

## **Synthesis of Potassium Alum**

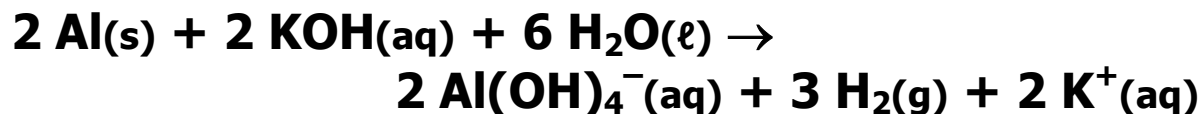
**Alums** are a class of double salts with the formula of  $MAl(SO_4)_2 \cdot 12 H_2O$ .

**M = alkali metal cation (Group 1A or +1 cation.**

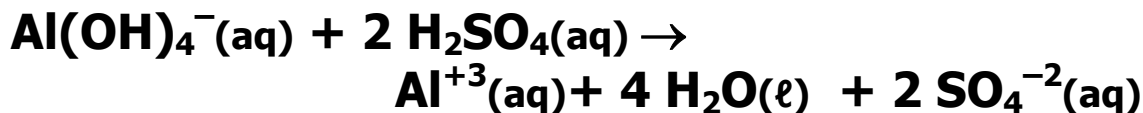
- **The alum available in grocery stores is potassium alum,  $KAl(SO_4)_2 \cdot 12 H_2O$ , potassium aluminum sulfate dodecahydrate.**
  - **Alum is used for pickling and in industry it is used in waste water treatment and in the production of paper.**
- **Formula is best be expressed as the complex cations of  $[K(H_2O)_6]^+$  and  $[Al(H_2O)_6]^{3+}$  with two  $SO_4^{2-}$  anions.**
- **It is a hydrated salt, e.g. it has water molecules associated with the salt. These water molecules are included in the molar mass or molecular weight.**

## Reactions:

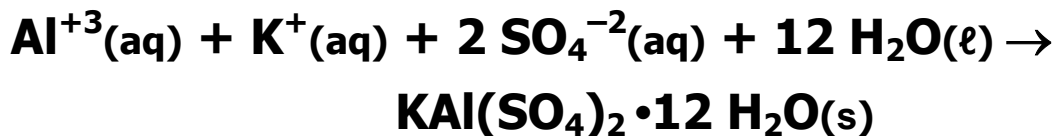
### Step 1: Dissolving the Al foil:



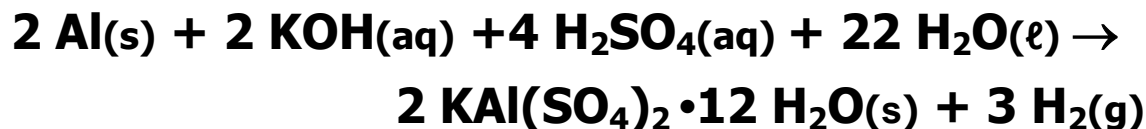
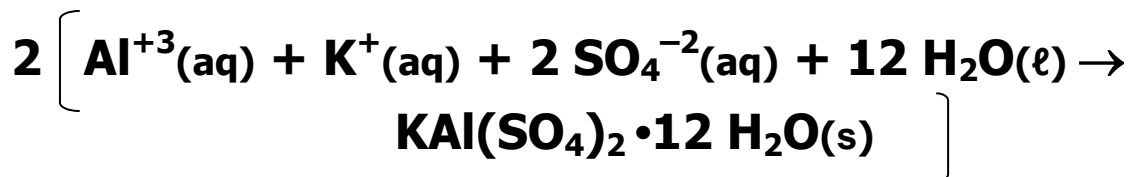
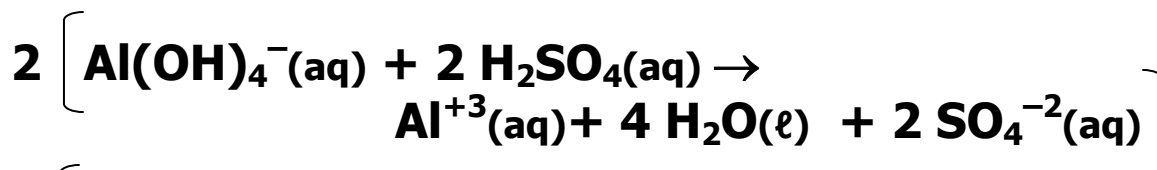
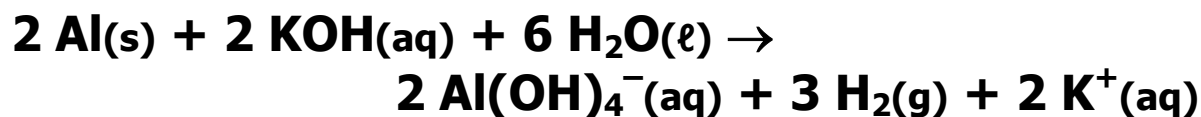
### Step 2: Neutralizing the OH<sup>-</sup>



### Step 3: Precipitate Potassium alum



To get the overall equation, you must multiply the 2<sup>nd</sup> and 3<sup>rd</sup> reactions by 2. This will cause the intermediate species to cancel completely.



**Theoretical Yield:** In theory, the amount of product that could be produced if the reaction were 100% efficient.

- **Always** start by calculating moles of known species (Al) and then doing a mole to mole ratio to determine the moles of the desired species (potassium alum).
- The last step converts the moles of the desired species to the needed units.
  - If a solid, generally find grams.
  - If aqueous solution, generally find Molarity or volume.

