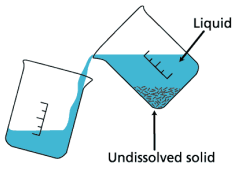
Lab 4B: Moles of Iron & Copper
Mini-Lab Report



Name:_____ **Block:** _____
Group Members:_____ **Date:** _____
Due Date:_____ **Drop Date:**_____

Criteria	Student Self Evaluation	Teacher Assessment
Objective: Clearly states the purpose of the experiment, written in your **own words** and briefly outlines the related theory.	**/2**	**/2**
Flow Chart: a visual representation of the procedure, to be completed *before* the lab! **Pre-Lab Questions:** displays a critical understanding of the background theory.		
Data, Results & Calculations: *(hand written neatly)* Provides results/observations (and diagrams where appropriate) that are presented in correctly annotated tables and/or graphs. Scientific tables & graphs are numbered *(eg Table 1:... or Graph 1...)* and include descriptive titles.	**/17**	**/17**
Conclusion: Identifies and defines important concepts and principles relevant to the experiment by relating back to the objective and hypothesis. ***Be sure to address the points*** listed in the lab handout when answering the conclusion.	**/3**	**/3**
Practical Evaluation: *(teacher assessed during practical lab work)* Demonstrates an organized and safe approach to experimental work & meticulously executed methodology to a high degree of accuracy.	**/3**	**/3**
Punctuality: Report is submitted in full on the due date. *(-1 per day until drop date)*	**/5**	**/5**
Results Summary	**/30**	**/30**

We will be doing the lab on _____. In order to be ready to go, you need to complete the following sections of your lab report:

- *Objective*
- *Flow Chart*
- *Pre-Lab Questions*
- *Data & Observations: Draw & set-up Table 1 & Table 2 into your lab notebook.*

Objective: *(you will need to write your own)* ***/2 marks***

Flow Chart: *(needs to be attached)*
Summarize the steps that you will follow in the lab. You will find this information on the attached pages, which give the "procedure" for the lab. These steps should be VERY simple, and easy to follow. You will not be permitted to carry books, and binders to your lab bench. So imagine the lab is not beside you. You will require THIS FLOW CHART to see what steps will follow.

Procedure: This lab is an excerpt from *Heath Chemistry*, a textbook of laboratory experiments. Information regarding the lab and detailed procedure are provided on the following pages.

Note: *Change Step 2 from 8.0 g of copper (II) chloride to approximately 3.0 g – 4.0 g*

NOTE: all data, observations and calculations are to be completed in numbered data tables with appropriate titles.

Safety glasses are to be worn at <u>all times</u>, for <u>all experiments!</u>

Reagent Disposal: All waste from this lab is to be collected in the designated waste container. All glassware used must be rinsed *<u>thoroughly</u>* in order to be used in following reactions.

Clean Up: clean up all materials, wipe lab bench with disinfectant and wash hands *well* with soap and water before you leave the lab each day.

MATERIALS

Apparatus		Reagents
beakers (250 mL)	safety goggles	copper(II) chloride
wash bottle	lab apron	2 iron nails
stirring rod	plastic gloves	(approx. 5 cm)
crucible tongs	sandpaper or	1*M* hydrochloric acid
centigram balance	emery cloth	distilled water
drying oven	face shield	

Pre-lab Questions: *(to be answered in full sentences **in the space provided below**)*
Carefully read the pre-lab discussion, and the procedure BASED ON Heath Chemistry page 55-57.
***These pages are attached** for reference & include supplementary information you may find helpful.*

1. How many particles are you weighing if you weigh 1 mole of ANY element?

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2. What unit is used for molar mass?

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3. Determine the **number of moles** in 34.0 g Fe.

4. Describe the process of " decanting".

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5. Provide a scientific diagram of how to properly decant. Be sure to include **and label** all equipment and substances

6. a) What solution(s) will be used to wash nails?

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b) What solution(s) will be used to wash the copper?

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7. Which solution is considered a hazard? Why?

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8. Why must you wait for the 2 products to dry before finishing this lab?

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9. a) What is a ratio?

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b) What ratio will be calculated in this lab?

Data & Observations

/ 3 marks

	Mass Before Reaction (g)	Mass After Reaction (g)
Empty, dry beaker		
Beaker + copper (II) chloride		
2 Iron nails		
Beaker + copper (II) chloride *(dry)*		

/ 5 marks

Substance	Observation
Fe nail *before*	
$CuCl_{(s)}$ before	
$CuCl_{(aq)}$ before	
0 mins	
5 mins	
10 mins	
15 mins	
20 mins	
Product #1:_____	
Product #2:_____	
Fe nails *after*	

Questions & Calculations *(questions are 1 mark each.* ***SHOW ALL WORKING OUT CLEARLY!****)*

/ 9 marks

1. Find the following masses by doing the appropriate subtractions:
    a. Mass of iron used in the reaction.

    b. Mass of copper(II) chloride used in the reaction.

    c. Mass of copper produced in the reaction.

2. Find the number of moles of the following:
    a. Moles of iron used in the reaction.

    b. Moles of copper produced in the reaction.

3. Find the number of atoms of each of the following:
    a. Number of atoms of iron used in the reaction.

    b. Number of atoms of copper produced in the reaction.

4. Calculate the percent composition of copper in the iron nails. Is it a good quality nail? (3-4% copper)

5. Was there any evidence that some of the copper(II) chloride was left in the beaker? Explain.

Conclusion:

/3 marks

- *Link to experimental objective(s)*
- *Discuss and summarize your experimental results (eg. mole ratio Fe:Cu)*
- *Present & explain any reasonable sources of experimental error & how this has impacted results.*

Practical Evaluation

In this lab, you will be given a practical evaluation, based on the ***quality*** of your data obtained. This will be based on the *ratio of moles of Fe : moles of Cu*.

