EXAM QUESTIONS IN THE DISCIPLINE “BIOLOGY”

Section 1 ‘Genetics’

1. Cell structure of prokaryotes and eukaryotes (structure and functions of the main components of the cell). Transport of substances through the membrane. Anabolism and catabolism.

2. Mitotic cycle and life cycle of the cell, their relationship. Interphase (periods of interphase and main processes). G_0 period. Examples of cells with different probability of division.

3. Characterisation of events occurring during mitosis. Biological significance of mitosis. Cell theory.

4. Meiosis as a process of haploid cells formation. Phases of meiosis, characterisation of the main processes. Significance of meiosis. Differences between meiosis and mitosis.

5. Gametogenesis (characterisation of ovogenesis and spermatogenesis). Differences between ovogenesis and spermatogenesis. Medical significance of the peculiarities of gametogenesis.

6. Reproduction is one of the fundamental properties of living things. Comparative characteristics of sexual and asexual reproduction. Methods of asexual reproduction in unicellular organisms.

7. Methods of asexual reproduction in multicellular organisms. Parthenogenesis. Variants of parthenogenesis. Gynogenesis. Androgenesis. Occurence in nature.

8. Subject and tasks of genetics. Stages of development of genetics. Role of domestic scientists (N.I. Vavilov, N.K. Koltsov, A.S. Serebrovsky, S.S. Chetverikov, S.N. Davidenkov, N.I. Timofeev-Resovsky, etc.) in the development of genetics.

9. Heredity and variability are the feature that determines the continuity of existence and development of living beings. Levels of organisation of hereditary material. Functions of genetic material. Specific features of the structure and function of the genetic apparatus of prokaryotes and eukaryotes.

10. Features of the genome of eukaryotes and humans.

11. Chemical organisation of the genetic material. Structure and properties of DNA.

12. Structure and types of RNA. Ribozymes. MicroRNA. Functions of RNA.

13. Genetic code as a way of recording hereditary information. Properties of the genetic code. Evidence for the hereditary role of nucleic acids.

14. Gene as the functional unit of heredity. Properties of genes. Features of the organisation of prokaryotic and eukaryotic genes.

15. Functional classification of genes (structural, regulators, modulators). Constitutive and regulated genes. Ways of regulation gene expression.

16. Stages in the realisation of genetic information: transcription, processing. Alternative splicing.

17. Stages in the realisation of genetic information: translation, post-translational processes. Features of gene expression in prokaryotes and eukaryotes.

18. Regulation of gene expression in prokaryotes and eukaryotes. Theory of the operon.

19. The chromosome, its chemical composition and structure. The concept of euchromatin and heterochromatin. Nucleosome model of chromosome structure.

20. Chromosome theory. Chromosome maps (genetic, physical, chemical). Principles of chromosome mapping. Classification of chromosomes by structure.

21. Karyotype and idiogram of human chromosomes. Denver and Paris classifications of chromosomes. Characterisation of the human karyotype in norm and pathology.

22. The concept of genotype and phenotype. Phenotype as a result of the realisation hereditary information in certain environmental conditions. Quantitative and qualitative specificity of gene manifestation in a trait: penetrance and expressivity.

23. Laws of monogenic inheritance (H. Mendel's laws). Hybridological method. Conditions of mendelian inheritance. Mendelinating traits of a human being.

24. Interaction of allelic genes: dominance, incomplete dominance, overdominance, codominance, incomplete dominance, overdominance, codominance, allelic exclusion. Examples of the interaction of these genes.

25. Inheritance of blood groups according to the ABO, Rh and MN systems. Medical significance of blood group determination. Rhesus conflict.

26. Interaction of non-allelic genes: epistasis, complementarity, position effect, modifying effect. Examples.

27. Interaction of non-allelic genes: polymerism. Multiple allelism. Pleiotropic effect of a gene. Examples in humans.

28. Linked inheritance of genes and crossing over. Works of T. Morgan. Chromosome theory. Examples of linked inheritance of traits in humans.

29. Sex of an organism. Primary and secondary sex characteristics. Influence of hereditary material and external environment on sex formation.

30. Formation of human sex characteristics in the process of ontogenesis.

31. Features of the structure of X and Y chromosomes. Inheritance of traits, sex-linked and sex-dependent.

32. Variability (definition, classification). Modification variability (characteristics, meaning, examples).

33. Variability (definition, classification). Combinative variability and its mechanisms. Medical and evolutionary significance of recombination of genetic material.

34. Mutational variability. Characterisation of mutations. The concept of genetic and chromosomal diseases. Biological antimutation mechanisms.

35. Classifications of mutations (by influence on viability, by influence on the phenotype, by type of damaged cells, by origin).

36. Genomic mutations, causes and mechanisms of their occurrence. Classification of genomic mutations. Significance of genomic mutations.

37. Chromosomal mutations, their classification. Causes and mechanisms of chromosomal mutations. The role of chromosomal mutations in the development of human pathological conditions and evolutionary process.

