*V211 FALL 2020 Chemistry Lab Report*

**Experiment E3**

**Spectrophotometric Analysis: Phosphates in Water**

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Section #: 7

Group #: 5

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*There are two main sections in each report, Pre-lab Exercises and Post-lab Report. Please finish the* ***Pre-lab*** *exercises before your scheduled lab time, which is* ***due at the beginning of each lab****. You need to submit* ***a hard copy*** *(double-sided printing) of your finished Pre-lab exercises (hand-written or typed) to your section TA when meet in the chemistry building. Please print out ‘****DATA SHEET’*** *to fill in raw data during the lab. You have* ***one week*** *to finish the* ***Post-lab*** *section after conducting each experiment (except E5). Submit the hard copy of completed report (double-side printing) to your section TA when meet for the next experiment in the lab.*

**This is for TAs ONLY!!! DO NOT write in this table!**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Grades** | | | | **Grader/s** |
| Pre-lab (100 pt) | |  | |  |
| Post-lab  (100+10 pt) | Calculation (30 pt) |  |  |  |
| Data Analysis (30 pt) |  |  |
| Discussion (30+10 pt) |  |  |
| Data Sheet (10 pt) |  |  |
| **Total** |  | |  |

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**PRE-LAB EXERCISE**

*Please finish the following exercises before experiment and bring the answers to the lab section. These exercises consist of 5 questions and are worth a total of 100 points, counted as 3% of the total course grade. These pre-lab exercises cover contents of Introduction and Experiment Procedure Part of Experiment E3. Please study the corresponding lab manual carefully before doing these exercises.*

***Question 1 (40 points)***

Here you need to write one or two short paragraphs about the content of Experiment 3 in the manual. You need to talk about the following topics. Note that you should manage these materials to make your answer like an official introduction to this lab.

*----Please briefly define the word "eutrophication" in the manual and state the cause of it.*

*----Please write the principle of spectrophotometric analysis. Since phosphate solution colorless, you need to give the coloring method.*

*----In your own words, summarize the basic way to construct a calibration curve.*

*----Please write the equation of Beer-Lambert Law and explain each parameter in the equation.*

Eutrophication refers to the phenomenon that a body of water becomes overly enriched with minerals and nutrients which induce excessive growth of algae and this may cause oxygen depletion of the water body and make the water unsafe for consumption. The lab experiment will determine one of the pollutants, phosphate in a water sample through spectrophotometric analysis. The spectrophotometric analysis depends on the principle that the amount of light absorbed by a sample shows a linear dependence upon the concentration of the compound present in the solution. Though phosphate solution is colorless, an ammonium vanadomolybdate reagent can be applied to color them. The calibration curve is used to determine the concentration and it can be constructed through deriving the slope and y-intercept, which can be done through linear fit. The *Beer-Lambert Law*, which indicates the linear relationship between absorbance and the concentration is represented as *A= εbc*. *A* represents the aborbance of the sample. *ε* represents the molar absorptivity. *b* represents the solution path length and *c* represents the molar concentration.

***Question 2 (20 points)***

What volume of 2.00 M phosphate stock solution is required to make 25.0 mL of a 4.00 M solution?

50.0ml of 2.00M phosphate stock solution is required.

***Question 3 (15 points)***

Please express the transmittance %T and absorbance A using original light intensity I0 and final light intensity I. When %T increases, will A increase or decrease?

When %T increases, A will decrease.

***Question 4 (20 points)***

Please list the chemical laboratory apparatus and their functions in the lab.

Spectrophotometer: To measure the %T in the experiment.

50- mL Volumetric flask: To determine the volume of a liquid.

1, 2, 5- mL Pipets and pipet bulb: To transfer and add liquid.

Cuvettes: To hold samples for spectroscopic analysis

500- mL Beakers: To stir, mix and heat liquids

***Question 5 (5 points)***

Please list another application of spectrophotometric analysis and state the tested compound and the corresponding coloring agent

Spectrophotometric analysis is used to test enzyme-catalyzed reactions and the coloring agent is ultraviolet light.