/ 3 marks

Moles of Iron and Copper

EXPERIMENT 4B

The mole is a convenient unit for analyzing chemical reactions. The mole is equal to 6.02×10^{23} particles, or Avogadro's number of particles. More importantly, however, the mass of a mole of any compound or element is the mass in grams that corresponds to the molecular formula, or atomic mass. Simply stated, the atomic mass of copper is 63.5 u, which means that the mass of one mole of copper atoms is 63.5 g. Likewise, the molecular mass of water is 18.0 u, and the mass of one mole of water molecules is 18.0 g.

The mole is the common language in chemical reactions. In this experiment, you will observe the reaction of iron nails with a solution of copper(II) chloride and determine the number of moles involved in the reaction.

Iron and copper, along with gold, silver, lead, and antimony, were known in very early times. Iron and copper occur naturally in the earth's crust as oxides or sulfides. Chemical analysis and calculation of ore content is vital to the mining industry. Today an ore containing 3–4% copper is considered high-grade, while iron producers are little interested in ores containing less than 20–30% iron.

OBJECTIVES

1. to determine the number of moles of copper produced in the reaction of iron and copper(II) chloride
2. to determine the number of moles of iron used up in the reaction of iron and copper(II) chloride
3. to determine the ratio of moles of iron to moles of copper
4. to determine the number of atoms and formula units involved in the reaction.

MATERIALS

Apparatus

beakers (250 mL)
wash bottle
stirring rod
crucible tongs
centigram balance
drying oven
safety goggles
lab apron
plastic gloves
sandpaper or emery cloth
face shield

Reagents

copper(II) chloride
2 iron nails (approx. 5 cm)
1*M* hydrodhloric acid
distilled water

CAUTION: Copper(II) chloride is very poisonous and can kill you. Do not get it in your mouth. Do not swallow any.

PROCEDURE

1. Find the mass of a clean, empty, dry 250 mL beaker. Record the mass to the nearest 0.01 g.
2. Add approximately 8 g of copper(II) chloride crystals to the beaker. Find the mass and record it in your notebook.
3. Add 50 mL of distilled water to the beaker. Swirl the beaker around to dissolve all of the copper(II) chloride crystals.
4. Obtain two clean, dry nails. If the nails are not clean, use a piece of sandpaper to make the surface of the nail shiny. Find the mass of the nails and record it in your notebook.
5. Place the nails into the copper(II) chloride solution, as shown in Figure 4B–1. Leave them undisturbed for approximately 20 min. 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.
6. Use the tongs to carefully pick up the nails, one at a time. Use distilled water in a wash bottle to rinse off any remaining copper from the nails before removing them completely from the beaker. (See Figure 4B–2.) If necessary, use a stirring rod to scrape any excess copper from the nails. Set the nails aside to dry on a paper towel.

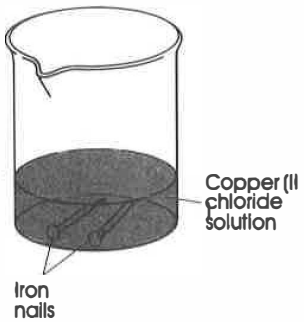

Figure 4B-1

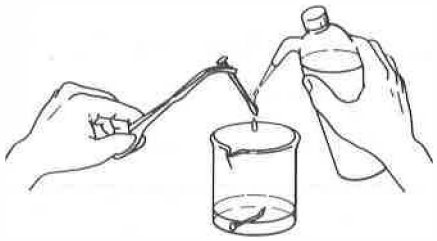

Figure 4B-2 *Any copper remaining on the nails may be washed back into the beaker with the use of distilled water from a wash bottle.*

7. After the nails are completely dry, find the mass of the nails and record it in your notebook.
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. (See Figure 4B-3.) Pour the liquid into another beaker so that in case you overpour, you can still recover the solid.

Figure 4B-3 *When decanting, it is helpful to direct the liquid into the second beaker along a stirring rod, as shown here.*

CAUTION: Hydrochloric acid is corrosive to skin, eyes, and clothing. When handling 1M hydrochloric acid, wear safety goggles, lab apron, and use a full face shield and gloves. Wash spills and splashes off your skin and clothing immediately using plenty of water. Call your teacher.

9. After decanting, rinse the solid again with about 25 mL of distilled water. Decant again. Repeat this step three or four more times.
10. Next, wash the solid with about 25 mL of 1*M* hydrochloric acid. Decant again; then, once more, clean the solid with 25 mL of distilled water.
11. After the final washing with water, place the copper in a drying oven to dry.
12. Allow the copper to become completely dry, then find the mass of the beaker plus the copper and record it in your notebook.
13. Clean up all of your materials. Before you leave the laboratory, wash your hands thoroughly with soap and water; use a fingernail brush to clean under your fingernails.

REAGENT DISPOSAL

Rinse all solutions down the drain with plenty of water. Place solids in the designated waste containers.

POST LAB DISCUSSION

In this experiment, you have reacted some of the iron from the nail at the same time as you have produced some copper. In order to find the moles of each of these substances, you will need to divide the mass of the iron used or the copper produced by the molar mass. You can also determine the moles of copper(II) chloride that you started with by dividing the mass of the copper(II) chloride by the molar mass. By multiplying by Avogadro's number, you will be able to determine the total number of atoms involved in the reaction. Finally, you will determine the ratio of moles of iron used to moles of copper produced.