

Lectures on Quantitative Analytical Chemistry

2x2hrs/week

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Introduction:

The definition, scope and function of analytical chemistry. Types of chemical reactions used in analytical chemistry. Chemical equilibria, equilibrium constants, acid-base theories (Arrhenius, Brönsted, Lux, Lewis, Pearson...)

Steps in quantitative analysis:

1. Sampling from solid and fluid materials. Gross samples, analytical samples. Moisture in samples. Determination of water in samples.
2. Preparation of sample for analysis. Reagents for dissolving samples. Decomposition of samples by fluxes. Decomposition of organic samples. Dry and wet ashing.
3. Separations of components for analysis. Distillation. Solvent extraction. Chromatographic methods: gas chromatography, high performance liquid chromatography, ion exchange chromatography, ion chromatography, capillary electrophoresis, planar chromatographic techniques.
4. Detailed description of chemical analysis.
Titrimetric methods of analysis. General aspects. Standard solutions. Chemical and instrumental end point detections.
Neutralization analysis. Reagents and indicators for neutralization titrations. Titration curves for strong acids, strong bases, weak acids, weak bases. Buffer solutions. Titrations in non-aqueous solvents. Application of neutralization titrations.
Complex formation titrations. Complex formation reactions. Reagents and indicators. Titrations with EDTA. Titrations with inorganic complexing agent. Applications of complex formation titrations.
Precipitation titrations. Precipitation equilibria. Reagents and indicators. Application of precipitation titrations.
Oxidation-Reduction titrations. Redox reactions. Redox potentials (standard and conditional). Titration curves in redox titrations. Permanganometry, bromatometry, cerimetry, chromatometry, iodometry, reductometry (standard solutions, indicators, applications).
Gravimetric methods of analysis. Principle of gravimetry, precipitation, filtration, washing, treating the precipitate prior to weighing. Gravimetric determinations. Electrogravimetry.
Instrumental methods of analysis. Introduction to spectroscopic methods of analysis. Interaction between electromagnetic radiation and matter. Atomemission spectroscopy (flame photometry, spectral analysis, ICP). Atomabsorption spectroscopy. Molecular spectroscopy (UV, VIS, IR). Molecular emission spectroscopy: (fluorescence).
5. Evulation of analytical data. Definition of terms. Random error, confidence interval, systematic error.
6. The main aspects in selection of analytical methods. Analytical literature (journals, text books, treaties etc.).

Recommended books:

D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch: Fundamentals of Analytical Chemistry (Thomson)

D.C. Harris: Quantitative Chemical Analysis (W.H. Freeman and Company)