VC211 Spring 2022 Chemistry Lab Report

Experiment E3

Spectrophotometric Analysis: Phosphates in Water

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This is for TAs ONLY. DO NOT write in this table.

Grades				Grader/s
Post-lab (100+10 pts)	Observation (10 pts)			
	Data Analysis (40 pts)			
	Discussion (40+10 pts)			
	Data Sheet (10 pts)			
	Total			

POST-LAB

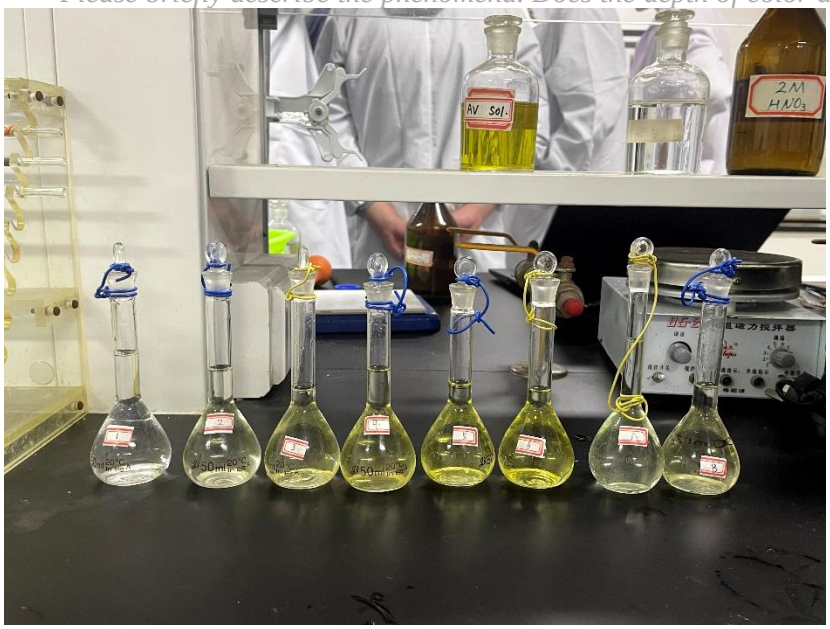
Please finish this memo during and/or after the lab and submit it through canvas (pdf file name convention: LASTNAME+last four digits of your student ID) before due time, typically 10 min before the next experiment. This memo consists of OBSERVATION, DATA ANALYSIS, DISCUSSION, and DATA SHEET, and are worth a total of 100 points, counted as 6% of the total course grade. This is an individual assignment and your own work is expected. The sample 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 of HONOR CODE and you will receive '0' point for Post-Lab Memo.

Note: This memo first describes experimental observations, then analyzes data, finally discusses the results. Although a frame is provided with useful tips, you are encouraged to conduct critical thinking on your own and try to write a coherent and complete report by yourself (passive piecing together tips is not considered to be a complete memo). Bonus is available for outstanding points as mentioned in detail below.

OBSERVATION

Part A. Preparation of Standard Solutions

- *Attach a figure which shows the color of six sample solution and two unknown solution.*
- *Please briefly describe the phenomena. Does the depth of color agree with the concentration?*



(1) the color of six sample solution and two unknown solutions

The concentration increases from 1# to 6# and the depth of color increases from #1 to #6, and the color of unknown A is between 1# and 2#, the color of unknown B is around #2 by the observation of naked eyes. The depth of color agrees with the concentration. With the same volume, the higher concentration leads to deeper color.

