Lab #2: 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 $CuSO_4 \bullet 5H_2O_{(s)}$ needed to make a 100 mL of 0.750 M solution.
2. Determine the volume of a 0.180 M of $H_2SO_{4\,(aq)}$ needed to dilute the acid to a concentration of 0.0180 M with a final volume of 100 mL.

Materials:

Large Beaker	Funnel	2 Volumetric Flasks (100 mL)	$CuSO_4 \bullet 5\ H_2O_{(s)}$
Electronic Balance	Stirring Rod	Pipet Bulb	$H_2SO_{4\,(aq)}$ (0.180 M)
Small Beaker	Pipets of various sizes	Wash Bottle	Distilled Water
Scoopula	Masking Tape	Bunsen Burner	Ring Stand
Small Iron Ring	Wire Gauze	Beaker Tongs	

Procedure:

A. Making 0.750 M of $CuSO_{4\,(aq)}$

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 $CuSO_4 \bullet 5\ H_2O$ needed for the solution (see Pre-lab exercise 1). Record the actual measurement.
3. Pour about 20 mL of distilled water into the small beaker. Using a stirring rod, dissolve as much of the copper (II) sulfate pentahydrate as possible.
4. Set up the heating apparatus with the Bunsen burner, ring stand, small iron ring and wire gauze. Heat the small beaker of partially dissolved $CuSO_{4\,(aq)}$ until it is completely dissolved. Turn off Bunsen burner, and remove hot beaker with beaker tongs. Let the beaker completely cool down on the bench.
5. Pour the solution into the 100 mL volumetric flask using a funnel and a stirring rod.
6. Wash the small beaker, funnel and stirring rod with distilled water in 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.
7. Top up the volumetric flask with distilled water up to the mark. Cap the flask and shake. After mixing well, uncap the top and use masking tapes to seal the volumetric flask. (This is because the high concentration of $CuSO_4$ might seal the flask from the inside making it hard to open for the next lab.)

B. Diluting $H_2SO_{4\,(aq)}$:

1. Using a correct volume pipet, wash it twice with 0.180 M of sulfuric acid. Discard the washed acid into a large waste beaker.
2. Pipet the correct amount to the 100 mL volumetric flask. Record this initial volume added.
3. Top up the volumetric flask with distilled water up to the mark. Cap the flask and shake.

Evaluation:

1. Explain why it is necessary to dissolve all the $CuSO_4 \bullet 5\ H_2O_{(s)}$ 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 $H_2SO_{4\ (aq)}$ prior to the actual diluting? What would happen to the final concentration if this step were omitted?
3. Explain the what would happen to the final concentration of $H_2SO_{4\ (aq)}$ 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 AP style 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.
   - five 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.
   - non-calculator proof – numbers should be easy to deal with (some extra info should be given).
   - correct answer should be indicated.

   Example:
   What is the mass required to make a 250 mL of 0.40 mol/L NaOH solution? (M = 40.0 g/mol)
   A. 0.4 g (40.0 g/mol ÷ 250 mL ÷ 0.40 mol/L)
   B. 2.5 g (0.40 mol/L × 250 mL ÷ 40.0 g/mol)
   C. 4.0 g (0.40 mol/L × 0.250 L × 40.0 g/mol) – correct answer
   D. 25 g (40.0 g/mol × 0.250 L ÷ 0.40 mol/L)
   E. 4.0 kg (0.40 mol/L × 250 L × 40.0 g/mol)

Conclusion: Summarize what you have learned from this lab.