Dilution Lab – $KMnO_4$

Introduction:
Spectrophotometers and colorimeters use different frequencies of light that are absorbed by a solution to varying degrees. This spectral analysis can serve as a "fingerprint" for a compound. The frequency or wavelength chosen is most often the wavelength corresponding to maximum absorbance for the compound. In spectrophotometry, light of a specific wavelength is passed through a sample; a photocell detects the intensity of the light and indicates either the absorbance or the percent transmittance. The value of this reading depends on the concentration of the solution being tested. This agrees with common sense, which indicates that the darker in colour a solution becomes, the more concentrated it is. The Beer-Lambert Law makes use of this relationship.

Purpose: Determine the concentration of an unknown solution by analyzing the absorption of standard solutions of various potassium permanganate concentrations.

Materials:

100 mL beaker	6 test tubes	LabQuest
electronic balance	test tube rack	colorimeter
100 mL volumetric	pipette	square cuvette
flasks	pipette pump or bulb	potassium
graduated cylinders	spectrophotometer	permanganate
droppers	cuvette	

Procedure:
1. Determine a method to prepare 100.0 mL of 0.040 mol/L $KMnO_4$ stock solution from solid potassium permanganate.
2. Prepare 100.0 mL of 0.0020 mol/L $KMnO_4$ by diluting your 0.04 mol/L solution.
3. Fill test tube 1 with this solution for later testing.
4. Prepare 100.0 mL of 0.00080 mol/L $KMnO_4$ by diluting your 0.0020 mol/L solution.
5. Fill test tube 2 with this solution for later testing.
6. Prepare 100.0 mL of 0.00040 mol/L $KMnO_4$ by diluting your 0.00080 mol/L solution.
7. Fill test tube 3 with this solution for later testing.
8. Prepare 100.0 mL of 0.00016 mol/L $KMnO_4$ by diluting your 0.00040 mol/L solution.
9. Fill test tube 4 with this solution for later testing.
10. Prepare 100.0 mL of 0.000080 mol/L $KMnO_4$ by diluting your 0.00016 mol/L solution.
11. Fill test tube 5 with this solution for later testing.

    Note: It is recommended that you do not dispose of the solutions until you have tested the absorbance and transmittance of each sample using both devices.

12. Starting with the **most dilute** standard, rinse a round cuvette with a small amount of solution from the test tube and then fill the cuvette 2/3 full. Make sure that the outside of the cuvette is clean and dry.
13. Place the cuvette into the spectrophotometer. Make sure that the line on the cuvette matches the line on the spectrophotometer, and close the lid.
14. Record the readings on the spectrophotometer.
15. Repeat steps 11-13 with the other solutions, working from most dilute to most concentrated.
16. Test the unknown solution provided by your teacher.

17. Repeat steps 12-16 using a square cuvette, the LabQuests and a colorimeter.

18. Graph (using a spreadsheet program) your concentrations versus transmittance and concentrations versus absorbance using data from your standard solutions. Include the equation of the line and the R^2 value.
19. Using the graph, determine the concentration of your unknown sample.

What conclusions can you make based on your research and the results from this lab?
What are your sources of error?
What improvements could be made?

Using the spectrophotometer:

1. Turn on the instrument using the left hand knob. Allow it to warm up for 15 minutes.
2. Select the appropriate wavelength (525 nm for this lab).
3. With the receptacle lid closed, adjust the left hand knob until the needle reads 0% transmittance.
4. Place a cuvette 2/3 full of distilled water in the receptacle and close the lid. Adjust the right hand knob until the needle reads 100% transmittance.
5. The instrument is now calibrated for testing your solutions.

Using the colorimeter:

1. Connect the colorimeter by plugging into CH2.
2. Plug in power cord and turn on LabQuest and let the system stabilize for 5 minutes.
3. Change the mode to "events with entry".
4. Press the < or > button on the colorimeter to select 565 nm.
5. Calibrate the colorimeter by place a cuvette 2/3 full of deionized water in the colorimeter. Line up a clear side with the arrow and close the lid.
6. Press the CAL button and release when the red LED begins to flash. The absorbance should now be 0.000 or 0.001.
7. When the LED stops flashing, the unit is ready to use.
8. Touch the table icon in the top corner, and it will change to a screen with:

Event	transmittance (%T)	absorbance

9. Place your sample in a cuvette to the 2/3 mark.
10. Touch the play button in the bottom left corner to record reading, and a new screen will open where you can enter your own Event label.
11. Note: For best results with a colorimeter, the absorbance readings should fall between 0.05 and 1.0. You may need to create a new solution to have 5 standards in this range.
12. Export your data to a USB flash drive to import into a spreadsheet for later analysis or record your data with pen.

Report:

- Include your prelab calculations for making your standard solutions.
    - Prelab means the calculations for all your standard solutions, including stock.
- Include your qualitative and quantitative observations.
- The graphs with equations and R^2 values.
- The concentration of your unknown.
- Answers to the three questions above.