DATA ANALYSIS

Part A. Preparation of Standard Solutions

- *Attach a table which shows the concentration of each sample solution.*
- *Show a sample calculation procedure (you only need to show the calculation equation of one sample).*

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)	0	2*10^-5	4*10^-5	6*10^-5	8*10^-5	10*10^-5

Take 2# as an example:

$$C = \frac{n}{V} = \frac{0.001M \times 3.0\,mL}{50\,mL} = 2 \times 10^{-5}\ M$$

Part B. Making the Absorbance Spectrum & Finding λ_{opt} using a Standard Solution

- *Please describe the relation between absorbance and wavelength of light. Also determine the chosen wavelength.*
- *Attach a table which shows absorbance data at each wavelength.*
- *Attach a figure of Absorbance vs. wavelength of light.*

Table 2: Absorbance under light with different frequency

(nm)	400	410	420	430	450
A	0.194	0.136	0.096	0.054	0.040

With the same concentration, when the wavelength of light increases, the absorbance of the solution decreases. The chosen wavelength is 400nm.

(2) wavelength: 450nm absorbance: 0.040

(3) wavelength: 430nm absorbance: 0.054

(4) wavelength: 420nm absorbance: 0.096

(5) wavelength: 410nm absorbance: 0.136

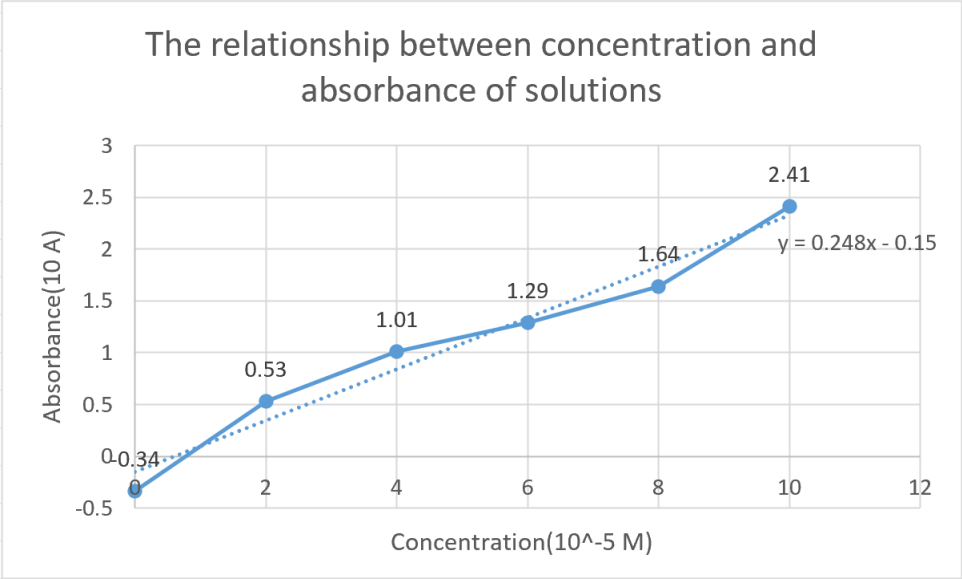
(6) wavelength: 400nm absorbance: 0.194

Part C. Making the Calibration Curve Using the standard Solutions

- *Attach a table which shows the absorbance data.*
- *Attach a figure of constructed calibration curve. You should mark the point in the figure.*
- *Show the mathematical expression of the calibration curve.*
- *Please evaluate the correctness and accuracy of your 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)	-0.034	0.053	0.101	0.129	0.164	0.241



(7) constructed calibration curve

The mathematical expression of the calibration curve is y = 0.248x – 0.15

According to Beer-Lambert law A = εbc, a plot of absorbance versus concentration gives a leaning straight line passing the (0,0) point. However, actually the calibration curve doesn't pass the (0, 0) point and has some slight errors. This may because the spectrophotometer is not so sensitive and causes some errors when measuring the absorbance of 1# solution. But the general tendency of the curve conforms with Beer-Lambert law and all the actual points are very near or on the curve.

Part D. Determination of Unknown Concentration

- *Please show the absorbance data of two unknown solutions.*
- *Please calculate the concentration of two unknown solutions.*
- *Please show the calculation procedure with the equation got in Part C.*

Table 4: Absorbance of Unknown solutions

Sample	7# A	7# B
Absorbance. (A)	0.018	0.048

$y = 0.248x - 0.15$

for A, $y_A = 0.018$, so $x_A = 0.416 \times 10^{-5}\ M$

for B, $y_B = 0.048$, so $x_B = 0.798 \times 10^{-5}\ M$

Therefore, the concentration of A is $0.416 \times 10^{-5}\ M$ and the concentration of B is $0.798 \times 10^{-5}\ M$.

