

**Part 4. Iron Content Determination by Visible Spectrophotometry**

**Known:** Absorbance of the  $\text{Fe}(\text{phen})_3^{2+}$  sample,  $A$   
 Molar absorptivity for  $\text{Fe}(\text{phen})_3^{2+}$  at 510 nm,  $\epsilon (\text{M}^{-1}\text{cm}^{-1})$   
 Dilution factors  
 Pathlength,  $l = 1 \text{ cm}$   
 Mass of the complex iron sample analyzed (g)

**To be determined:** Moles of  $\text{Fe}^{3+}$  per gram of sample (mole/g)

- Calculations:**
- $M(\text{Fe}(\text{phen})_3^{2+}) = \frac{A}{\epsilon l}$  (mole/L)
  - Total dilution factor =  $5 \times 5 \times X$ , where  $X$  is your final dilution
  - $M_{\text{original}}(\text{Fe}^{3+}) = M(\text{Fe}(\text{phen})_3^{2+}) \times \text{Total dilution factor}$
  - In 25 ml of solution:  $\text{moles Fe}^{3+} = M_{\text{original}}(\text{Fe}^{3+}) \times 0.025 \text{ L}$
  - $\text{Moles Fe}^{3+}/\text{g sample} = \frac{\text{moles Fe}^{3+}}{\text{mass of sample (g)}}$

 **$\text{K}_x\text{Fe}_y(\text{C}_2\text{O}_4)_z \cdot z\text{H}_2\text{O}$  Molecular Formula Determination**

**Known:** Moles of  $\text{C}_2\text{O}_4^{2-}$  per gram of sample (mole/g sample)  
 Moles of  $\text{K}^+$  per gram of sample (mole/g sample)  
 Moles of  $\text{Fe}^{3+}$  per gram of sample (mole/g sample)  
 $y = 1$

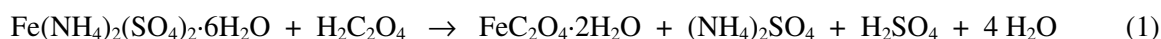
**To be determined:**  $x$  and  $z$

- Calculations:**
- $\frac{x}{y} = \frac{\text{moles of } \text{C}_2\text{O}_4^{2-} / \text{g sample}}{\text{moles of } \text{Fe}^{3+} / \text{g sample}} \Rightarrow x - ?$
  - $\text{g Fe}^{3+}/\text{g sample} = \text{moles Fe}^{3+}/\text{g sample} \times \text{MW (Fe)}$
  - $\text{g C}_2\text{O}_4^{2-}/\text{g sample} = \text{moles C}_2\text{O}_4^{2-}/\text{g sample} \times \text{MW (C}_2\text{O}_4^{2-})$
  - $\text{g K}^+/\text{g sample} = \text{moles K}^+/\text{g sample} \times \text{MW (K)}$

5.  $\text{g H}_2\text{O/g sample} = 1.000 \text{ g} - \text{g Fe}^{3+}/\text{g sample} - \text{g C}_2\text{O}_4^{2-}/\text{g sample} - \text{g K}^+/\text{g sample}$
6.  $\text{mole H}_2\text{O/g sample} = \frac{\text{g H}_2\text{O/g sample}}{\text{MW (H}_2\text{O)}}$
7.  $\frac{z}{y} = \frac{\text{moles of H}_2\text{O / g sample}}{\text{moles of Fe}^{3+} / \text{g sample}} \Rightarrow z - ?$

### Determination of the Theoretical Yield and Percent Yield of $\text{K}_x\text{Fe}_y(\text{C}_2\text{O}_4)_x \cdot z\text{H}_2\text{O}$

#### Chemistry involved:



**Note:** Equation (2) has to be balanced before you start working on these calculations

#### Known:

Actual yield of the product (g)

Mass of the starting material,  $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$  (g)

Assume  $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$  to be the limiting reactant in reaction (1)

Assume  $\text{FeC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$  to be the limiting reactant in reaction (2)

**To be determined:** Theoretical yield (g) and Percent yield (%)

- Calculations:**
1.  $\text{Moles Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O} = \frac{\text{mass of Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O (g)}}{\text{MW (Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O)}}$
  2.  $\text{Moles FeC}_2\text{O}_4 \cdot 2\text{H}_2\text{O} = \text{Moles Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$  (determined from the stoichiometry of equation 1)
  3. Determine moles of  $\text{K}_x[\text{Fe}_y(\text{C}_2\text{O}_4)_x] \cdot z\text{H}_2\text{O}$  from moles of  $\text{FeC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$  using the stoichiometry of equation (2)\*
  4.  $\text{Theoretical yield (g)} = \text{Moles K}_x[\text{Fe}_y(\text{C}_2\text{O}_4)_x] \cdot z\text{H}_2\text{O} \times \text{MW (K}_x[\text{Fe}_y(\text{C}_2\text{O}_4)_x] \cdot z\text{H}_2\text{O)}$
  5.  $\text{Percent yield} = \frac{\text{actual yield (g)}}{\text{theoretical yield (g)}} \times 100\%$

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\* If you are unable to balance equation (2) due to the erroneous molecular formula determination, leave equation (2) unbalanced and use a 1-to-1 molar ratio of  $\text{FeC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$  to  $\text{K}_x[\text{Fe}_y(\text{C}_2\text{O}_4)_x] \cdot z\text{H}_2\text{O}$  at this step.