

Formal Lab: Iron, Copper, and Stoichiometry

This lab will be an attempt to get the highest possible percent yield in performing a single replacement reaction. You'll be taking an iron nail and placing it in a copper (I) chloride solution. The result will be pure copper metal. The question is: given around 3 grams of copper(I) chloride, how many grams of copper metal will you produce? By working carefully and taking careful measurements, your goal will be to get as close to a 100.00% yield for the lab as possible.

Question for the Hypothesis. Given the amount of copper(I) chloride you started with, how much copper should you make? (**This should be a number** based on a gram-gram calculation. Show your set-up in your final report.)

Procedure: (remember in your write-up to use the past passive voice)

1. Find the mass of a clean dry 150- mL beaker. Record the mass to the nearest .01 g.
2. Add around 3.00 grams of copper (I) chloride to the beaker. Record the mass of the beaker plus the CuCl to the nearest .01 g.
3. Add 50 mL of distilled water to the beaker. Swirl the beaker around to dissolve as much of the copper (I) chloride crystals as will dissolve (it won't be much).
4. Obtain two clean, dry nails. Find the mass of the nails and record it.
5. Place the nails into the copper(I) chloride solution. Leave them undisturbed at least overnight. During that time, you should see the formation of copper in the beaker. At the same time, some of the iron will be used up. Note: **CuCl is just barely soluble in water. Most of the CuCl you put in the water will not initially dissolve! However, as the reaction proceeds more and more of the CuCl will dissolve until all of it has a chance to react with the iron in the nails. This is a process that will take overnight.**
6. The next day use a magnet to carefully pick up the nails. Use distilled water in a wash bottle to rinse off any remaining copper from the nails before removing them completely from the beaker. Try to remove as much of the black material off the nails with a paper towel. Set the nails aside to finish drying on a piece of paper towel.
7. After the nails are completely dry, find the mass of the nails and record it.

8. *Decant* means to pour off only the liquid from a container that is holding both solid and liquid. Carefully decant the liquid from the solid. Pour the liquid into another beaker (not directly into the sink) so that in case you over pour you can still recover the solid.
9. After decanting, rinse the solid with about 25 mL of distilled water. Decant again. Repeat this step three or four more times.
10. After the final washing with water, place the copper in a drying oven to dry overnight.
11. The next day, when the copper is completely dry, find the mass of the beaker with the copper in it. Record. Dispose of the copper in the appropriate container, clean out the beaker, and wash your hands thoroughly with soap and water. Put the rinsed out beaker in the hood. Your instructor will have to get rid of the FeCl_2 stain on the beaker with HCl .

Questions and Calculations: Show all your set-ups, even in the cases of simple subtraction. Include the question in your answers so that the answers make sense to someone who doesn't have a copy of the questions in front of them.

1. Assuming that the brown (ugly) aqueous product was iron(II) chloride, what is the balanced equation of the chemical reaction that took place in this lab?
2. How much copper did you actually make?
3. What was your percent yield for the copper that was made?
4. Reverse the calculation: given the amount of copper you made, how much iron from the nails should have been used up?
5. How much iron was actually used up?
6. What is your percent yield for the iron that was used up?
7. What was the limiting reactant in this lab? How do you know?

Conclusions: Be sure to include a brief lab summary, an evaluation of your hypothesis, and an evaluation of the lab itself as the Formal Laboratory Report guidelines say.

Be sure to follow the Formal Laboratory Report guidelines when writing up the final lab report. Make the conclusions complete and thoughtful, please!