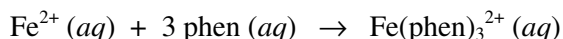


**Part 3. Standard Iron Solution Calculations****Dilution calculations:**  $M_1V_1 = M_2V_2$ ,where  $M_1$  and  $M_2$  are the molarities of the original concentrated and the final dilute solutions and  $V_1$  and  $V_2$  are the volumes of the original concentrated and the final dilute solutions**Calculations:** 1. Convert g/L into a mole/L concentration for the standard  $\text{Fe}^{2+}$  solution

2. Calculate the molarity of the stock
- $\text{Fe}(\text{phen})_3^{2+}$
- solution prepared from the standard
- $\text{Fe}^{2+}$
- solution using the stoichiometry of the following equation (note that 1,10-phenanthroline is used in excess in this reaction):



3. Calculate the molarities of the five standard
- $\text{Fe}(\text{phen})_3^{2+}$
- solutions prepared from the stock
- $\text{Fe}(\text{phen})_3^{2+}$
- solution (
- dilution calculations*
- )

**Part 4. Iron Content Determination by Visible Spectrophotometry****Beer's law:**  $A = \epsilon l c$ 

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

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

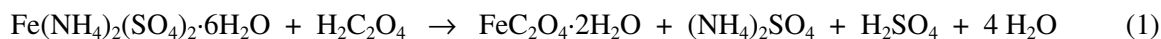
**Known:** Moles of  $\text{C}_2\text{O}_4^{2-}$  per gram of sample (mole/g sample)  
 Moles of  $\text{K}^+$  per gram of sample (mole/g sample)  
 Moles of  $\text{Fe}^{3+}$  per gram of sample (mole/g sample)  
 $y = 1$

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

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

### 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 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)
  - Moles of  $\text{FeC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ , produced in reaction (1) and used as a starting material in reaction (2). See Post-lab 5, question 5 for reference
  - 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:**
- 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)\*
  - Theoretical yield (g) = Moles  $\text{K}_x[\text{Fe}_y(\text{C}_2\text{O}_4)_x] \cdot z\text{H}_2\text{O} \times \text{MW (K}_x[\text{Fe}_y(\text{C}_2\text{O}_4)_x] \cdot z\text{H}_2\text{O})$
  - 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.