

Iron Content Determination by Visible Spectrophotometry**Beer's law:** $A = \epsilon l c$ **Dilution calculations:** $V_1 M_1 = V_2 M_2$,*where M_1 and M_2 are the molarities of the original concentrated and the final dilute solutions and V_1 and V_2 are the volumes of the original concentrated and the final dilute solutions*

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

Moles of 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: $\text{moles Fe}^{3+} = M_{\text{original}}(\text{Fe}^{3+}) \times 0.025 \text{ L}$
 - $\text{Moles Fe}^{3+}/\text{g sample} = \frac{\text{moles Fe}^{3+}}{\text{mass of sample (g)}}$

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

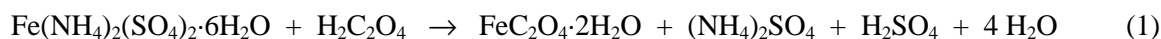
Known: Moles of $\text{C}_2\text{O}_4^{2-}$ per gram of sample (mole/g sample)
 Moles of K^+ per gram of sample (mole/g sample)
 Moles of Fe^{3+} per gram of sample (mole/g sample)
 $y = 1$

 $x = ?$ and $z = ?$

- Calculations:**
- $\text{C}_2\text{O}_4^{2-} : \text{Fe}^{3+} = \frac{\text{moles of C}_2\text{O}_4^{2-} / \text{g sample}}{\text{moles of Fe}^{3+} / \text{g sample}} \Rightarrow x - ?$
 - $\text{g Fe}^{3+} / \text{g sample} = \text{moles Fe}^{3+} / \text{g sample} \times \text{MW (Fe)}$
 - $\text{g C}_2\text{O}_4^{2-} / \text{g sample} = \text{moles C}_2\text{O}_4^{2-} / \text{g sample} \times \text{MW (C}_2\text{O}_4^{2-})$
 - $\text{g K}^+ / \text{g sample} = \text{moles K}^+ / \text{g sample} \times \text{MW (K)}$
 - $\text{g H}_2\text{O} / \text{g sample} = 1.000 \text{ g} - \text{g Fe}^{3+} / \text{g sample} - \text{g C}_2\text{O}_4^{2-} / \text{g sample} - \text{g K}^+ / \text{g sample}$
 - $\text{mole H}_2\text{O} / \text{g sample} = \frac{\text{g H}_2\text{O} / \text{g sample}}{\text{MW (H}_2\text{O)}}$
 - $\text{H}_2\text{O} : \text{Fe}^{3+} = \frac{\text{moles of H}_2\text{O} / \text{g sample}}{\text{moles of Fe}^{3+} / \text{g sample}} \Rightarrow z - ?$

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 product yield (g)
 - Mass of the starting material, $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$ (g)
 - theoretical yield (g) – ? and percent yield (%) – ?

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

* If you were unable to balance equation (2) due to the erroneous molecular formula determination, use a 1-to-1 molar ratio of $\text{FeC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ to $\text{K}_x[\text{Fe}_y(\text{C}_2\text{O}_4)_x] \cdot z\text{H}_2\text{O}$ to complete the theoretical yield calculation.