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, non-coding RNA)
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
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, heritability, threshold effect model)
77 Twin method, concordance
78 Gene linkage, gene mapping, LOD score
79 Genome-wide association studies (GWAS), SNPs, examples of diseases
80 Population genetics, allele frequency theory (Hardy-Weinberg equilibrium)
81 Factors affecting a population gene pool (inbred, assortative pairing, selection, drift, migration)
82 The human genome project, information content of the human genome
83 Architecture of the human genome (coding and non-coding genome, repetitive sequences)
84 Tandem repeats (classification, significance)
85 Dispersed repeats: mobile genetic elements
86 Variability of the genome (polymorphisms and gene variants)
87 Epigenetics (genetic and epigenetic code)
88 DNA methylation
89 Histone modifications
90 Genomic imprinting, uniparental disomy
91 Non-coding RNAs and chromosome X inactivation
92 Innate and adaptive immunity, immune response

93 Components of the immune system
94 Immunoglobulins, antibody diversity, V-D-J recombination
95 T cell and B cell receptors (TCR, BCR)
96 Major histocompatibility complex, compatibility, transplantation
97 Genetic determination of ABO blood group system
98 Genetic disorders of the immune system
99 The origin of life on Earth and genetic evolutionary mechanisms
100 Evolution of genes and genomes
101 Species and speciation, human evolution

Selected aplications of medical biology

102 Cancer classifications systems, tumour as complex tissue
103 Carcinogenesis
104 Tumour suppressors and oncogenes
105 Hereditary cancer syndromes
106 Hallmarks of cancer (Weinberg and Hanahan model)
107 Basic principles of cancer therapy
108 Molecular classification of cancer and therapy personalization
109 Cancer genome, variant classification, precision oncology
110 Bacterial genome, transcriptome and proteome
111 Phylogenetic relationship, genetic diversity and plasticity of bacterial genomes
112 Mechanisms of genetic recombination in bacteria
113 Regulation of bacterial genome transcription, variation of antigens in the proteome
114 Structure, reproduction and recombination of viruses
115 Replication and pathogenesis of viruses
116 Transduction and development of viral vectors for gene therapy
117 Forward and reverse genetics, from affected tissue to its function and therapy
118 Basic methods of molecular biology (biological material, restriction enzymes, electrophoretic methods)
119 PCR and quantitative PCR
120 Methods for identification of mutations (RFLP, Sanger sequencing)
121 DNA microarrays
122 Next-generation sequencing
123 Gene cloning and recombinant DNA
124 Animal models in biomedicine
125 Gene therapy (history, types)
126 Basic strategies of gene therapy
127 Methods of DNA delivery to target tissues
128 Gene-editing approaches
129 Medicinal gene therapy products
130 Antibodies - their production and use in medicine
131 Microbiome, symbiosis of the human body with microorganisms
132 Formation of the human microbiome during life and in disease
133 Principles and methods of classification of prokaryotic organisms based on their genome and rRNA
134 Basic characteristics of stem cells
135 Structure and function of the stem cells "niche"
136 Stem cells and cell therapy
137 Principles and methods of tissue engineering