Chem115 Fall 2023 - Ilana Berlin/Lab9: Chemical Reactions: Copper and Copper (II) Ions/LabReport9

Jason Cody - Nov 03, 2023, 9:51 AM CDT

Assignment #18 - LabReport9

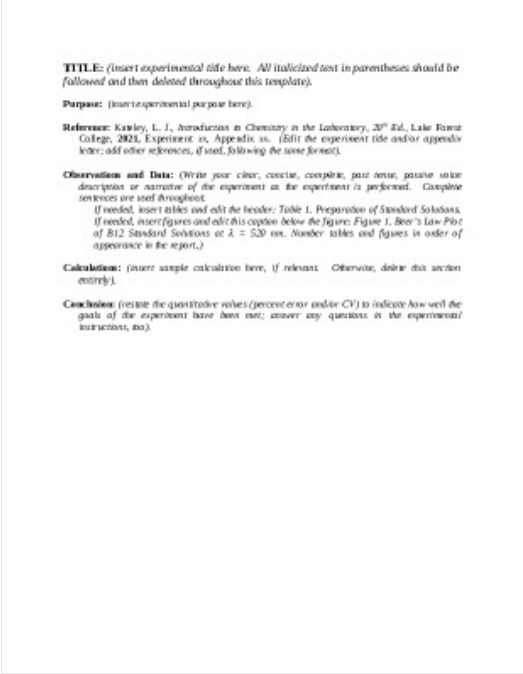
You cannot edit this entry after it is graded.

Description	Copper Cycle
I worked in a group with	
The work for this assignment is in	My notebook

Grade **9.5 / 10**

Graded on Nov 03, 2023, 9:51 AM CDT

Jason Cody - Oct 01, 2021, 10:37 AM CDT



TITLE: *(insert experimental title here. All italicized text in parentheses should be followed and then deleted throughout this template).*

Purpose: *(insert experimental purpose here).*

Reference: Kauley, L. J., *Introduction to Chemistry in the Laboratory*, 20th Ed., Lake Forest College, **2021**, Experiment xx, Appendix xx. *(Edit the experiment title and/or appendix letter; add other references, if used, following the same format).*

Observation and Data: *(Write your clear, concise, complete, past tense, passive voice description or narrative of the experiment as the experiment is performed. Complete sentences are used throughout.*
If needed, insert tables and edit the header: Table 1. Preparation of Standard Solutions.
If needed, insert figures and edit this caption below the figure: Figure 1. Beer's Law Plot of B12 Standard Solutions at λ = 520 nm. Number tables and figures in order of appearance in the report.)

Calculations: *(insert sample calculation here, if relevant. Otherwise, delete this section entirely).*

Conclusion: *(restate the quantitative values (percent error and/or CV) to indicate how well the goals of the experiment have been met; answer any questions in the experimental instructions, too).*

ReportTemplate.docx (15.5 kB)

Jason Cody - Oct 14, 2020, 12:52 PM CDT

Date and Title

Ilana Berlin - Oct 30, 2023, 11:13 AM CDT

Chemical reactions Using Copper and Copper(II) Ions.

Monday October 30th

Jason Cody - Oct 14, 2020, 12:52 PM CDT

Purpose

Jason Cody - Nov 03, 2023, 9:43 AM CDT

Five different reactions, a redox reaction, metathesis reaction, a decomposition reaction, an acid-base reaction, and a metal displacement reaction, will be observed. what about copper? You never mentioned it! % recovery will be determined?

Jason Cody - Oct 14, 2020, 12:52 PM CDT

Reference

Jason Cody - Nov 03, 2023, 9:43 AM CDT

Spencer, James N, et al. *Chemistry: Structure and Dynamics, 5th Edition*. Wiley Global Education, 10 Dec. 2010, pp. 209–215. Good.

Kateley, L. J., *Introduction to Chemistry in the Laboratory, 20th Ed*., Lake Forest College, **2021**, Experiment 9 Appendix B.

Jason Cody - Oct 14, 2020, 12:52 PM CDT

Data and Observations

Jason Cody - Nov 03, 2023, 9:49 AM CDT

Litmus paper - acid=red(blue to red) base=blue(red to blue) This is a note to yourself--should this start off your Observations section?

Reaction 1.

$Cu(s) + 4HNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 2NO_2(g) + 2H_2O(l)$ Good.

A small piece of copper wire was cleared with Emery paper. Cleaning with emery paper removes dirt and increased reactivity by adding surface area through scratches. It weighed 0.0603g and was a shiny orange copper color. The wire was placed in a centrifuge tube and the tube was places in a beaker of hot tap water. 30 drops, approximately 1mL, of 16M nitric acid solution was added. The solution fizzed bright green and released an amber gas. The end solution was a transparent dark green liquid that smelled like chlorine. Good observation. The solution turned bluer as it cooled. 4mL of room temperature deionized water was added to the solution further lightening the color. Blue litmus paper (turning red) was used to confirm the acidity of the solution.

