Grades		Grader/s
Pre-lab (100 pts)		

PRE-LAB EXERCISE (*E3*)

Name: Xiao Luyan Section: 11

*Please finish the following exercises before conducting the experiment. These exercises consist of 5 questions and are worth a total of 100 points, counted as **2%** of the course grade. These pre-lab exercises cover contents of Experiment E1. Please study the corresponding lab manual carefully before doing these exercises. Please turn in the **electronic version** to Canvas. No late submission will be accepted.*

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 the phosphate solution is 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.

Water eutrophication refers to the phenomenon that under the influence of human activities, nitrogen, phosphorus and other nutrients required by organisms enter slow-flow water bodies such as lakes, rivers and bays in large quantities, causing algae and other plankton to multiply rapidly, water dissolved oxygen to decline, water quality to deteriorate, and fish and other organisms to die in large numbers. Our work in this experiment is to test the concentration of phosphate in water with spectrophotometric analysis.

Spectrophotometric analysis is based on the theory that the amount of light absorbed by a sample shows a linear dependence upon the concentration of the compound present in the solution. We can use vanadate-molybdate reagent to color the solution. This reagent includes ammonium metavanadate (NH_4VO_3) and molybdate (MoO_4^{2-}) and reacts with the phosphate to form a yellow compound. Since the molar absorptivity of the compound is not known, constructing a calibration curve is a good way to find it.

To construct a calibration curve, we need to construct x-axis of concentration and y-axis of absorbance. Then we will measure the absorbance of the five standard phosphate solutions and draw their points on the coordinate system. The curve passing or near the five points is the calibration curve.

According to Beer - Lambert law, as long as we account for a blank solution in our studies, a plot of absorbance versus concentration gives a straight line with slope = "εb" and y-intercept=0.

The Beer-Lambert law: $A = \varepsilon bc$

"A" is the absorbance of the sample

b" represents the solution path length

"ε" is the molar absorptivity with units L.mol-1.cm-1

"c" represents the molar concentration of absorbing species in the sample (mol/L).

Question 2 (20 points)

What volume of 5.00 M phosphate stock solution is required to make 20.0 mL of a 1.00 M solution?

$C_1 = 5.00\ M \quad C_2 = 1.00\ M \quad V_2 = 20.0\ mL$

$$V_1 = \frac{C_2 \cdot V_2}{C_1} = 4.0\ mL$$

Therefore, 4.0 mL of 5.00 M phosphate stock solution is required.

Question 3 (15 points)

Please express the transmittance %T and absorbance A using original light intensity I_0 and final light intensity I. When %T increases, will A increase or decrease?

$$\%T = \frac{I}{I_0} \times 100 \qquad A = -\log_{10}\left(\frac{\%T}{100}\right) = 2 - \log_{10}(\%T)$$

When %T increases, A will decrease.

Question 4 (20 points)

Please list at least 4 types of chemical laboratory apparatus in this experiment and their functions in the lab.

Spectrophotometer: to quantitatively determine the amount of light absorbed by a solution

50-mL volumetric flask: to accurately dilute the solution to 50.0 mL

1, 2, 5 mL pipets and pipet bulb: to accurately get x mL 0.001 M PO_4^{3-} solution, 2.00 mL 2M HNO_3 solution and 1.00 mL AV solution and remove them to the 50-mL volumetric flask

Cuvettes: to measure the solution path length.

Question 5 (5 points)

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

Spectrophotometric analysis can also be used to test the amount of iron.

The tested compound is Fe^{3+} solution. (Before the experiment it should be reducted to Fe^{2+} solution).

The corresponding colour agent is phenanthroline.