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.

Bonus:

1. *Provide some suggestions helpful for students conducting this experiment.*
2. *Provide improvements for the experiment.*
3. *Talk about other applications of spectrophotometric analysis and compare them with this experiment.*

A. Preparation of Standard Solutions

- Sample solutions of certain concentration need to be prepared, while there might be some errors from the theoretical value. Please talk about the effect of the errors and the reasons of it.

The effect of the errors may be the decrease in actual concentration compared with theoretical value. This is possibly because I look up to read the scale of the pipet, leading to less PO_4^{3-} in the solution. Or it is because the rinsing process of the pipet with PO_4^{3-} solution is not thorough enough so the solution is diluted.

The effect of the errors may also be the increase in actual concentration compared with theoretical value. This is probably because I look down to read the scale of the pipet, leading to more PO_4^{3-} in the solution.

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

- The measured absorbance data might be not precise. Please write possible reasons for it.

It is mainly caused by the non-monochromatic effect of the incident light, as well as the inaccurate value of the instrument wavelength and absorbance. Or it is because the transmittance surface of the cuvette is unclean, resulting in disturbance of the light, so that the measurement is not accurate.

C. Making the Calibration Curve Using the standard Solutions

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

I use **least-square method** to get the calibration curve. This is a way to minimize the sum of squares of the error. Not all splashes fit a linear relationship and has some deviation from the curve. It is probably due to some errors between the actual concentration of solutions and the theorical value. Or it is due to errors of the measurement of the spectrophotometer.

D. Conclusion

- Write the conclusion of the whole report. You may refer to some reports on the Internet for the style. Don't use Baidu.

This experiment verifies Beer-Lambert law by showing the directly proportional relationship between absorbance and concentration with the constructed calibration curve. Based on the curve, we achieve the concentration of two unknown Na_3PO_4 solutions according to their absorbance. The concentration of A is 4.16×10^{-6}M and B is 7.98×10^{-6}M. To improve the experiment, the wavelength should be measured from large to small to reduce the mechanical error.

REFERENCE

- Please list all the references here.

CHEM2110J-VC211 SP22 E3 Manual.pdf
VC211-E3-lecture.pptx

DATA SHEET

VC211 EXPERIMENT E3 DATASHEET: Spectrophotometric Analysis: Phosphates in Water

Name: Luyan Xiao	Student ID: 5223709108	Section: 11
TA: Anlin Ma	Group: 5	

Concentration of Phosphate Stock Solution: 0.001M

Part A: Prepare 6 Standard Solution and 2 Solutions of Unknown Concentration

Sample	#1	#2	#3	#4	#5	#6	#7 A	#7 B
Volume (mL)	0	1.00	2.00	3.00	4.00	5.00	5.00	5.00

Part B: Find λ_{opt}

λ (nm)	400	410	420	430	450
A	0.194	0.136	0.096	0.054	0.040

Part C: Find Absorbance of Prepared Samples with λ_{opt}

Sample	#1	#2	#3	#4	#5	#6
Absorbance (A)	-0.034	0.053	0.101	0.129	0.164	0.241

Part D: Find Absorbance of Solution of Unknown Concentration with λ_{opt}

Sample	#7 A	#7 B
Absorbance (A)	0.018	0.048

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)	0	2×10^{-5}	4×10^{-5}	6×10^{-5}	8×10^{-5}	1×10^{-4}

Table 2: Absorbance under light with different frequency

(nm)	400	410	420	430	450
A	0.194	0.136	0.096	0.054	0.040

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)	-0.034	0.053	0.101	0.129	0.164	0.241

Table 4: Absorbance of Unknown solutions

Sample	7# A	7# B
Absorbance. (A)	٥.٥١٨	٥.٥٤٨