

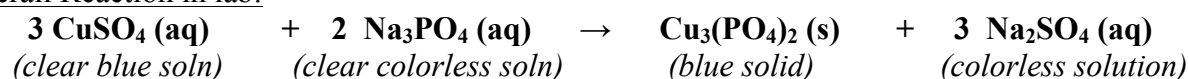
HINT Sheet for $\text{Cu}_3(\text{PO}_4)_2$ Lab

INTRODUCTION: Ideally, a chemist wants all of his reactants to react, as much product as possible to be collected, and all products to be pure. However, reactions often don't go this smoothly. Sometimes, not all of the reactants react, different substances contaminate the products, and some mass is just lost completely.

Ideally, in this lab, you should not have lost any mass overall, both of your yields should have been 100% and both of your products should have been pure. (We did not really test for purity, but if your Na_2SO_4 was blue, you know it was contaminated.) This sheet will help you think through what could have gone wrong in your lab.

DIRECTIONS: Please try to answer the following questions with your lab partner. This sheet will not be graded. Once you have gone through this sheet, you should be able to work on developing a good solid conclusion for your lab.

Overall Reaction in lab:



- Based on your lab experience, state whether each of these substances are soluble or insoluble in water: (Definition: A soluble substance is a substance that dissolves into water when stirred into water.)
 - CuSO_4 soluble
 - Na_3PO_4 soluble
 - $\text{Cu}_3(\text{PO}_4)_2$ insoluble
 - Na_2SO_4 soluble
- If one filtered a water mixture containing all of the above substances, which substance(s) would get caught in the filter paper? $\text{Cu}_3(\text{PO}_4)_2$ Which ones(s) would go through the filter paper? All the others (Hint—soluble substances must go through filter!!)
- In this lab, you wanted to completely react both the CuSO_4 and Na_3PO_4 . However, it is very difficult to add exactly 3 moles of CuSO_4 for every 2 moles of Na_3PO_4 . So, instead, you tried to add just a slight excess of the Na_3PO_4 in order to make sure all of the CuSO_4 reacted.
 - If some **Na_3PO_4 was in excess**, would this unreacted Na_3PO_4 get caught in the filter paper or would it go through? go through
Thus, having excess Na_3PO_4 would increase the yield of which product-- **$\text{Cu}_3(\text{PO}_4)_2$ or Na_2SO_4 ?**
 Na_2SO_4 since the Na_3PO_4 and Na_2SO_4 are both soluble
 - However, if it did not work out as planned and **some of the CuSO_4 was actually in excess**, would this unreacted CuSO_4 get caught in the filter paper or would it go through? go through.
Thus having excess CuSO_4 would increase the yield of which product-- **$\text{Cu}_3(\text{PO}_4)_2$ or Na_2SO_4 ?**
 Na_2SO_4 since the $\text{Cu}_3(\text{PO}_4)_2$ and Na_2SO_4 are both soluble

4) Some people had a clear blue solution in their flask after filtering and others had a clear colorless solution after filtering. Which situation discussed in question #3 would cause ...

a) a clear blue solution to form in the flask? **excess Na_3PO_4 or excess CuSO_4**

b) a clear colorless solution to form in the flask? **excess Na_3PO_4 or excess CuSO_4**

Situation (b) in #3, excess CuSO_4 , would cause observation (a) since CuSO_4 forms a clear blue solution.

Situation (a) in #3, excess Na_3PO_4 , would cause observation (b) since Na_3PO_4 forms a clear colorless solution.

5) In step 10 of the procedure, you were told to wash the blue solid in the filter paper with water. If the solid was not washed enough, how would this have affected the masses of each of your two products? Why?

If not washed, the $\text{Cu}_3(\text{PO}_4)_2$ would retain some of the residue from the solution, primarily the soluble Na_2SO_4 . This would increase the measured mass of the solid product and decrease the measured mass of the aqueous product.

6) In step 12, you boiled away the water in the flask to quickly separate the Na_2SO_4 from the water. It would have taken longer, but it would have been better, to just put the solution in an oven overnight to evaporate away the water. When boiling on a very hot hotplate, two significant errors, listed below, can occur. **How would each of the errors have affected the mass of the Na_2SO_4 product? Explain why for each.**

Error #1: The Na_2SO_4 might decompose if it gets too hot. *(This might occur if all the water boils away and the flask is left on the hot plate for a while longer. One might see the solid turn black.*

The reaction for the decomposition of Na_2SO_4 is $\text{Na}_2\text{SO}_4(\text{s}) \rightarrow \text{Na}_2\text{O}(\text{s}) + \text{SO}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g})$

Decomposition would decrease the measured mass of the aqueous product because it would lose one S and 3 O atoms per mole to SO_2 and $\frac{1}{2} \text{O}_2$ gases.

Error #2: The Na_2SO_4 solution might splatter out of the flask.

Splattering of the solution out of the flask would expel some of the Na_2SO_4 in the flask, decreasing the measured mass.

7) We allowed the blue solid product to dry overnight. How would the mass of the blue solid have been affected if it were not completely dry when we massed it out the next day?

If not completely dry, excess water would add to the measured mass of the blue solid.