38. Gene mutations and their classification. Causes and mechanisms of occurrence, frequency of occurrence, biological consequences of gene mutations.

39. Genetic engineering, its tasks, possibilities, methods, achievements, prospects.

40. Importance of genetics for medicine. Methods of studying human genetics: biochemical, twin, molecular diagnostics (polymerase chain reaction). Purpose of the method, brief procedure.

41.Features of a human being as an object for genetic research. Methods of studying human genetics: genealogical (features of different types of inheritance), cytogenetic (karyotyping, determination of sex chromatin). Purpose of the method, brief sequence of operations.

42.Methods of studying human genetics: population-statistical, phenotypic analysis with portrait diagnostics, molecular diagnostics (electrophoresis). Purpose of the method, brief procedure.

43.Methods of studying human genetics: modelling method, molecular diagnostics (restriction analysis, DNA probing, DNA sequencing). Purpose of the method, brief sequence of operations.

44.Non-traditional inheritance of traits (cytoplasmic inheritance, genomic imprinting). Examples of human diseases with non-traditional inheritance.

45.Prenatal diagnostics of human hereditary diseases. Medical genetic counselling and its medical significance.

46.Monogenic, chromosomal and multifactorial human diseases, mechanisms of their occurrence and manifestation. General approaches to diagnostics, treatment and prevention of hereditary diseases.

47.Cell cycle regulation (cyclins, cyclin-dependent kinases, checkpoints).

48.Population (definition). Main characteristics of a population: population area, number of individuals and their dynamics, sex and age structure, morphological and ecological unity. Gene pool (concept, characteristics). Hardy-Weinberg law.

49.Marriage systems (varieties of marriages), their influence on the frequencies of alleles and genotypes in the population. Specificity of the action of of natural selection in human populations.

Section 2 ‘Parasitology’

1. The role of the Russian scientists in the development of general and medical parasitology (V.N. Dogel, V.N. Beklemishev, E.N. Pavlovskii, K.I. Scryabin, etc.).

2. E.N. Pavlovskii’s doctrine on the natural nidality of diseases. Components of a natural focus. Parasitic natural focus diseases (examples). The concept of vector-borne diseases. The concept of vectors of pathogens (obligate and facultative). Classification of diseases according to the source of infection (anthroponoses, zoonoses, anthropozoonoses).

3. Parasites development cycles. Alternation of generations in the parasites development cycles (through the example of representatives of different types and classes). The concept of the principal, reservoir and intermediate hosts. Mammals as intermediate hosts and natural reservoirs of the causative agents of human diseases.

4. Protozoa subkingdom. Systematic position and classification of the subkingdom. Characteristic features of the organization. Representatives having medical significance.

5. Dysenteric amoeba. Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

6. Lamblia, trichomonads. Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

7. Leishmanias. Systematic position, morphology, development cycle, routes of infection, localization in the human body, pathogenic effect, justification of laboratory diagnostic methods and preventive measures.

8. Trypanosomas. Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

9. Balantidium. Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

10. Malaria plasmodium. Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

11. Toxoplasma. Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

12. Flukes class. Systematic position. General characteristics of the structure and life activity. Medical significance of class representatives.

13. Liver fluke (Fasciola hepatica). Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

14. Feline fluke (Opisthorchis felineus). Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures. Foci of opisthorchiasis in the CIS.

15. Chinese fluke (Clonorchis sinensis). Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

16. Lung fluke (Paragonimus westermani). Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

17. Schistosomes. Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

18. Tapeworms class. Systematic position, general characteristics of the structure and life activity, features of the life cycles. Forms of tapeworm measles.

19. Pork tapeworm. Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

20. Cysticercosis. Causative agent, its systematic position, morphology, routes of infection, localization of measles. Methods of diagnostics, treatment and prevention.

21. Beef tapeworm. Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

22. Dwarf tapeworm. Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

23. Echinococcus, alveococcus. Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

24. Broad tapeworm. Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

25. Nematodes type. Systematic position, features of the structure and life cycles. Medical significance of class representatives.

26. Human ascarid (Ascaris lumbricoides). Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures. The role of various organisms in environment clearance from ascarid's eggs.

27. Pinworm (Enterobius vermicularis). Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics, preventive measures and methods of drug-free treatment.

28. Whipworm (Trichocephalus trichiuris). Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

29. Hookworms. Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

30. Threadworm (Strongyloides stercoralis). Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

31. Trichinella. Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

32. Guinea worm. Systematic position, morphology, development cycle, routes of infection, justification of the methods of laboratory diagnostics and preventive measures.

33. Filaria: Wuchereria, Brugia, Onchocerca. Systematic position, morphology, development cycle, routes of infection, localization in the human body, pathogenic effect, justification of laboratory diagnostic methods and preventive measures.

34. Methods of diagnostics of parasitic diseases (through the examples of representatives of various types and classes).

35. Arthropods type. Systematic position, classification, representatives. Characteristic features of the structure and life activity. Medical significance of class representatives.

