

Final Exam Questions in Medical Biology For the Students of Medical Faculty

1. The universal features of cells (having - DNA, mRNA, Proteins, enzymes-catalysts, free energy consumption, plasma membrane);
2. Genetic information of prokaryotic cells;
3. Evolving of eukaryotic cells;
4. Genetic information of eukaryotic cells;
5. The tree of life;
6. Four major families of small organic molecules: sugars, fatty acids, amino acids, nucleotides);
7. Oxidation of organic molecules and ATP synthetic reactions (glycolysis, fermentations, citric acid cycle, electron transport reactions, oxidative phosphorylation);
8. DNA and chromosomes (the structure of eukaryotic chromosomes);
9. DNA replication and repair;
10. From DNA to RNA;
11. From RNA to Proteins;
12. Genes and genome, mobile genetic elements and viruses;
13. Membrane structure (the lipid bilayer: phospholipids, sphingolipids, cholesterol, lipid rafts, glycolipids);
14. Membrane proteins (transmembrane, peripheral, integral);
15. Carbohydrate layer of plasma membrane, lectins;
16. Membrane transport (passive transport, active transport, coupled transport, channel proteins, carrier proteins, uniporters, symporters, antiporters, Na⁺ - driven carrier proteins, ATP-driven pumps, Na⁺ - K⁺ pump);
17. Structure of the nucleus (nuclear envelope, nuclear pore complexes, nuclear lamina proteins, chromatin, nucleolus, nucleoplasm); Functions of the nucleus;
18. Gated transport: Nuclear import and export mechanisms (protein with nuclear localization signal, nuclear import receptor, protein with nuclear export signal, nuclear export receptor, Ran-GTP, Ran-GDP);
19. Structure of mitochondrion (mitochondrial membranes, mitochondrial matrix, mitochondrial DNA); Functions of mitochondria;
20. Transmembrane transport: The import of proteins into mitochondria (mitochondrial precursor proteins, protein translocators: TOM, TIM, OXA complexes, chaperone proteins);

21. Structure of peroxisomes (peroxisomal membrane, peroxisomal enzymes), Functions of peroxisomes;
22. Transmembrane transport: The import of proteins into peroxisomes (peroxisomal import signal, import receptor, peroxins, ATP);
23. A model for new peroxisomes formation;
24. Structure of the endoplasmic reticulum (ER membranes, ER lumen), Functions of ER;
25. Co-translation transport: The import of proteins into the Endoplasmic reticulum (ER signal sequence, SRP, SRP-R, protein translocator);
26. Protein glycosylation in the rough Endoplasmic reticulum (lipid molecule-dolichol, lipidlinked oligosaccharide, oligosaccharyl transferase, N-linked oligosaccharides, O-linked oligosaccharides);
27. Vesicular transport (COPI, COPII, klathrin, adaptin, dynamin, Rab-GTP, Rab-GTP effector, SNAREs);
28. Structure of the Golgi apparatus (cis and trans faces, cis network, trans network, Golgi vesicles, secretory vesicles); The functional compartmentalization of the Golgi apparatus;
29. Processing of Oligosaccharide chains in the Golgi apparatus; assembling of proteoglycans in the Golgi apparatus;
30. Transport from the ER through the Golgi apparatus (COPII-coated vesicles, SNARE proteins, ER resident proteins);
31. The retrieval pathway of proteins to the ER using sorting signals (KDEL sequence, KDEL receptor, COPI-coated transport vesicles);
32. Structure of lysosomes (lysosomal membrane characteristics, acid hydrolases); Functions of lysosomes;
33. The transport of newly synthesized lysosomal hydrolases to lysosomes (lysosomal hydrolase precursor, M6P, M6P-receptor, clathrin-coat, late endosome, mature lysosomal hydrolase);
34. Pathways to degradation in lysosomes (endocytosis, early endosomes, late endosomes, autophagy, autophagosome, phagocytosis, phagosome);
35. Specialized lysosomes of melanocytes and their exocytosis;
36. Phagocytosis (professional phagocytes, phagosomes, actin filaments, Fc receptors);
37. Pinocytosis (clathrin-coated pits, caveolae);
38. Receptor-mediated endocytosis (LDL, transferrin);
39. Transcytosis (receptor-antibody complexes, recycling endosome);
40. Constitutive secretory pathway;
41. Regulated secretory pathway.
42. Cytoskeleton (microtubules, actin filaments, motor-proteins);

43. Mitochondrial diseases, Peroxisomal diseases, Lysosomal diseases;
44. Cystic fibrosis, Familial hypercholesterolemia;
45. The phases of cell cycle;
46. The M phase of the cell cycle;
47. Chromatin condensation;
48. Breakdown of the nuclear envelope;
49. The assembly and function of the mitotic spindle;
50. Chromosomes movement to the middle of the cell;
51. The separation of sister chromatids to opposite poles;
52. Cytokinesis;
53. Cell cycle control system (checkpoints, cyclins, cdks, inhibitor proteins, tumor suppressive proteins p53, Rb);
54. Apoptosis (caspases, signaling pathways to activate caspase cascade);
55. Characteristics and benefits of sexual reproduction;
56. Characteristics of I division of meiosis (homologs pairing, crossing over, assembling and disassembling of synaptonemal complex, homologs segregation);
57. Characteristics of II division of meiosis;
58. Primordial germ cells and sex determination in mammals (migration of primordial germ cells, influence of Sry on gonad development);
59. Structural features of an egg (ovum);
60. Structural features of a sperm (spermatozoon);
61. The stages of oogenesis and their characteristics;
62. The stages of spermatogenesis and their characteristics;
63. The role of capacitation in process of fertilization and its molecular mechanisms;
64. The role of acrosome reaction in process of fertilization and its molecular mechanisms;
65. The role of cortical reaction in process of fertilization and its molecular mechanisms;
66. Characteristics of coming together of the sperm and egg nuclei;
67. Stem cells;
68. Transplantation.