

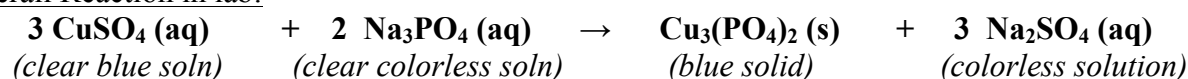
HINT Sheet for $\text{Cu}_3(\text{PO}_4)_2$ Lab (counts as HW)

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 _____
 - Na_3PO_4 _____
 - $\text{Cu}_3(\text{PO}_4)_2$ _____
 - Na_2SO_4 _____
- If one filtered a water mixture containing all of the above substances, which substance(s) would get caught in the filter paper? _____ Which ones(s) would go through the filter paper? _____ (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? _____
Thus, having excess Na_3PO_4 would increase the yield of which product-- **$\text{Cu}_3(\text{PO}_4)_2$ or Na_2SO_4** ?
 - 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? _____
Thus having excess CuSO_4 would increase the yield of which product-- **$\text{Cu}_3(\text{PO}_4)_2$ or Na_2SO_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 clear blue solution to form in the flask? **excess Na_3PO_4 or excess CuSO_4**
 - a clear colorless solution to form in the flask? **excess Na_3PO_4 or excess CuSO_4**
- In step 5 of the procedure, it says to swirl the mixture for 3 minutes to make sure the reactants have fully reacted. Let's suppose the reaction had not fully occurred when the mixture was filtered. And now, let's suppose that the reaction does take place in the flask (after reactants go through filter.) In this situation, what would be observed in the flask?

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

7) 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 $\text{Na}_2\text{SO}_4(\text{s}) \rightarrow \text{Na}_2\text{O}(\text{s}) + \text{SO}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g})$)*

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

8) 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?

9) So far, you have explained how errors have affected the masses of each of the products. However, you have not discussed whether there are any errors that would cause a difference between the total mass of reactants compared to the total mass of products.

a) One of the errors mentioned previously would cause the total mass of the products to be greater than the total mass of the reactants. Which error would do this? Why?

b) Come up with a common error (one not previously mentioned) that would cause the total mass of the products to be less than the total mass of the reactants.