36. Arachnids class. Systematic position, classification, representatives. Characteristic features of the structure and life activity. Medical significance of class representatives.

37. Ticks order: systematic position, morphology, development cycles and medical significance of argasid and acariform ticks.

38. Lice. Systematic position, morphology, development cycle, epidemiological significance, control measures.

39. Fleas. Systematic position, morphology, development features, epidemiological significance, control measures.

40. Family of flies: tsetse fly, housefly, Wohlfahrtia magnifica. Systematic position, morphology, epidemiological significance, control measures.

41. Mosquitos. Systematic position, morphology, development cycle, medical significance, control measures.

42. Mosquitoes. Systematic position, morphology, development cycle, medical significance, control measures.

43.Forms of biotic relationships in nature. Parasitism as an ecological phenomenon. Classifications of parasitism, parasites and hosts. Distribution of parasites in nature. Origin of ectoparasitism and endoparasitism.

Section 3 'General Biology'

1. Development of ideas about the nature of life. Definition of life. Fundamental properties of living systems.

2. Levels of organisation of life. Elementary units, elementary phenomena and manifestations of the main properties of life at different levels of its organisation.

3. Regeneration as a process of maintaining morpho-physiological integrity of biological systems at the organism level. Physiological regeneration, its significance. Manifestations of regeneration at the subcellular and cellular levels. Phases of physiological regeneration, mechanisms of its regulation.

4. Reparative regeneration, its significance. Methods of reparative regeneration. Typical and atypical regeneration. Regulation of regeneration.

5. Postembryonic period of ontogenesis, its periodisation (ecological and embryological classification, general biological classification, anthropological periodisation of postembryonic ontogenesis).

6. Ageing as a natural stage of ontogenesis. Manifestation of ageing at molecular-genetic, cellular, tissue, organ and organismic levels.

7. Fundamental regularities of the ageing process. Hypotheses of ageing.

8. History of evolutionary ideas formation. The essence of Ch. Darwin's ideas about the mechanisms of evolution of living nature. Synthetic theory of evolution.

9. Origin of life: the hypotheses of panspermia and abiogenic origin of life. The main stages in the origin and development of life.

10. The origin of the cell as the starting point of biological evolution. Hypotheses of the origin of eukaryotic cells (symbiotic, invagination). Emergence of multicellularity. The differences between the cells of unicellular and multicellular organisms.

11. Elementary evolutionary factors: mutational variability, combinatorial variability, population waves, gene drift (genetic-automatic processes), migration and isolation.

12. The struggle for existence. Natural selection is the driving and directing force of evolution. Forms of natural selection.

13. Microevolution. Methods of speciation. Species: definition, structure and criteria. Genetic unity, integrity of species.

14. Macroevolution. Directions of evolution: aromorphosis, idioadaptation, morphophysiological regression. Forms of evolution of groups: phyletic, divergent, convergent, parallel. Path of evolution: biological progress and biological regression.

15. The position of man in the system of the animal world (justification of the systematic position of the species Homo sapiens). Biological conditions for the progressive development of hominids (anthropomorphosis).

16. Qualitative characteristics of species Homo sapiens. Biosocial nature human being. Correlation of biological and social factors in human formation at different stages of anthropogenesis.

17. Modern ideas about the origin of man. Intraspecies differentiation of man.

18. Correlation of ontogenesis and phylogenesis. Law of germinal similarity of C. Baer. The basic biogenetic law of F. Muller and E. Heckel. The concept of recapitulation and cenogenesis. A.N. Severtsov's doctrine of filembryogenesis. Provisory and definitive, homologous and similar organs.

19. Phylogenesis of the vertebrate nervous system. Phylogenetically determined malformations of brain development as a result of disturbances of ontogenesis.

20. Phylogenesis of the vertebrate circulatory system. Phylogenetically determined malformations of the heart and vessels as a result of disturbance ontogenesis.

21. Phylogenesis of the vertebrate urogenital system. Phylogenetically determined malformations of the genitourinary system as a result of disturbance ontogenesis.

22. Human population structure. Dems, isolates, non-isolated populations. Distribution and frequency of hereditary diseases in different human populations. Influence of mutational variability, migration, isolation, gene drift on the gene pool of human populations.

23. Ecology as a science. Subject, structure and content of ecology. Ecological factors (abiogenic, biogenic, anthropogenic). Concepts: optimum, pessimum, endurance limit. Limiting factor.

24. Ecosystem and biogeocenosis: definition, characteristics and structure (functional, spatial, species). Food chains and food networks. Ecological pyramids of wealth, biomass, energy.

25.The concept of human ecology. Man as a creative ecological factor. Agrocenoses (agroecosystems), their characteristics and differences from natural ecosystems.

26.Concept of biosphere. Structure of the biosphere. Functions of living matter. Biochemical cycles of substances in the biosphere (carbon, nitrogen)