INTEGRATING LABVIEW® SOFTWARE IN CLASSICAL CHEMISTRY LABORATORY EXPERIMENTS

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In this paper a number of classical chemistry laboratory experiments is presented using adapted glassware (for manual use) linked to the computer with suitable electronic equipment and controlled by LabView® programs. Following automated experiments can be performed: potentiometric and conductimetric titrations, potentiometric real-time kinetics and freezing point depression experiments. A potentiometer and a conductivity meter as well as a cryostat are provided with the classical electronic input/output connections. The column buret is adapted with a light sensor and an electronic valve. The valve controlls the flow rate, the light sensor counts the number of drops coming out of the buret. In preliminary on-line calibration experiments the volume of one drop is exactly measured. Consequently, a normal titration procedure can be executed automatically. pH/mV or conductivity is registrated and displayed on screen as a function of time, which is proportional with the amount of titrant volume. Equivalence points can be determined using the first derivative. Raw data are firstly smoothed to eliminate experimental inaccuracy and noise. For conductivity measurements, the equivalence point can easily be determined interactively from the nod point. In the case of the real-time kinetic experiment, the reaction:

$$S_2O_8^{2-} + 2\,I^- \rightleftharpoons I_2 + 2\,SO_4^{2-}$$

is studied by measuring potentiometrically the amount of iodine formed as a function of time. On screen, the potential is visualized versus time. An internal electrode calibration system is integrated. The experiment ends when the measured potential remains constant. Experiments can be performed at different constant temperatures using a cryostat. The concentration of formed iodine or reacted $S_2O_8^{2-}$ is displayed as a function of time. Raw data can first be smoothed before calculation and ln ($S_2O_8^{2-}$) versus time is then plotted. Using a linear-least square fit, the slope is determined. From the slope the student can calculate the rate constant k. In each lab session, this real-time kinetic experiment is performed at different temperatures. Using the obtained k-values at a different temperature, the activation energy can be calculated by means of an Arrhenius plot. In the freezing point depression experiment, a cryostat is used at a constant cooling rate. A temperature sensor is connected with the PC and the temperature of pure solvent (e.g. cyclohexane), which is placed in a double jacket vessel, is followed on screen as a function of time. A next experiment of a 1% and 2% naphtalene solution in cyclohexane is performed in the same way. The student determines interactively the freezing point using the nod point of each curve and a suitable extrapolation method. Using the melting enthalpy of cyclohexane, the freezing point of cyclohexane and the freezing point of the naphtalene solution, the student is able to calculate the molecular weight of naphtalene.