



Name: _____

Partner's Name(s): _____

Lab Date: _____ Lab Instructor's Name: _____

INVESTIGATION OF A COPPER CYCLE LAB NOTEBOOK PAGES

All purpose, procedure(s), and data/observations must be recorded in the lab notebook in pen with permanent, waterproof ink (black or blue). Pencils, markers, highlighters, and correction fluid (white-out) are not permitted. No information can be recorded elsewhere and transferred after leaving the lab. Lab notebooks can be digital or paper; you may write directly on the lab notebook pages in your lab manual or download a digital copy onto your electronic device and then write in it. Refer to the Guide for Success in the General Chemistry Laboratory section in the front of this lab manual for more detailed instructions.

- ⦿ **Before Lab:** Make sure to complete the Purpose and Procedure sections as well as any required data tables in the Data and Observations section in your lab notebook pages.
- ⦿ **After Lab:** Upload your notebook pages to the appropriate Carmen assignment within 48 hours after the start time of your in-person lab session. If you used the notebook pages in your paper copy of your lab manual, you should scan or take photos of the pages. Do not remove them from your lab manual. Refer to the CYC Notebook upload assignment in Carmen for more detailed instructions.

PURPOSE _____

Describe the what, why, and how of the experiment in bullet points or a few sentences. Consult the Expected Learning Outcomes and the procedure for the experiment to develop the purpose.

PROCEDURE CITATION _____

Chemistry 1210: General Chemistry Laboratory Manual, Fall 2025–Summer 2026.; Weaver, T. A., Opoku-Agyeman, B., Fontes N. Da Silva, C., Welch, A. N., Stern, J. E., Wroblewski, R. A., Walter, C., van Helmond, A. Eds.; Van-Griner Learning: Cincinnati, OH; pp. 71–78 .

PROCEDURE

PART A. OBSERVATIONS OF A COPPER CYCLE

Write a summary or step-by-step procedure for this part of the experiment in the space below.

PART B. EXPLORATION OF ALTERNATIVE REAGENTS FOR USE IN A COPPER CYCLE

Before Lab: Write a *step-by-step* procedure you plan to use. Be as detailed as possible.

During Lab: Note any updates/adjustments you made to your procedure before you leave the lab.

CLEAN UP AND WASTE DISPOSAL

All solutions and any excess CuO solid should be collected in a personal waste beaker at your workstation and transferred to the class Chemical Waste beakers upon completion of the experiment. You must fill in the Chemical Waste Disposal Form. Used large (50-mL) test tubes should be cleaned and placed back in your drawer. **Emptied** microcentrifuge tubes must be shown to your lab instructor and can then be collected in the Blue Solid Waste bucket on the bottom of the reagent cart. After cleaning up, wipe down your work area with 70% ethanol spray and a paper towel. Wash your hands thoroughly after completing this experiment.

DATA AND OBSERVATIONS

INVESTIGATION OF A COPPER CYCLE

PART A. OBSERVATIONS OF A COPPER CYCLE

PRODUCT OF REACTION 1	Starting material: 0.05 M $\text{Cu}(\text{NO}_3)_2$	Initial observations of $\text{Cu}(\text{NO}_3)_2$ solution:	
	Amount used (mL): _____		
REACTION 2	Reagent added: 0.6 M NaOH	Observations after reaction:	
	Amount used (mL): _____		
REACTION 3	Reagent added: heat (Δ)	Observations after reaction:	
	Amount used: time (s) _____		
REACTION 4	Reagent added: 3 M HCl	Observations after reaction:	
	Amount used (mL): _____		
REACTION 5	Reagent added: Al	Observations after 30 s:	Observations after 10 min:
	Amount used (# pieces): _____		

PART B. EXPLORATION OF ALTERNATIVE REAGENTS FOR USE IN A COPPER CYCLE

Before Lab: Create your own Data and Observations section based on the procedure you think you'll use. Be sure your table(s) contain(s) volumes and masses of any reagents used as well as units and proper significant figures. It may be helpful to model your data table after the one provided in Part A.

During Lab: Make adjustments to the prepared data tables to match what you and your partner actually did in lab.

IN-LAB QUESTIONS

Answer the following questions in your lab notebook or lab manual. They will be graded for completion (you will receive full points as long as all are answered and reviewed by your lab instructor before you leave). Review your experimental observations to help you develop the reaction equations.

