

BSc. Biological Chemistry study programme
State exam Omics in Systems Biology
Including Introduction to Bioinformatics, Omics in Systems Biology questions
(as compiled/collated on 15. 1. 2026 by FD, KH, ZF)

Students are randomly picking ONE question from Part 1 (ca 10 minutes), ONE question from Part 2 (ca 10 minutes), and ONE question from Part 3 (ca 15 minutes).

Part 1 – Genomics/transcriptomics

1. System biology general terms and terminology
(origin of system biology, system definition, phases, features of the system...)
2. Genomic
(types, definition, prokaryotic vs eukaryotic genome)
3. Sequencing
(types, application, principles, genome sequencing steps)
4. Genetic variations
(types, sources of GV, SNP, types of mutations)
5. Transcriptomics
(basic terms, RNA, types, transcription, splicing)
6. RNA work
(types of isolation, quality control, mRNA isolation, cDNA, reverse transcription)
7. Experimental approaches to characterize transcriptome-1
(gene-by-gene approach, hybridization methods)
8. qPCR-1
(how it works, one step vs 2 step, qPCR chemistry, melting analysis)
9. qPCR-2
(absolute vs relative, reference gene, reaction efficiency)
10. Experimental approaches to characterize transcriptome-2
(sequencing-based methods – SAGE, CAGE, RNA seq)

Part 2 – Proteomics

1. General Terms and Terminology
(MS, Mass Spectrum, m/z, Isotopes, Resolution, monoisotopic and average mass)
2. Ionization Techniques in Mass Spectrometry
(MALDI, ESI, nanoESI)
3. Mass Analyzers and Their Principles
(Q, TOF, Orbitrap, FT-ICR-MS, hybrid analyzers)
4. Chromatographic Techniques in Proteomics
(LC, HPLC, nanoLC)
5. Sample Preparation in Proteomics
(extraction, digestion, desalting)

6. Acquisition Methods
(DDA, DIA)
7. Protein Identification
(bottom-up proteomics, PMF, MS/MS Ion Search)
8. Protein Quantification
(absolute and relative quantification in proteomics)
9. Structural MS-based Proteomics
(HDX, Cross-Linking and native MS)
10. MALDI Biotyping, MALDI Imaging

Part 3 – Lipidomics

1. General lipidomics
(lipids, lipidome, lipidomics, classification, nomenclature, ...)
2. Important lipid categories – functions and structures
(FA, GL, GP, SP, ST)
3. Sample preparation
(sample, collection, processing, storage, ...)
4. Lipid extraction
(LLE, SLE, SPE, purification ...)
5. Analysis of lipids
(DI-MS, GC-MS, LC-MS, desorption techniques, ...)
6. Lipid class separation approach
(NPLC, HILIC, SFC, ...)
7. Lipid species separation approach
(RPLC, silver ion, chiral separation, ...)
8. Quantitation in lipidomics
(strategies, standards, matrix effects, isotopic corrections, ...)
9. Method validation
(purpose of validation, parameters, QC samples, ...)
10. Clinical applications in lipidomics
(dysregulation, biomarker discovery, statistical models, ...)