask

Procedure
DAY 1
1. Obtain a piece of copper wire or several pieces of copper shot and record the mass.
2. Place the copper in the bottom of a 50-mL beaker (if necessary, fold the wire so that it stays in the bottom). Label the beaker with your group members’ names and class period so that you can identify it.
3. Carefully add 20 mL of HNO₃ to the beaker and immediately cover the beaker with a watch glass.
4. Observe the reaction for several minutes and record your observations. The brown gas given off is nitrogen dioxide. Do not inhale this gas, as it is an irritant.
5. Place the beaker in the fume hood and remove the watch glass.
6. Leave the beaker in the hood overnight to allow the copper to react completely.
DAY 2

7. Record your observations of the solution in the beaker.
8. Transfer the solution to a 100-mL beaker and test the pH of the solution with pH paper by dipping a stirring rod into the solution and touching it to the paper. Record your observations.
9. Obtain 20 mL of sodium hydroxide solution. Test the pH in the same manner as the copper solution.
10. Fill a 250-mL beaker with ice water and carefully set the beaker containing the copper solution so that it floats upright in the ice water. Make sure that there is enough ice in the outer beaker so that the smaller beaker does not sink below the surface of the water.
11. Slowly add the sodium hydroxide solution to the copper solution. Use caution during this step, as the reaction will evolve heat and can be violent.
12. Once all of the sodium hydroxide has been added, stir the solution using a stirring rod and test the pH of the solution. Do not get any precipitate on the pH paper, as this will skew the results. If the pH of the solution does not match the pH of the original sodium hydroxide solution, add additional sodium hydroxide until it does.
13. Record your observations about the precipitate.
14. Transfer the precipitate to a 250-mL beaker and add enough distilled water so that the beaker is filled between the 150-mL and 200-mL marks. If necessary, wash out any precipitate in the small beaker with distilled water. Do not use tap water.
15. Set up a Bunsen burner and gently boil the solution using a blue flame until all of the solid is converted. Do NOT leave the beaker unattended, as the reaction can cause the beaker to shake. The beaker should be held in place using a stirring rod to prevent it from shaking off the ring stand. Do not heat the beaker if the water level is below the 150-mL mark, as this may cause the contents of the beaker to explode.
16. Record your observations about the solid. Carefully decant the water using a stirring rod. Avoid losing any of the solid during the decanting.
17. Wash the solid with 50 mL of distilled water and decant a second time.
18. In a fume hood, carefully add 50 mL of hydrochloric acid to the solid. Stir the beaker for several minutes and record your observations. Once the reaction is completed, transfer the solution back to a clean 100-mL beaker.
19. Obtain a piece of aluminum wire. Coil the wire to make a handle so that the coil can be in the solution and the handle can hang over the edge of the beaker. Place the aluminum wire in the beaker and IMMEDIATELY cover the beaker with a watch glass.
20. As the aluminum wire changes, shake the wire to dislodge the copper and allow the reaction to continue. Record your observations.
21. Still in the fume hood, remove the watch glass. A secondary reaction in this part occurs between the aluminum and leftover hydrochloric acid to produce hydrogen gas and more aluminum chloride. Use caution, as hydrogen gas is highly flammable.

DAY 3

22. Remove the remaining wire using forceps and remove any small bits of wire mixed in with the copper. Do not use your hands, as the solution may still contain left over hydrochloric acid.
23. Filter the copper and solution. Wash the solid with 50 mL of distilled water and then with 10 mL of ethanol. The filtrate should be disposed of in a waste container.
24. Examine your solid product and allow it to dry overnight.

DAY 4
25. Record the final mass of recovered copper.

Analysis
1. Calculate the percent yield of copper.
2. Write balanced equations including the symbols for the state of matter for each of the reactions that occurred in this experiment.
3. Explain why the amount of copper recovered at the end of the lab did or did not match the amount of copper at the beginning of the lab.
4. Explain how your observations from this lab support the statement, “Although chemical changes can totally alter the properties of matter, the original matter is never destroyed.”
5. Relate this lab to the recycling processes used today to salvage materials such as aluminum and glass. Explain why a recycled product may be more expensive than the same product made from raw materials.