Name _____**Chem 162, Section**: _____**Team Number:** _____

ALE 3. Spectrophotometry in Chemical Analysis

References for this assignment

1. *Tools of the Chemistry Laboratory — Spectrophotometry in Chemical Analysis*, pp. 281–282 in the *Silberberg 5th edition.*
2. Pages 1 – 4 of *Lab 2, Spectroscopic Determination of Allura Red: How Much Dye is in my Gatorade?*

Important!! For answers that involve a calculation you must show your work neatly using dimensional analysis with correct significant figures and units to receive full credit. No work, no credit. Report numerical answers to the correct number of significant figures. **CIRCLE ALL NUMERICAL RESPONSES**.

1. Problem 7.87: Visible light provides green plants with the energy needed to drive photosynthesis. Horticulturists know that for many plants leaf color depends on how brightly lit the growing area is: a plant grown with low levels of light will be dark green, while the same plant grown with high levels will be pale green.
   a.) Use the photon theory of light to explain why it is advantageous for a plant adapt this way (i.e. to be dark green when grown with low levels of light and pale green with high levels of light).

   b.) What change in leaf composition might account for this behavior?

2. Problem 7.92: Fish-liver oil is an excellent source of vitamin A. Its concentration is measured spectrophotometrically at a wavelength of 329 nm.
   a.) Suggest a reason for using a wavelength of 329 nm.

   b.) In what region of the spectrum does this wavelength lie?

   c.) When 0.1232 g of fish-liver oil is dissolved in 500. mL of solvent, the absorbance is 0.724 (absorbance doesn't have units!). When 1.67×10^{-3} g of vitamin A is dissolved in 250. mL of solvent the absorbance is 1.018. Calculate the vitamin A concentration in the fish-liver oil. *Circle your answer*.

3. Problem 7.101 (modified): The use of phosphate compounds in laundry detergents and their subsequent environmental discharge has led to serious imbalances in the natural life cycle of freshwater lakes. A chemist studying water pollution used a spectrophotometric method to measure total phosphate and obtained the following data for standard phosphate solutions.

Absorbance at 400 nm	0	0.10	0.16	0.20	0.25	0.38	0.48	0.62	0.76	0.88
Phosphate Concentration (mol/L)	0.0	2.5×10^{-5}	3.2×10^{-5}	4.4×10^{-5}	5.6×10^{-5}	8.4×10^{-5}	10.5×10^{-5}	13.8×10^{-5}	17.0×10^{-5}	19.4×10^{-5}

a.) Use *Excel* to graph the data above and determine the equation of the line. Before printing the graph, be sure to label all axes fully, give it an appropriate title and include the equation and your full name on the graph. Tape your graph in the space below—cut your graph with scissors to fit below!

b.) If a sample of lake water has an absorbance of 0.55 at 400 nm, use the equation of the standard curve in part a, above, to calculate the phosphate concentration in the lake water in mol/L. *Circle your answer.*

Comprehensive Questions

4. Carbon—Carbon bonds form the "backbone" of nearly every organic and biological molecule. The average bond energy of the C—C bond in 347 kJ/mol. Calculate the frequency and wavelength in *nanometers* of the *least* energetic photon that can *break* this bond. In what region of the electromagnetic spectrum is this radiation? *Circle your answers*.

5. Problem 7.85a: In fireworks displays, light of a characteristic wavelength is related to the presence of a particular element. Fireworks containing lithium ions, Li^{1+}, emit light with a wavelength of 671 nm. Calculate the *frequency* of this light and determine its color. *Circle your answers.*