

## Question list for Medical biology oral exam

### Cell and molecular biology

- 1 Medical biology as a science, hallmarks in the history of biology and genetics
- 2 Chemical composition of the cell and the human body. Chemical bonds in biomolecules
- 3 Biopolymers, general structure, lipids, polysaccharides
- 4 Protein structure
- 5 Protein functions
- 6 Architecture of prokaryotic and eukaryotic cell
- 7 Biomembranes (structure, function)
- 8 Membrane proteins and membrane transport
- 9 Cellular organelles (overview, structure, function)
- 10 Cytoskeletal system - overview, intermediate filaments
- 11 Cytoskeletal system - microtubules, microfilaments
- 12 Experiments leading to the discovery of DNA as a carrier of genetic information
- 13 Nucleic acids structure
- 14 Prokaryotic and eukaryotic genomes (characteristics and differences)
- 15 Structure of human genome (histones, nucleosomes, chromatin)
- 16 Mitochondrial genome
- 17 DNA replication
- 18 Comparison of DNA replication in prokaryotes and eukaryotes
- 19 Types of DNA damages and their causes
- 20 Mechanisms of DNA repair (NER, BER, mismatch repair)
- 21 DNA double-strand breaks repair
- 22 Chromosomal instability and aneuploidy
- 23 Central dogma of molecular biology, prokaryotic and eukaryotic gene
- 24 Types of RNA molecules and general features of transcription
- 25 Transcription in prokaryotes
- 26 Transcription in eukaryotes
- 27 Post-transcriptional modifications in eukaryotes
- 28 RNA editing and reverse transcription
- 29 Genetic code
- 30 tRNAs and aminoacyl-tRNA synthetases, ribosome structure
- 31 Translation
- 32 Post-translational modifications
- 33 Protein folding and protein degradation, protein sorting
- 34 Regulation of gene expression in prokaryotes - operon model, examples
- 35 Regulation of gene expression in eukaryotes (overview)
- 36 Regulation at the transcriptional level, transcription factors
- 37 Regulation of expression at the post-transcriptional level (export from the nucleus, mRNA degradation, no
- 38 Regulation of expression at the chromatin level
- 39 General principles of cell signalling
- 40 Intracellular (nuclear) receptors
- 41 Cell surface receptors (classification, general description)
- 42 Ion-channel-coupled receptors (function, examples)
- 43 G-protein-coupled receptors (function, examples)

- 44 Receptors with enzyme activity (function, examples)
- 45 Cell cycle
- 46 Checkpoints and regulation of the cell cycle
- 47 Cell cycle deregulation and its consequences
- 48 Types of cell division and their significance
- 49 Mitotic cell division
- 50 Mitotic apparatus (centrosomes and mitotic spindle), chromatid separation
- 51 Errors in mitosis and their consequences
- 52 Meiosis and gametogenesis
- 53 Genetic impact of meiosis - crossing-over and its significance
- 54 Errors in meiosis and their consequences
- 55 Gametogenesis, differences in gametogenesis in women and men
- 56 Basic types of cell death and their significance
- 57 Apoptosis - extrinsic pathway of apoptosis, death receptors
- 58 Apoptosis - intrinsic pathway of apoptosis, the role of mitochondria
- 59 Regulation of apoptosis, errors of the regulation
- 60 Principle of tissue arrangement of cells (cytoskeleton and extracellular matrix)
- 61 Connective tissues and extracellular matrix
- 62 Epithelia and intercellular junctions
- 63 Transient intercellular interactions
- 64 Disorders of cell to cell interactions and cell to extracellular matrix interactions

### **Genetics**

- 65 Mendel's laws. Monohybridism. Dihybridism
- 66 Interactions of non-allelic genes
- 67 Genealogical method (principles and examples)
- 68 Autosomal recessive inheritance (principles, examples)
- 69 Autosomal dominant inheritance (principles, examples)
- 70 Gonosomal recessive inheritance (principles, examples)
- 71 Gonosomal dominant inheritance (principles, examples)
- 72 Dominance and codominance, penetrance and expressivity
- 73 Chromosomal disorders (overview)
- 74 Chromosomal aneuploidy (numerical chromosomal aberrations)
- 75 Structural aberrations of chromosomes
- 76 Multifactorial inheritance (multifactorial trait determination, examples of diseases, heritability, threshold effect)
- 77 Twin method, concordance
- 78 Gene linkage, gene mapping, LOD score
- 79 Population genetics, allele frequency theory (Hardy-Weinberg equilibrium)
- 80 Factors affecting a population gene pool
- 81 The human genome project, information content of the human genome
- 82 Architecture of the human genome (coding and non-coding genome, repetitive sequences)
- 83 Tandem repeats (classification, significance)
- 84 Dispersed repeats: mobile genetic elements
- 85 Variability of the genome (polymorphisms and gene variants)
- 86 Epigenetics (genetic and epigenetic code)
- 87 Genomic imprinting, uniparental disomy
- 88 Non-coding RNAs and chromosome X inactivation

- 89 Innate and adaptive immunity, immune response
- 90 Components of the immune system, genetic disorders of the immune system
- 91 Immunoglobulins, antibody diversity, V-D-J recombination
- 92 T cell and B cell receptors (TCR, BCR)
- 93 Major histocompatibility complex, compatibility, transplantation
- 94 Genetic determination of ABO blood group system
- 95 Basic stages of the mammalian embryonic development
- 96 Embryonic cleavage and embryo polarization
- 97 Embryonic genome activation
- 98 Transcription factors, signalling pathways and morphogenes important for mammalian development
- 99 The origin of life on Earth and genetic evolutionary mechanisms
- 100 Evolution of genes and genomes
- 101 Species and speciation, human evolution

**Selected applications of medical biology**

- 102 Cancer classifications systems, tumour as complex tissue
- 103 Carcinogenesis, tumour suppressors and oncogenes
- 104 Hereditary cancer syndromes
- 105 Hallmarks of cancer (Weinberg and Hanahan model)
- 106 Basic principles of cancer therapy
- 107 Molecular classification of cancer and therapy personalization
- 108 Cancer genome, variant classification, precision oncology
- 109 Bacterial genome and mechanism of genetic recombination in bacteria
- 110 Classification and structure of viruses
- 111 Life cycle of viruses and their significance in pathogenesis
- 112 Transduction and development of viral vectors for gene therapy
- 113 Basic methods of molecular biology (biological material, restriction enzymes, electrophoretic methods)
- 114 PCR and quantitative PCR
- 115 Next-generation sequencing
- 116 Gene cloning and recombinant DNA
- 117 Gene therapy (history, types), classification of viral vectors for gene therapy
- 118 Basic strategies of gene therapy
- 119 Methods of DNA delivery to target tissues, viral vectors
- 120 Gene-editing approaches
- 121 Antibodies - their production and use in medicine
- 122 Microbiome, symbiosis of the human body with microorganisms
- 123 Formation of the human microbiome during life and in disease
- 124 Basic characteristics of stem cells
- 125 Structure and function of the stem cells "niche"
- 126 Stem cells and cell therapy
- 127 Principles and methods of tissue engineering