**Post-Lab Report**

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*Please finish (hand-written or typed) this report during and/or after the lab and submit it (double-sided printing) to your section TA when meet for the next experiment. This report consists of CALCULATION & OBSERVATION, DISCUSSION, and DATA SHEET, and are worth a total of 100 points, counted as 6% of the total course grade. The DATA SHEET is for recording of raw data during your lab work and shall be submitted as it is (the very original copy you filled in during lab). Calculations and data analysis shall use the original data you obtained in the lab. Any alteration to raw data is a serious violation to HONOR CODE and you will receive ‘0’ point for Post-Lab Report.*

CALCULATION & OBSERVATION

**Part A. Preparation of Standard Solutions**

**A.1 Data Processing**

In this part, we regulate six kinds of phosphate solutions. Then we calculate and prepare three sample solutions with stock phosphate solution. We used 0 mL, 1 mL, 2 mL, 3 mL, 4 mL, 5 mL to drop to the Volumetric flasks to prepare samples. Then we get six samples of different concentrations.

*TODO: Please show your data in the table and calculate the corresponding concentration. This part should include: 1) a table which shows the concentration of each sample solutions. 2) a sample calculation procedure (you only need to show the calculation equation of one sample). 3) a figure which shows the color of six sample solution and two unknown solutions.*

**Table 1: Concentrations of standard solutions**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sample | 1# | 2# | 3# | 4# | 5# | 6# |
| Volume (mL) | 0.0 | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 |
| Conc. (M) |  |  |  |  |  |  |

**A.2 Observation**

*TODO: Please briefly describe the phenomena. Does the depth of color agree with the concentration?*

**Part B. Adjusting the Spectrophotometer**

**Part C. Making the Absorbance Spectrum & Finding using a Standard Solution**

**C.1 Data Processing**

In this part, we test the absorbance spectrum and find. We test light frequency ranging from 400 nm to 450 nm to find the corresponding absorbance. In the process, we make use of Spectrophotometer. Then we choose the light under whose frequency the absorbance reaches the highest level.

*TODO: Please show your data in the table. This part should include: 1) a table which shows absorbance data at each wavelength. 3) a figure of Absorbance vs. wavelength of light.*

**Table 2:Absorbance under light with different frequency**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| (nm) | 400 | 410 | 420 | 430 | 450 |
| A |  |  |  |  |  |

**C.2 Observation**

*TODO: Please describe the relation between absorbance and wavelength of light. Also determine the chosen wavelength*

**Part D. Making the Calibration Curve Using the standard Solutions**

**D.1 Data Processing**

In this part, we construct the calibration curve based on the data got first. We use light with 400 nm to test the absorbance of six standard sample solutions.

*TODO: Please show your data in the table. This part should include: 1) a table which shows the absorbance data. 2) a figure of constructed calibration curve. You should mark the point in the figure. 3) the mathematical expression of the calibration curve.*

**Table 3: Absorbance of six sample solutions**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sample | 1# | 2# | 3# | 4# | 5# | 6# |
| Volume (mL) | 0.0 | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 |
| Absorbance (A) |  |  |  |  |  |  |

**D.2 Analysis**

*TODO: Please evaluate the correctness and accuracy of your calibration curve.*

**Part E. Determination of Unknown Concentration**

**E.1 Data Processing**

In this part, we measure the absorbance of two samples with unknown concentration. Then we use the constructed calibration curve to determine their concentration.

*TODO: Please show your data and do the calculation. This part should include: 1) the absorbance data of 2 unknown solution. 2) the concentration of 2 unknown solution. 3) the calculation procedure with the equation got in Part D.*

**Table 4:Absorbance of Unknown solutions**

|  |  |  |
| --- | --- | --- |
| Sample | 7# A | 7# B |
| Absorbance. (A) |  |  |

DISCUSSION

This is the most important part of the report. You will be given an instruction of this part, but you are encouraged to add something creative to enrich the report. Especially, you can provide suggestions of ways to improve this experiment.

**A. Preparation of Standard Solutions**

*TODO: In this part, you need to prepare sample solutions of certain concentration. However, there may be some errors in the theoretical value. Please talk about the effect of the errors and the reasons of it.*

**B. Making the Absorbance Spectrum & Finding using a Standard Solution**

*TODO: In this part, the measured absorbance data may be not precise. Please write possible reasons for it.*

**C. Making the Calibration Curve Using the standard Solutions**

*TODO: Please state the method you use to get calibration curve from a set of splashes. Do the splashes fit a linear relationship? If not, please list possible reasons.*

**D. Other** *(optional for up to 10 pt bonus)*

*TODO: Please do other discussions on this part. You can provide some suggestions helpful for students or talk about other applications of spectrophotometric analysis and compare them with this experiment.*

**E. Conclusion**

*TODO: Please write what you have learnt in this lab. And briefly describe the procedure of the experiment and final result of the concentration of 2 solution of unknown concentration.*

REFERENCE

*Please list all the references heree.*

DATA SHEET

