Experiment #5: Qualitative Absorption Spectroscopy

One of the most important areas in the field of analytical chemistry is that of spectroscopy. In general terms, spectroscopy deals with the interactions of radiant energy with matter (i.e., atoms, ions, or molecules) in various physical and chemical states. This energy is usually some type of electromagnetic radiation, abbreviated EMR, consisting of electric and magnetic components. In most spectroscopic methods, only interactions of the electric component of the EMR are of interest.

Electromagnetic radiation exhibits a “dual nature”, showing characteristics of both a cyclic wave motion and discrete particles of energy called photons. Wave properties explain such phenomena as reflection, refraction, and optical interference, while particulate properties are required to explain the photoelectric effect and optical emission and absorption processes.

The major cyclic wave motion properties are wavelength (λ) and frequency (ν).The wavelength is the distance between corresponding points on the EMR wave, and frequency refers to the number of complete wave cycles which pass a given point per unit time. Thus, the velocity, c, of the EMR wave is given by the equation: velocity = wavelength x frequency (or $c = \lambda\nu$). EMR is often classified with respect to the number of different energies or wavelengths in the beam of radiation. Monochromatic EMR has only one energy or wavelength; polychromatic EMR has more than one type of energy or wavelength.

pass through the solution. Thus, a “blue” solution is one which transmits wavelengths corresponding to the color “blue”. However, it is equally valid (and of more interest chemically) to describe a solution in terms of the colors or wavelengths of light which are absorbed. A “blue” solution then, is one which absorbs the color complementary to blue, namely yellow.

cuvette, and insert the cuvette into the sample compartment. Leave the compartment cover up so the EMR beam can be observed as a reflection on the smooth, slanted surface of the chalk. Leave the left control in the counter-clockwise position, turned just enough to turn on the instrument. Looking down at the chalk, turn the right control until the color band can he clearly seen.

Set the top wavelength dial to 400

Dye absorption spectrum

Select a dye solution from the reagent shelf. If working in groups, your instructor will instruct you as to whether each student should select a different dye solution. or whether the same dye solution will be

Data treatment and report

A three-page report must be submitted by each student. Each page must contain a complete heading, listing: experiment title, student name, names of members in the group, instructor's name, class number and section number, and date on which the report was submitted.

The first page of the report will contain a neat, complete titled, copy of the data given in Table I. All information taken in the laboratory procedure must be included, using a format identical to that of Table I.

The second page of the report will consist of a titled copy of Table II, giving all data recorded in lab. In addition, the specific name of the dye must be reported if known. The information should he examined determine the light colors and wavelengths which are best transmitted by the dye solution as well as the colors and wavelengths which are best absorbed. Conclusions about the regions of transmittance and absorption should be expressed in a summary statement.

The third and final page of the report will consist of the absorption and transmittance spectra of the indicator solution. On the same sheet of graph paper (18 x 24 cm), make two separate plots, one of % T vs. λ and a second of calculated A vs. λ. The following specifications and instructions must be obeyed in performing the graphical data treatment.

The long axis must be used as the abscissa (horizontal axis), upon which the wavelength (in nm's) is scaled in increasing values from left to right. The left ordinate (vertical axis) is to be used for the calculated absorbance values, while the right ordinate (vertical axis) will be the % T axis.

Use independent linear scales for each axis, and maximize the scale values to use most of the graph paper. The % T axis should be scaled to go from a starting value of 0% T to an upper value of 100% T. The A axis should begin at 0, but the upper value should he chosen to expand the data points over most of the graph sheet.

Connect the data points of each curve in a smooth, continuous line. Do not make connect-a-dot curves. Include a plot title and complete heading on the graph page, and make sure to identify the specific dye used in the spectroscopic measurement.