

EXPERIMENTS IN THE PTCL 1ST YEAR PRACTICAL COURSE

X.1 An Introduction to Solution Chemistry Techniques

This experiment is one of five in the 1st year PTCL practical course designed to illustrate topics which form a fundamental part of the training of almost every chemist.

One of the commonest tasks in chemistry is the quantitative analysis of a sample. Many different analytical methods exist, from instrumental methods such as atomic absorption spectroscopy or uv/visible absorption, to titration methods relying on the colour change of an indicator, or measurements of the conductivity of a solution. In this experiment you will use different methods to determine the concentration of calcium, fluoride ion or copper in samples of unknown composition, and be asked to assess the relative value of each method.

In this two-day experiment you will:

- Prepare solutions of precisely known concentration
- Perform titrations to determine calcium concentrations using both an indicator and a pH probe; (sections 3 and 4)
- Use a calcium ion specific electrode (ISE) to determine the quantity of calcium ion in a sample; (section 6)
- Record electronic spectra using a ultraviolet / visible spectrometer to determine the concentration of a copper solution, and follow the kinetics of a reaction; (sections 5 and 7)
- Perform a critical analysis of results
- Compare your results with those of others who have completed the experiment, to develop experience in the statistical analysis of data (post-experiment).

X.2 An Introduction to the Statistical Analysis of Data (Part I: optical rig)

Measurement is a central task in science; indeed, we might consider measurements to be the "products" of physical chemistry in the same way that samples are often the products of an organic laboratory exercise.

This experiment introduces the analysis of experimental measurements. In it, you will gather data from an optical rig in the PTCL, which is controlled through the Internet, using a web browser. The data generated by the rig will be used to illustrate various elements of simple statistics.

X.3 Experimental Treatment of Errors (Part II)

In this experiment you will apply the theory of errors to data relating to radioactive decay. The objective is to learn how errors in individual measurements affect the uncertainty of a final result where several measurements are combined, as happens in most quantitative experiments. You will use a radioactive source and radiation detector to examine how radiation is attenuated by different thicknesses of metal. The result is used to find the thickness of an unknown foil, for comparison with estimates of the same quantity by direct measurement and by indirect measurement from the weight and dimensions of the foil.

X.4 An Introduction to Vacuum Line Techniques

In this experiment you will learn:

- to construct vacuum systems from standard components,
- the uses of different pressure gauges,
- how to locate leaks in vacuum apparatus,
- how to use gas cylinders safely,
- about pumping speed, and how pipes affect it,
- to use liquid nitrogen and freezing mixtures.

As part of the practical you will determine how the vapour pressure of a volatile solvent depends on temperature.

X.5 An Introduction to Optics

Optical methods and spectroscopy are used in every branch of chemistry from the most biological to the most physical. Wave properties, which light exemplifies, also underlie the modern ideas of atomic structure and chemical bonding. The purpose of this practical is to give a grounding in the principles of optics as used in chemistry. At the same time it introduces the use of lasers and gives hands-on experience of principles taught in the Optics part of the first year physical chemistry course.