Name_____ Partner_____

Purification and Analysis of a Chemical Spill

The Ohio River is responsible for 15% of the countries electricity and over one billion dollars of commerce each year. It is imperative that it is kept clean, safe and operational. A massive spill of copper (II) sulfate has been reported from an oil refinery up river. Your teams' mission is to use a single displacement reaction of iron with copper (II) chloride to extract as much pure solid copper as possible. Copper ions are much more dangerous in water than iron ions. You have to tell the chemical engineers exactly which chemical reaction is taking place. Is Fe+3 or Fe+2 forming? This will have an impact on the amounts of materials required to quickly and efficiently clean up the process.

There is a model for this. Go to the “Atomsmith” program. Click on “Models” and then “Reaction Lab”. Click on “General Chemistry”. Under “Single Displacement” explore the Iron (nail) and copper (II) sulfate reaction. This is similar to the one we are doing. We are not sure though if it is Fe+3 or Fe+2. How can we determine this experimentally?

A. Place the data and the answers to the calculations in a predetermined spreadsheet that you will be provided. You should not write in units. They have been put in for you. You will electronically submit this!!!! You may do it on your own or with your partner if you agree.
B. You must have a hard written copy of your data, the answers to the calculation. The written copy must have units labels and sample calculations. Everyone must turn this in.
Use the entries suggested at the end of the procedure section.
This advance preparation will save you time and allow you to concentrate on making the required observations during the time available.

*PROCEDURE

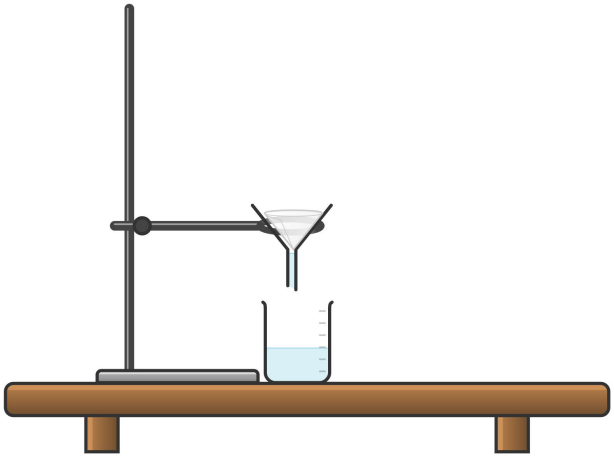
Day 1

Person A

1. Get a beaker.
2. Fill to about 50 to 100 mL of warm water.
3. Add a tablespoon (about 12.5 g) of copper (II) sulfate.
4. Dissolve the copper (II) sulfate.

Person B

1. Take some steel wool and clean two nails.
2. Record the mass of two clean nails.
3. Place nails in beaker with copper (II) sulfate and water.
4. Use nails to stir the solution and dissolve the copper (II) sulfate.
5. About every 5 minutes, scrape off the red material on the nails into the beaker.
6. Get mass of filter paper. Write names and bell on filter paper in PENCIL. Set up filter and ring stand.



1. Pick up the nails, one at a time. Using a wash bottle, wash all of the reddish-brown material from the nails into the beaker and scrape off the material into the beaker.
2. Put the nails aside on a piece of paper toweling to dry overnight.
3. Carefully decant the solution from the reddish-brown material remaining in the beaker. Decant means to pour off the liquid, leaving the solid behind.
4. Wash the remaining solid with about 25 mL of distilled water and decant. Repeat the washing and decanting procedure 4 or 5 times. Be careful to lose as little of the solid as possible.
5. Next, wash the solid with about 25 ml of 1 M HCl solution. Decant and wash again with distilled water and decant.
6. Set up a filtration apparatus and filter the solid into the filter paper as directed by your teacher. (See diagram above.)
7. Open the wet filter paper and lay flat on paper towel to dry overnight with the nails.

Day 2

1. Weigh the nails (on the same balance) to determine their combined mass. Record this mass to the nearest 0.0001 g.
2. Weigh the combined filter paper and solid and record their mass to the nearest 0.0001 g.
3. Discard the filter paper and solid in the trash can and place the used nails back in the box.

Observations

*PROCESSING THE DATA

1. Determine the mass of iron lost by the nails.
2. Determine the moles of iron used. Recall that the mass of any substance multiplied by the moles per gram of that substance equals the number of moles.
3. Determine the mass of dry product.

4. Assuming the product to be copper, determine the moles of copper produced.
5. Determine the mole ratio: moles of Fe
moles of Cu
Divide the moles of Fe by the moles of Cu to obtain a decimal number. Be sure to express your answer using the correct number of significant figures.
6. What evidence did you observe that would suggest some of the copper was left in the solution?
7. If your copper was not dry, how would this affect your final result?

*CONCLUSION
Based upon your mole to mole ratio above, determine the correct balanced chemical equation for the reaction that you observed. Your teacher will provide you with the possible equations

A. $Fe_{(s)} + CuSO_{4(aq)}$ yields $FeSO_{4(aq)} + Cu_{(s)}$
B. $2Fe_{(s)} + 3CuSO_{4(aq)}$ yields $Fe_2(SO_4)_{3(aq)} + 3\ Cu_{(s)}$

Conclusion Question.

If you were to weigh your copper and it was still wet, how would that affect the mass of copper formed. Would it be higher or lower than the true answer of dry copper? How would this affect the final ratio? How would this affect which reaction to choose?

What is due:

You must electronically submit a spreadsheet (I will provide the information on how to do this).
You MUST provide a hard copy of calculations.

Data Table

Names/Bell	
Mass of nails before reaction (g)	
Mass of nails after reaction reaction (g)	
Mass of dry filter paper(g)	
Mass of filter paper and solid(g)	
Mass of iron lost by nails (g)	
Moles of iron used in reaction(moles)	
Mass of dry copper produced (g)	
Moles of copper produced (moles)	
Moles ratio of iron to copper	
Which reaction occurred? A or B?	