Stoichiometry calculations for gravimetric analysis of Iron as Fe$_2$O$_3$

**Introduction:**
A sample containing iron can be analyzed by precipitation of the hydrated hydroxide from basic solution, followed by ignition to produce Fe$_2$O$_3$. In this lab, you will have to determine what your sample is based on prior quantitative assumptions and gravimetric analysis/stoichiometric calculations of iron in your sample.

The potential choice are (iron in all these samples is in the form of Fe$^{2+}$):

1) Iron(II) fumarate  
2) Iron(II) sulfide  
3) Ferrous ammonium sulfate

Chemical analysis based on weighing a final product is called **gravimetric analysis**. One (1) gram of iron will be dissolved and then converted into solid Fe$_2$O$_3$. From the mass of Fe$_2$O$_3$, you will be able to calculate the mass of original in the iron sample. Then by stoichiometric calculations, you will be able to you're your original assumptions on the “mystery” solid and demonstrate which one it is.

**Step 1**
Dissolve ~1.1 g of the solid in 150 ml 0.1 M HCl. Then add 4 ml of hydrogen peroxide (H$_2$O$_2$; 3% wt:wt) to the solution and mix it well. The Iron (II) in the clear liquid is oxidized to iron(III) with excess H$_2$O$_2$:

$$2\text{Fe}^{2+} + \text{H}_2\text{O}_2 + 2\text{H}^+ \rightarrow 2\text{Fe}^{3+} + 2\text{H}_2\text{O}$$

(1)

**Step 2**
Add 10 ml of 2M ammonium hydroxide (NH$_4$OH) to the solution and mix it with the stir bar. The NH$_4$OH is added to precipitate the oxidized Fe(III), which is a gel. The gel is filtered and heated in a furnace to convert it to pure solid Fe$_2$O$_3$:

$$\text{Fe}^{3+}(\text{aq}) + 3\text{OH}^- (\text{aq}) + x\text{H}_2\text{O}(l) \rightarrow \text{Fe(OH)}_3 \cdot x\text{H}_2\text{O}(s) \rightarrow \text{Fe}_2\text{O}_3(s)$$

(2)

**Questions**

1) Average the two duplicate values and determine the average Fe content in your final product. Do you have a lot of difference between the two measurements? If
you do, comment why and how you could improve your procedure to reduce that difference.

2) Determine the Fe content in your original sample using the measured weight of the Fe₂O₃ produced.

3) Using that answer against your original assumptions and demonstrate quantitatively what the “mystery” compound is.

4) What mass of 3% H₂O₂ solution is required to provide 50% excess of reagent for reaction (1)?

5) Demonstrate quantitatively that you have enough H⁺ in solution to allow reaction (1) to go to completion.

6) What volume of 2M NH₄OH is needed to provide 50% excess of reagent for reaction (2)?