PART A. OBSERVATIONS OF A COPPER CYCLE

REACTION 1	Write the balanced chemical equation for the reaction of copper metal with nitric acid. Identify this reaction as a neutralization, redox, precipitation, or decomposition reaction type.
	<p>Example: $4 \text{HNO}_3 (aq) + \text{Cu} (s) \rightarrow \text{Cu}(\text{NO}_3)_2 (aq) + 2 \text{NO}_2 (g) + 2 \text{H}_2\text{O} (l)$</p> <p><i>Reaction type: Redox</i></p>
REACTION 2	Write the balanced chemical equation for the reaction of copper(II) nitrate with sodium hydroxide. Identify this reaction as a neutralization, redox, precipitation, or decomposition reaction type.
REACTION 3	Write the balanced chemical equation for the formation of copper(II) oxide upon heating a solution containing copper(II) hydroxide. Identify this reaction as a neutralization, redox, precipitation, or decomposition reaction type.
REACTION 4	Write the balanced chemical equation for the reaction of copper(II) oxide with hydrochloric acid. Identify this reaction as a neutralization, redox, precipitation, or decomposition reaction type.
REACTION 5	Write the balanced chemical equation for the reaction of copper(II) chloride with elemental aluminum. Identify this reaction as a neutralization, redox, precipitation, or decomposition reaction type.

For each reaction in your Standard Operating Procedure indicate the reagent used and draw what the contents of your test tube look like on a molecular level after each reaction is complete. You do not need to include water molecules, as they are too numerous. An example of what we're looking for has been filled in below for the products of Reaction 1; a test tube of $\text{Cu}(\text{NO}_3)_2$ solution. Copper and nitrate are shown as ionic species because copper(II) nitrate is soluble in water. Also, the reagent used in Reaction 1 has been filled in for you. When you are done, have your lab instructor check your work.

Copper Cycle

Reaction 1: HNO_3 + [] → []

Reaction 2: [] + [] → []

Reaction 3: [] → [] + []

Reaction 4: [] + [] → []

Reaction 5: [] + [] → []

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FIGURE CYC.1

An illustration of the copper cycle at a molecular level.

PART B. EXPLORATION OF ALTERNATIVE REAGENTS FOR USE IN A COPPER CYCLE

REACTION 4	Looking at Reaction #4 in Part A, what type of reaction occurred?		
	Circle the reagents available in Part B that could be used to produce a similar product via the same reaction type. Cross out reagents that would not produce a similar product via the same reaction type.		
	0.6 M NaOH	3 M H ₂ SO ₄	Zn
3 M NaOH	3 M H ₃ PO ₄	Cu	
		Mg	
	Recall that our goal in Reaction #4 is to dissolve the copper (II) oxide to produce an aqueous solution of Cu ²⁺ . When reacted with copper (II) oxide, would all the reagents circled above produce an aqueous solution? Would any produce an insoluble precipitate?		
REACTION 5	Looking at reaction #5 in Part A, what type of reaction occurred?		
	Circle the reagents available in Part B that could be used to produce a similar product via the same reaction type. Cross out reagents that would not produce a similar product via the same reaction type.		
	0.6 M NaOH	3 M H ₂ SO ₄	Zn
3 M NaOH	3 M H ₃ PO ₄	Cu	
		Mg	

PART C. EXPLORATION OF ALTERNATIVE REAGENTS FOR USE IN A COPPER CYCLE

You found alternatives to Reactions 4 and 5 of your Standard Operating Procedure in Part B. In **Figure CYC.2** below, indicate the reagents used and draw what the contents of your test tubes look like on a molecular level after each reaction is complete. You do not need to include water molecules, as they are too numerous. When you are done, have your lab instructor check your work.

The diagram shows five test tubes arranged in a row. Above the first three test tubes are arrows labeled 1, 2, 3, 4, and 5, indicating the sequence of reactions. Below each test tube is a chemical equation with a box for the reagent:

- Test tube 1: $\text{1} + \text{HNO}_3$
- Test tube 2: $\text{2} + \text{[]}$
- Test tube 3: $\text{3} + \text{[]}$
- Test tube 4: $\text{4} + \text{[]}$
- Test tube 5: $\text{5} + \text{[]}$

Below the test tubes is a large test tube containing a blue solution. The label on this test tube lists the substances present: CuO , CuO , and CuO . The copyright notice "©Van-Griner, LLC" is located in the top right corner of the diagram area.

FIGURE CYC.2

An illustration of the copper cycle at a molecular level for the updated Standard Operating Procedure.

