

2023 Oral exam topics

Instrumental analysis

1. The physical-chemical basis of signal parameters. The main parts of an analytical instrument. The process of analytical measurements. Calibration methods. Parameters characterizing the measurements. Signal to noise ratio.
2. Potentiometric methods. Potentiometric electrodes. Potentiometry in practice.
3. Conductometric methods. Conductometry in practice and applications.
4. Principles of the major spectrochemistry methods. Spectral regions. The spectrum. The Lambert-Beer law. Measuring the concentration with spectrophotometer.
5. Spectrophotometry in practice. The operating principles of single-beam and double-beam spectrophotometers. Monochromators. Cuvettes. Photomultiplier tube.
6. Molecular spectroscopy methods. Principles. Ultraviolet (UV) – Visible and infrared (IR) spectroscopy. Types of infrared vibrations. The IR spectrum. Information obtained from IR spectra.
7. Principles of atomic spectroscopy. Atomic absorption and emission techniques. ICP. Atomic spectra. Atomic spectrometer.
8. Principles of Nuclear magnetic resonance spectroscopy (NMR). The chemical shift. Spin-spin interactions (coupling). The coupling constant (J). The proton NMR spectrum of ethanol. The NMR spectrometer.
9. Principles of chromatographic separations. Types of chromatographic methods. Chromatographic parameters. The chromatogram. Qualitative and quantitative evaluation.
10. The practice of high performance liquid chromatography (HPLC). The HPLC instrument. Injection. Columns. Detection methods.
11. Principles of gas chromatography. GC in practice. The GC instrument. Injection. Columns. Detection methods.
12. Electrophoresis. Theoretical background. Electroosmotic flow (advantages and disadvantages). Modes of capillary electrophoretic separations I. Zone electrophoresis. The capillary electrophoresis instrument.
13. Modes of capillary electrophoretic separations II. Isoelectric focusing. Gel-electrophoresis. Electrochromatographic methods. Chiral separations.
14. Thermal Analysis: Thermal Gravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetric (DSC).
15. Mass spectrometry. Basic principles. General scheme of a mass spectrometer. Analytical information obtained from the mass spectra Types of ion sources (electrospray, electron impact, MALDI)
16. Types of mass analyzers (quadrupole, ion trap, time of flight). Detectors.
17. Fluorescence. Principles and applications.