Chemistry 20: Simple Stoichiometry Lab
TEACHER NOTES

Name _____ Lab Partner _____ Score _____

Purpose: To predict and collect a precipitate formed in a double replacement reaction.

Problem: What is the effect upon the mass of precipitate formed if the amount of copper (II) sulfate is changed?

All students will be using 100 mL of 1.50 mol/L NaOH(aq) or 0.15 mol of sodium hydroxide
So using the following balanced reaction

$$2NaOH(aq) + CuSO_4.5H_2O(s) \rightarrow Cu(OH)_2(s) + Na_2SO_4(aq) + H_2O(l)$$

Since we must ensure that the sodium hydroxide is always the excess reagent, then it is important to limit the amount of copper (II) sulfate they can use.

The students will all be using 0.15 moles of NaOH
So the maximum number of moles of Copper (II) sulfate penta hydrate is 0.075 moles
Molar mass of copper (II) sulfate pentahydrate is 249.72g/mol
Note if you have anhydrous copper (II) sulfate (without the 5 water) the molar mass is going to be very different (159.62g/mol)

You might assign several students do each of the following masses. Or at least have one group do each mass of copper (II) sulfate if you have a small class.

Assigned to	Moles of copper (II) sulfate pentahydrate	Mass of copper (II) sulfate pentahydrate (g)	Theoretical yield of copper (II) hydroxide precipitate (g)
	0.060 mol	14.98	5.85
	0.055 mol	13.73	5.37
	0.050 mol	12.49	4.88
	0.040 mol	9.99	3.90
	0.030 mol	7.49	2.93
	0.020 mol	4.99	1.95

Equipment:
electronic scale
Weighing paper
100 mL graduated cylinder
Meniscus finder
Copper II sulfate pentahydrate
Sodium hydroxide (a deliquescent ionic substance)
Distilled water
Beakers (various sizes)
Stir rod
Wash bottle

Funnel and filter paper
Ring clamp and stand

Prelab

1. Write a balanced reaction for a double replacement reaction between solid copper (II) sulfate pentahydrate and a solution of sodium hydroxide.

   $2NaOH(aq) + CuSO_4.5H_2O(s) \rightarrow Cu(OH)_2(s) + Na_2SO_4(aq) + H_2O(l)$

2. Your assigned mass of copper (II) sulfate that will be used in this lab is ____ g

   Using this value and assuming excess sodium hydroxide, calculate the mass of precipitate that should be formed. (Theoretical value). You will have to share this value with other lab groups …. So be certain it is correct!
   SEE table above for values

3. Identify the manipulated, responding and control variable(s) for this lab
   Manipulated mass of copper (II) sulfate Responding mass of copper (II) hydroxide

   Control moles of sodium hydroxide, process, equipment

Procedure:

1. Clean and dry all glassware.
2. Weigh YOUR assigned amount of $CuSO_4.5H_2O(s)$ and place it in a clean beaker
   - Make a list on the board of which groups have which masses. Students need to collaborate and get information from other groups with different starting masses of copper (II) sulfate
3. Record the exact amount of mass that you have used.
4. Measure out 100 mL of the 1.50 mol/L NaOH(aq) that is provided
5. Add this solution to the copper (II) sulfate and stir.
6. Record your observations.
7. Decant off the liquid part of the mixture in your beaker. Do NOT lose any solid chunks while doing this. It is safe to put the decanted liquid down the sink.
   - If students have not done decanting before, demonstrate for them. A good mixture of water and soil will work if you have nothing else.
   - Remember the liquid coming off should NOT contain solid parts.
8. Get and weigh a large piece of filter paper. Record the mass.
9. Set up the funnel and filter paper using the ring stand.
10. Be sure the filter paper is rinsed with distilled water and has a good seal with the side of the filter.
11. Carefully transfer all the solid left in your beaker to the filter paper. Try to spread the solid out so that it will dry faster. (this is why a BIG piece of filter paper is good)
12. Using a minimum of water to rinse, ensure that ALL the solid precipitate from the beaker is transferred to the filter paper.
13. Allow the funnel and filter paper to dry at least over night
14. Weigh the filter paper and the precipitate. Record the mass

Observations: Decide how many marks you will give for accuracy here

You must record your own observations and observations from four other groups who will have started with a different mass of copper (II) sulfate pentahydrate.

My observations

Mass of $CuSO_4.5H_2O(s)$	Mass of filter paper	Mass of precipitate and filter paper
Theoretical yield of precipitate	Actual yield of precipitate	% yield for your value

Summary of observations from 5 groups

Mass of $CuSO_4.5H_2O(s)$	Theoretical yield of precipitate	Actual Lab yield for precipitate	Percentage yield

Analysis:

Is there a general pattern for the percentage yield? If or if not, give scientific reasons why this has happened. Remember that an error in measurement is not a scientific reason!!!! Never give this as an excuse for being off from the expected value!

Assuming that everyone has fairly equal skill, the percentage yield should be relatively constant.
But remember a small loss from a small sample amplifies the error. Whereas a small loss from a bigger sample minimizes the error

Conclusion:

Remember that a conclusion must answer the problem. It must be based on your observations and must be supported with accepted scientific theories and knowledge. DO NOT restate your observations. Conclusions must give a "WHY DID YOU SEE THIS?"

- Students should talk about the balanced reaction and how the number of moles that they start with is proportional to the number of moles of precipitate they will form.
- But since the problem talks about mass, not MOLES, they should be able to conclude that a bigger starting mass will yield a bigger mass of precipitate
- They can quote the law of definite proportions, conservation of mass etc etc