

Lab #3: Solution Preparations

Objectives:

1. To accurately prepare solution from a solid solute.
2. To accurately prepare a dilute solution.

Hypothesis / Pre-lab Exercise:

1. Calculate the mass of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}_{(s)}$ needed to make a 100 mL of 0.375 M solution.
2. Determine the volume of a 0.180 M of $\text{H}_2\text{SO}_4_{(aq)}$ needed to dilute the acid to a concentration of 0.00720 M with a final volume of 250 mL.

Materials:

Large Beaker	Funnel	1 Volumetric Flask (100 mL)	$\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}_{(s)}$
Electronic Balance	Stirring Rod	1 Volumetric Flask (250 mL)	$\text{H}_2\text{SO}_4_{(aq)}$ (0.180 M)
Small Beaker	Pipets of various sizes	Pipet Bulb	Deionized Water
Scoopula	Masking Tape	Wash Bottle	Hot Plate

Procedure:

A. Making 0.375 M of $\text{CuSO}_4_{(aq)}$

1. With the small beaker on the electronic balance, calibrate it to zero.
2. Using the scoopula and a beaker, carefully measured out the mass of $\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$ needed for the solution (see Pre-lab exercise 1). Record the actual measurement used.
3. Pour about 40 mL of deionized water into the 150 mL beaker. Using a stirring rod, dissolve as much of the copper (II) sulfate pentahydrate as possible. Leave the stirring rod in the beaker the whole time. Do not take it out.
4. Set up the heating apparatus using a hot plate. Heat the small beaker of partially dissolved $\text{CuSO}_4_{(aq)}$ until it is completely dissolved. Turn off hot plate, and remove hot beaker using heat resistant gloves or heavily folded up paper towels. Let the beaker cool down on the bench until it is safe to touch with your bare hands. Leave the stirring rod in the beaker. Do not take it out even when finish stirring
5. Place the funnel into the 100 mL volumetric flask. Take the stirring rod and wash it thoroughly with deionized water from a wash bottle. After washing, place the stirring rod on the table.
6. When the beaker of copper (II) sulfate solution is sufficiently cooled, pour it into the 100 mL volumetric flask using a funnel.
7. Wash the small beaker and funnel with deionized water from a wash bottle. All washed fluid should be transfer to the volumetric flask during the actual washing. Be careful not to pass the mark on the volumetric flask.
8. Top up the volumetric flask with deionized water up to the mark. Cap the flask and shake. (Optional: If the instructor requested, then empty the solution from the volumetric flask into a clean reagent bottle.) Label your solution with the chemical formula, concentration and your name.

B. Diluting $\text{H}_2\text{SO}_4_{(aq)}$:

1. With the larger beaker, obtain around 50 mL of the 0.180 M $\text{H}_2\text{SO}_4_{(aq)}$.
2. Using a correct volume pipet, wash it twice with the 0.180 M of sulfuric acid. Discard the washed acid as directed by your instructor.
3. Pipet the correct amount to the 250 mL volumetric flask. Record this initial volume added.
4. Top up the volumetric flask with deionized water up to the mark. Cap the flask and shake. (Optional: If the instructor requested, then empty the solution from the volumetric flask into a clean reagent bottle.) Label your solution with the chemical formula, concentration and your name.

Evaluation:

1. Explain why it is necessary to dissolve all the $\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}_{(s)}$ in the beaker with a significantly smaller volume of water before transferring to the volumetric flask.
2. Why is it necessary to wash the pipet twice with the 0.180 M of $\text{H}_2\text{SO}_4_{(aq)}$ prior to the actual diluting? Specify what would happen to the final concentration if this step were omitted?
3. Explain the what would happen to the final concentration of $\text{H}_2\text{SO}_4_{(aq)}$ if there is
 - a. an air bubble in the pipet?
 - b. water present in the volumetric flask when transferring from the pipet?
4. Create two multiple-choice questions. One with making solution out of a solid solute and the other that deals with dilution. Both questions should follow the guidelines below.
 - four choices – all choices must accompany an explanation of how one might arrive that answer.
 - questions does not have to be numerical. Conceptual or lab-technique questions are allowed.
 - correct answer should be indicated.

Example:

What is the mass required to make a 250 mL of 0.40 mol/L NaOH solution?

- A.** 0.4 g ($40.0 \text{ g/mol} \div 250 \text{ mL} \div 0.40 \text{ mol/L}$)
B. 2.5 g ($0.40 \text{ mol/L} \times 250 \text{ mL} \div 40.0 \text{ g/mol}$)
C. 4.0 g ($0.40 \text{ mol/L} \times 0.250 \text{ L} \times 40.0 \text{ g/mol}$) – correct answer
D. 25 g ($40.0 \text{ g/mol} \times 0.250 \text{ L} \div 0.40 \text{ mol/L}$)

Conclusion:

Summarize what you have learned from this lab.