

Chem 353

Take-Home Assignment 3

Due on Wednesday, February 27th

1. The following molar absorptivities are known for the cobalt and nickel complexes of 8-quinolinol in an acetone solution that is 1 M in HCl: $\epsilon_{\text{Co}, 365 \text{ nm}} = 3529$; $\epsilon_{\text{Ni}, 365 \text{ nm}} = 3228$; $\epsilon_{\text{Co}, 700 \text{ nm}} = 428.9$; $\epsilon_{\text{Ni}, 700 \text{ nm}} = 0$ [all values are with units of $\text{M}^{-1} \text{ cm}^{-1}$; data from Mukhedkar, A. J.; Deshpande, N. V., *Anal. Chem.*, **1963**, 35, 47-48]. Calculate the concentrations of cobalt and nickel in a solution for the which the absorbance at 365 nm is 0.721 and the absorbance at 700 nm is 0.067. Assume that the sample cell is 1.00 cm.
2. Suppose you are to prepare a set of calibration standards for the spectrophotometric analysis of acetone at a wavelength of 211 nm using a 1.00 cm cell. The molar absorptivity for acetone at this wavelength is 562. To maintain an acceptable precision for the analysis you wish to keep the %T for your standards between 15% and 85%. What is the most concentrated and the least concentrated standard that you would want to prepare for this analysis?
3. The amount of calcium in tissue samples can be determined spectrophotometrically. In a typical analysis, a 10.0 gram sample of tissue was homogenized in a calcium-free buffer solution. The homogenate was diluted to 50.0 mL, and centrifuged to remove cellular debris. A 10.0 mL portion of the clear supernatant fluid was mixed with 10.0 mL of trichloroacetic acid, precipitating any proteins and filtered. The clear filtrate was then analyzed spectrophotometrically giving an absorbance of 0.505. A calibration curve prepared using external standards showed the following relationship between absorbance and the concentration of Ca^{2+}

$$\text{abs} = 0.070 + 1.885 \times [\text{Ca}^{2+} (\text{mM})]$$

Report the concentration of Ca^{2+} in the original tissue sample as mmol/gram.

4. The amount of boron in plant material can be determined spectrophotometrically after complexing with Azomethine H to form a highly-colored complex. In a typical procedure a 7.94 g sample was treated to destroy organic material and the residue transferred to a 250-mL volumetric flask, diluting to volume with 0.35 M H_2SO_4 . A 50.00 mL aliquot was transferred to a 100-mL volumetric flask along with 20.00 mL of an Azomethine H solution. After diluting to volume the solution was allowed to stand for two hours to allow the color to develop. The resulting absorbance at 430 nm in a 1-cm cell was 0.364. A second 50.00 mL aliquot was treated in an identical manner except that a 4.00 mL aliquot of a 3.00 ppm boron standard was added before diluting to 100 mL. The absorbance of this solution was 0.688. What is the % w/w B in the plant sample?