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 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, connection to extracelullar matrix, transient intercellular interactions
63 Disorders of cell to cell interactions and cell to extracellular matrix interactions

Genetics

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

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

Selected aplications of medical biology

98 Cancer classifications systems, tumour as complex tissue
99 Carcinogenesis, tumour suppressors and oncogenes; hereditary cancer syndromes
100 Hallmarks of cancer (Weinberg and Hanahan model)
101 Cancer genome, variant classification, precision oncology
102 Bacterial genome and mechanism of genetic recombination in bacteria
103 Klasification and structure of viruses
104 Life cycle of viruses and their significance in patogenesis
105 Transduction and development of viral vectors for gene therapy
106 Basic methods of molecular biology (biological material, restriction enzymes, electrophoretic methods)
107 PCR and quantitative PCR
108 Sanger sequencing, next-generation sequencing
109 Gene cloning and recombinant DNA
110 Gene therapy (history, types), clasification of viral vectors for gene therapy
111 Basic strategies of gene therapy, methods of DNA delivery to target tissues, viral vectors
112 Gene-editing approaches (CRISPR/Cas9)
113 Antibodies - their production and use in medicine
114 Microbiome, symbiosis of the human body with microorganisms
115 Formation of the human microbiome during life and in disease
116 Basic characteristics of stem cells, structure and function of the stem cells "niche"
117 Stem cells and cell therapy, principles and methods of tissue engineering