Name: _____

Preparation of Alum

Introduction: Alum or potassium aluminum sulfate dodecahydrate ($KAl(SO_4)_2 \cdot 12H_2O$) is used as a mordant in dyeing and also puts the "crunch" in pickles. Aluminum from recycled sources is much less expensive than that formed from aluminum ore. Aluminum may also be recovered chemically. In this experiment metallic aluminum is converted to Alum then analyzed by melting point, water of hydration, and percent sulfate.

$$2\ Al(s) + 2\ KOH(aq) + 6\ H_2O(l) \rightarrow 2\ K[Al(OH)_4](aq) + 3\ H_2(g)$$

$$2\ K[Al(OH)_4](aq) + H_2SO_4(aq) \rightarrow 2\ Al(OH)_3(s) + K_2SO_4(aq) + 2\ H_2O(l)$$

$$2\ Al(OH)_3(s) + 3\ H_2SO_4(aq) \rightarrow Al_2(SO_4)_3(aq) + 6\ H_2O(l)$$

$$K_2SO_4(aq) + Al_2(SO_4)_3(aq) + 12\ H_2O(l) \rightarrow 2\ KAl(SO_4)_2 \cdot 12H_2O\ (s)$$

Overall Reaction:

$$2\ Al(s) + 2\ KOH + 4\ H_2SO_4 + 10\ H_2O \rightarrow 2\ KAl(SO_4)_2 \cdot 12H_2O + 3\ H_2$$

Purpose: The purpose of this experiment is to prepare alum from aluminum metal and calculate the percentage yield.

Equiptment/Materials:

50% water:ethanol	hot plate
aluminum (cans or foil)	ice bath
aspirator or hand vacuum pump	parafilm
balance	potassium hydroxide 3M
beaker (150, 250, & 400 mL)	ring stand
beaker tongs	rubber policeman
buchner funnel	stirring rod
filter paper	sulfuric acid 3M
graduated cylinder	wash bottle
glass boiling beads	

Safety:

- Always wear goggles in lab
- Both sulfuric acid and potassium hydroxide can cause burns and are very hazardous to the eyes
- Use caution and follow proper procedure when using suction filtration

Procedure:

1. Tear approximately one gram of aluminum into small pieces (5mm x5 mm), then measure and record exact mass.
2. Transfer aluminum pieces to 400-mL beaker. Save the weigh boat.
3. Set up a buchner funnel. Secure it with clamp and ring stand before connecting it to a vacuum line. Add filter paper and rinse paper with small amount of water.
4. Add 25 mL of 3 M potassium hydroxide (caution) to the aluminum in the beaker and observe the reaction until bubbling stops.
5. Vacuum filter the mixture to remove any solid particles.
6. Use a **small** amount of water from a wash bottle to rinse all of the solution out of the 400mL beaker into the filter.
7. Transfer the filtrate to a clean 250- mL beaker.
8. Discard the residue and filter paper.
9. Use a small amount of water to rinse the filter flask into the beaker.
10. **Slowly** add 35 mL of 3 M H_2SO_4 (sulfuric acid) to the filtrate with stirring (caution).
11. If any solid remains, the solution must be vacuum filtered.
12. Transfer the filtrate to a clean, labeled 150- mL beaker. Discard filter paper & residue.
13. Add 2-3 glass boiling beads and cover beaker with a watch glass.
14. Boil the solution on the hot plate gently to reduce its volume to about 50 mL.
15. Use a spatula to remove the boiling beads.
16. Cool the solution on a ceramic tile briefly. Cover with Parafilm and set the beaker where it an stand undisturbed.
17. Allow the solution to remain undisturbed until crystals from, at least overnight. If no crystals from, scrape the bottom of the beaker with a stirring rod. Do not proceed until you have crystals.
18. Determine the mass of the filter paper and a weigh boat. Place the filter paper in the Buchner funnel.
19. Gently scrape to loosen the crystals from bottom of beaker.
20. Transfer crystals and liquid to the funnel for vacuum filtration. Filter with suction until all the mobile liquid is removed. Rinse with a total of 50 mL of 50%

ethanol/water. DO NOT USE PURE WATER.

21. Discard the filtrate.
22. Transfer filter paper and crystals to your labeled weigh boat and allow the crystals to dry at room temperature 1-2 days.
23. When dry, determine the mass of the weigh boat, filter paper, and alum.

Data Table

mass of labeled weigh boat	
mass of aluminum and weigh boat	
mass of filter paper (from step 18)	
mass of filter paper, weigh boat, and crystals	

Calculations:

Assume aluminum is the limiting reactant. Using your initial mass of aluminum and the balanced overall equation, calculate the theoretical yield of ($KAl(SO_4)_2 \cdot 12H_2O$).

Using the final mass of ($KAl(SO_4)_2 \cdot 12H_2O$) and the theoretical yield, calculate your percent yield.

Calculations Table

mass of aluminum (Al)	
molar mass of aluminum (g/mol)	**1 mole Al = 26.982 g Al**
moles of aluminum	
theoretical mole ratio of alum : Al	**1 mole alum : 1 mole Al**
theoretical yield of alum (mol)	
molar mass of alum	**1 mole alum = 474.384 g alum**
theoretical yield of alum (g)	
actual yield of alum (g)	
actual yield of alum (mol)	
percent yield of alum	