The reaction was indicated by formation of gas bubble, color change, change in smell, and disappearance of the copper wire. I determined the reaction was complete when it stopped emitting NO_2 gas and the copper wire was completely dissolved. The solution was darker green/blue before the addition of water. The $Cu(NO_3)_2$ product is solvable because it is an aqueous solution, dissolved in water. Good.

Reaction 2.

$Cu(NO_3)_2(aq) + 2NaOH(aq) \rightarrow Cu(OH)_2(s) + 2NaNO_3(aq)$ Good.

$HNO_3(aq) + NaOH(aq) \rightarrow NaNO_3(aq) + H_2O(l)$ Good.

The centrifuge tube containing the $Cu(NO_3)_2$ solution was cooled in an ice bath. After cooling to room temperature, 3mL of a 6M NaOH was added to the solution. The solution turned a vivid cobalt blue and formed a precipitate. Red litmus paper (turning blue) was used to confirm that the solution was basic. The tube was placed in the centrifuge and spun for 30 seconds. The solid blue precipitate ($Cu(OH)_2$) gathered to the side on the tube and a clear colorless liquid rose to the top. Good.

$Cu(OH)_2$ is insoluble because it formed a precipitate. The NaOH reacted with remaining HNO_3 from reaction one to form H_2O and $NaNO_3$ both of which are in the clear colorless liquid.

Reaction 3.

$Cu(OH)_2(s) \rightarrow CuO(s) + H_2O(l)$

Centrifuge tube containing solution was placed in beaker of hot tap water to heat, stirring as it heated. As it heated the precipitate turned into a black/murky dark brown powdery substance (CuO) and the solution yellowed. The tube was placed in the centrifuge for 30 seconds. The black precipitate condensed to the bottom of the tube and the yellowish transparent liquid rose to the top. The liquid was decanted and the precipitate was cleaned with deionized water, small amounts of the precipitate were lost during this process. The decanted solution was proved basic using litmus paper. Good.

Reaction 4.

$CuO(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + H_2O(l)$

$2NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$

The CuO precipitate was transferred from the centrifuge tube to a 150mL Kimax beaker using deionized water. Good, approximate amount of water used? 12mL of a 3M sulfuric acid solution was added to the beaker. The solution turned a pale sky blue and the precipitate dissolved. Blue litmus paper (turning red) confirmed the acidity of the solution.

Excess H_2SO_4 is present in the solution in addition to the intended products of $CuSO_4$ and H_2O (as well as the original H_2O). It reacts with remaining excess NaOH to create Na_2SO_4. The $CuSO_4$ is soluble.

Reaction 5.

$CuSO_4(aq) + Zn^{2+}(s) \rightarrow Cu(s) + ZnSO_4(aq)$ Zn starts as metallic (no charge).

$Zn^{2+}(s) + H_2SO_4(aq) \rightarrow H_2(g) + ZnSO_4(aq)$

0.667g of Zn were added to the $CuSO_4$ solution. The solution immediately turned cloudy and began fizzing (sign of gas production). Good. The precipitate turned red throughout the reaction and the solution became clear and transparent. The reaction was finished when the solution stopped bubbling and all the precipitate had changed color. Blue litmus paper (turning red) was used to confirm the acidity of the solution. The copper precipitate was separated and cleaned using vacuum filtration. The clear filtrate was removed, leaving behind a dark red/brown solid.

The petri dish without the copper weighed 24.7292g. The petri dish with the copper weighted 24.8351g. 0.1059g of copper were produced. Good, but seems very high!

Jason Cody - Oct 14, 2020, 12:52 PM CDT

Calculations

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Mass of copper = 24.8315 - 24.7292= 0.1059

Percent Copper = 0.1059g/0.0603g x100 = 176% Yikes!

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Conclusions

Jason Cody - Nov 03, 2023, 9:50 AM CDT

sons for the percent copper being higher than 100% include added weight from water in the copper, unreacted zinc, or oxidization of the copper. Copper and copper ions were lost in multiple stages of reactions. Bits of copper remained in equipment or in decanted solutions. The copper turned from shiny orange (Cu) to transparent green blue ($Cu(NO_3)_2$) to bright cobalt blue ($Cu(OH)_2$) to black/dark brown (CuO) to a pale sky blue ($CuSO_4$) and lastly back to a dark powdery orange (Cu^{2+}) ?? elemental copper has no charge. The first reaction also produced and amber gas (NO_2). The reaction between Zn and excess H_2SO_4 should ensure that there is no remaining Zn left to contaminate the copper solution. The faint blue color is copper oxide. Good, except that the blue color is from $Cu^{2+}(aq)$.