

3. Here at CMU, the Collins' Lab is designing Fe activators for hydrogen peroxide, which are being used as an environmentally benign alternative to Chlorine bleaches. A typical bleaching study in the lab mixes together a dye solution with peroxide and very small amounts of the activator in an aqueous solution.

You have 3.00 mL of a 3.75×10^{-3} mol/L solution of calmagite, a deep pink dye. The reaction conditions for this study indicate the following molar ratio of the components:

1 activator : 300 calmagite : 3000 hydrogen peroxide

- a) (1 point) As an initial "back of the envelope" estimate, what are the approximate concentrations of activator and hydrogen peroxide? You only need to give an answer as a power of ten.
- b) (4 points) Using the above concentration of calmagite and ratio, calculate the number of moles of hydrogen peroxide and Fe activator that will also be in the 3.00 mL solution.
- c) (2 points) Lab grade hydrogen peroxide comes as a 30% solution (by weight) in water. What volume of peroxide should you measure out to give you the number of moles of peroxide calculated in part b?

4. (7 points) Aspartame, an artificial sweetener marketed under the brand name of Nutrasweet®, is synthesized from two amino acids, and has the following composition:

C	57.13%
H	6.16%
N	9.52%
O	27.18%

What is empirical formula of aspartame?

5. Hydrazine, N_2H_2 , emits a large quantity of energy when it is combusted with oxygen gas, which has led to its use as rocket fuel. During the reaction, hydrazine reacts with oxygen gas, O_2 , to form Nitrogen gas, N_2 , and water, H_2O .

a) (2 points) Write a balanced equation detailing this reaction.

b) (3 points) If I make and launch a small, homemade rocket with 325 g of hydrazine and a 150 g bottle of oxygen that I "borrowed" from the lab, how many grams of Nitrogen are formed?

Problem 1	2	3	4	5	Total
/3	/5	/7	/5	/5	/20