Name: ____

Lab Instructor:__________________________________

PREPARATION FOR CHEMISTRY LAB: TITRATION

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1. We call an aqueous solution of H_2SO_4 an acidic solution. Why?

2. What is a neutralization reaction?

   Give the balanced equation for the reaction between phosphoric acid and sodium hydroxide.

3. 21.26 mL of a NaOH solution is needed to exactly neutralize 16.32 mg of pure vitamin C. How many mg of vitamin C are in a vitamin C containing sample if 13.64 mL of the NaOH solution is needed to exactly neutralize the vitamin C in the sample. (**DO NOT** use the molar mass of vitamin C or calculate the molarity of the NaOH solution is this problem.)

4. The chemical formula for vitamin C is given in the experiment. What is the molar mass of vitamin C?

5. 22.47 mL of a NaOH solution is needed to exactly neutralize 38.51 mg of pure vitamin C. What is the molar concentration of the NaOH solution? The reaction that occurs between vitamin C and NaOH is given in the experiment.

TITRATION

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Titration is a procedure in which one solution is used to analyze another. Titration includes any number of methods for determining, volumetrically, the concentration of a desired substance in solution by adding to it another solution of known concentration (stock solution). Usually, a change in color of an indicator that is present in the reaction mixture signals the end or completeness of reaction.

INTRODUCTION

When chemists are interested in obtaining quantitative information (numerical information concerning the species present) rather than the identity of the species present (qualitative analysis) they often use titration.

Read and/or review Sections 5-6, 12-4.1, 12-5, and 13-1 in your textbook.

Vitamin C (or ascorbic acid, $HC_6H_7O_6$) is an antioxidant and an acid. Ascorbic acid can be titrated with a base (sodium hydroxide, NaOH) using the indicator, phenolphthalein. Phenolphthalein changes from colorless to pink (or red) when all of the acid has been neutralized.

The equation for the neutralization reaction that occurs when Vitamin C is titrated with sodium hydroxide is given below:

$$HC_6H_7O_6(aq) + NaOH(aq) \rightarrow NaC_6H_7O_6(aq) + H_2O(l)$$

When ascorbic acid reacts with sodium hydroxide (a base) the salt $NaC_6H_7O_6$ (actually Na^+ and $C_6H_7O_6^-$ ions in solution) and water are produced. The acid and base react in a 1:1 ratio. That is, one mole of acid is exactly neutralized by one mole of base. If we know the volume and concentration of the base that exactly neutralizes all of the acid in an experiment, we can calculate the amount of acid that was initially present.

Because **pure vitamin C** is available, it is a simple matter to determine the number of mg of vitamin C (in solution) that are neutralized by one mL of base. This information will allow us to bypass knowing (or determining) the actual molar concentration of base used in the titration, thus greatly simplifying the calculations.

PROCEDURE

Make written observations as you proceed. You will not be prompted to do so because it should be instinctive. Questions at the end of the experiment will reinforce the habit

Solutions of vitamin C are rapidly oxidized by air. Have your buret set up and ready to titrate before you start the procedure. Add water to the vitamin C sample just before you are ready to titrate.

Part A: Analysis of Pure Vitamin C

Fill a buret with the NaOH solution that is provided. Weigh about 150 mg of pure vitamin C and record the exact mass. Work quickly, vitamin C is light- and air-sensitive. Recap the container immediately. Transfer the acid to your flask and add about 50 mL of water to dissolve it. Add two or three drops of phenolphthalein indicator. Titrate with base to the faintest, lasting pink color. Record the volume of base used. Do at least two more titrations with more weighed samples of pure acid.

For each titration, calculate the number of mg of pure acid that are titrated by each mL of base consumed. The average value of all your titrations must be within 0.2 mg/mL of each individual result. Repeat the titrations if necessary to get this level of precision.

Part B: Analysis of Commercial Vitamin C Tablets

Choose one brand of vitamin C tablet. Record the name of the brand, the vitamin C potency, and the other ingredients used in making the tablet. This information is on the label.

Weigh and record the mass of one whole tablet. Crush two tablets in a mortar. Weigh between 0.20 and 0.30 g of the powder (+/- 0.01g), record the exact mass, and transfer, without spilling, to a clean titration flask. Add about 50 mL DI water and two or three drops of indicator. Swirl the flask several times to help dissolve the vitamin C.

Titrate with aqueous NaOH and indicator just as you did in Part A. Repeat at least two more times with weighed amounts of crushed tablets until the appropriate level of precision (Part A) is obtained.

Calculate the number of milligrams of vitamin C in each sample titrated and in a whole tablet. Report average values of precise data.

DATA AND ANALYSIS SHEET: TITRATION

Name: ____

Date ______________ Lab Partner ______________________

Part A: Analysis of Pure Vitamin C

	Trial 1	Trial 2	Trial 3
Mass of pure vitamin C (mg)			
Initial buret reading (mL)			
Final buret reading (mL)			
Volume base used (mL)			
mg acid/mL base			

average mg acid/mL base: ___________________________

Part B: Analysis of Commercial Vitamin C Tablets

Tablet information:

Mass of one tablet: _______________ mg

	Trial 1	Trial 2	Trial 3
Mass of sample (mg)			
Initial buret reading (mL)			
Final buret reading (mL)			
Volume base used (mL)			
Vitamin C in sample (mg)			
mg vitamin C/mg sample			

Average: mg vitamin C/mg sample: __________________

Average: mg vitamin C/tablet: _____________________

Average: percent, by mass, of vitamin C in a tablet: ____________________

Name: ______________________________________

Lab Instructor:_________________________________

QUESTIONS ABOUT THIS LAB: TITRATION

1. How soluble is pure vitamin C (ascorbic acid) in water? (Qualitative/descriptive answer, numbers are not needed)

2. Why can't the titration method used in this experiment be used for the analysis for vitamin C in pink lemonade?

3. Convert your average mg vitamin C in a tablet to an average number of moles of vitamin C in a tablet.

   How many moles of NaOH are required to exactly neutralize the average number of moles of vitamin C in one tablet.

   How many mL of a 0.132 M NaOH solution are required to neutralize the average number of moles of vitamin C in one tablet?

4. 25.17 mL of a NaOH solution is needed to exactly neutralize 18.72 mg of pure vitamin C. How many mg of vitamin C are in a vitamin C containing sample if 20.67 mL of the NaOH solution is needed to exactly neutralize the vitamin C in the sample. (DO NOT use the molar mass of vitamin C or calculate the molarity of the NaOH solution is this question.)

5. 18.64 mL of a NaOH solution is needed to exactly neutralize 42.16 mg of pure vitamin C. What is the molar concentration of the NaOH solution?