- **Find moles of potassium alum**

$$\text{mol K alum} = \text{g Al} \times \frac{1}{\text{MW Al}} \times \frac{2 \text{ mol KAl(SO}_4)_2 \cdot 12 \text{ H}_2\text{O}}{2 \text{ mol Al}}$$

- **Find grams of potassium alum**

$$\text{g K alum} = \text{mol alum} \times \text{MW alum}$$

- **Or one step calculation:**

$$\text{g K alum} = \text{g Al} \times \frac{1}{\text{MW Al}} \times \frac{2 \text{ mol alum}}{2 \text{ mol Al}} \times \text{MW K alum}$$

### **Actual or Experimental Yield:**

The actual amount of *product* recovered in the experiment.

- ***Never*** weigh chemicals directly on a balance, weigh your product by difference weighing.

$$\frac{\text{Weight of watch glass + product} - \text{Weight of watch glass alone}}{\text{Weight of product}}$$

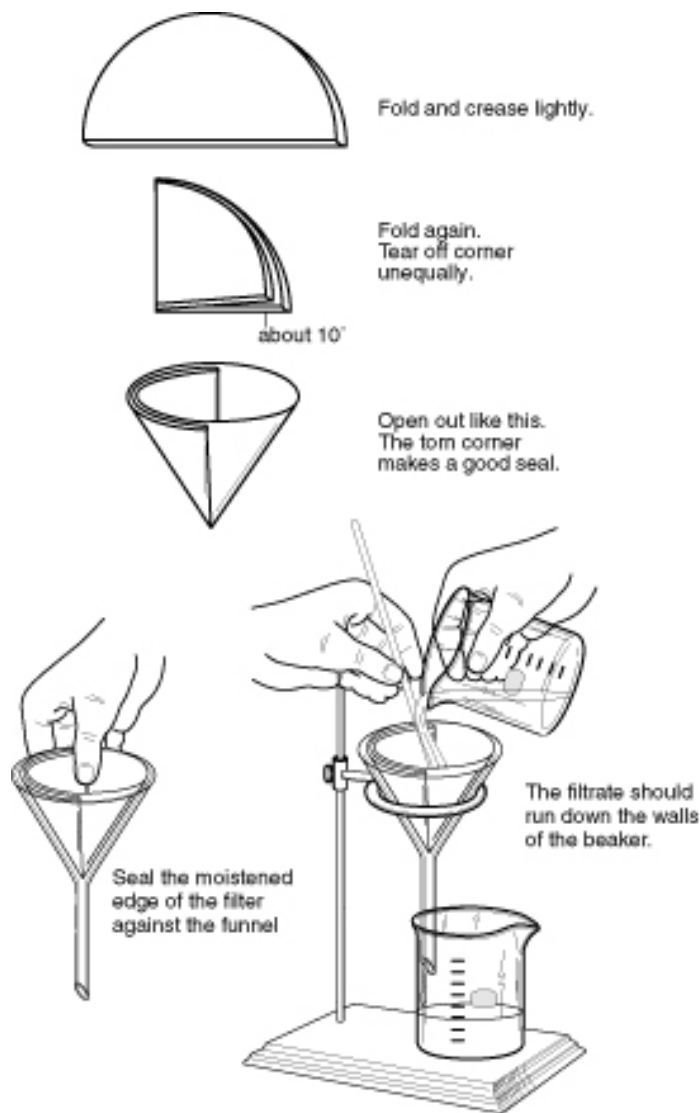
**Percent Yield:** The ratio of the actual (or experimental) yield to the theoretical yield multiplied by 100%.

$$\% \text{ yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$$

# Lab Techniques

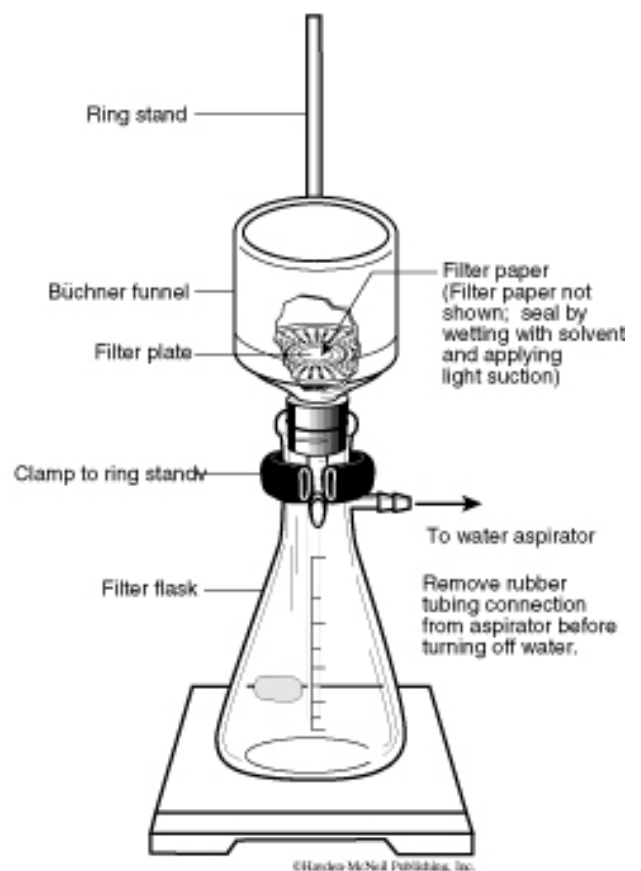
You will use two filtration apparatus, gravity filtration and vacuum filtration.

## Gravity Filtration:



Gravity Filtration

## Vacuum Filtration:



Suction Filtration