EXAMINATION QUESTIONS IN NORMAL PHYSIOLOGY FOR 2ND-YEAR STUDENTS OF MEDICAL FACULTIES

1. Subject and problems of physiology. Branches of modern physiology. Methods of investigation in physiology. Experiment as the basic investigation method in physiology. Value of physiology in medical education.

2. The concept of the blood system. Basic functions of blood. Composition and volume of blood. The kinds and causes of hypervolemia and hypovolemia. Hematocrit, its normal values and changes at various kinds of hyper- and hypovolemias. The depots of blood and its value. Hemorrhages and their effects.

3. Blood plasma, its composition and properties. Proteins of blood plasma, their characteristic, amount and functions.

4. Physical and chemical properties of blood. Osmotic pressure, its determining factors and normal values. Hyper-, hypo- and isotonic (physiological) solutions. Oncotic pressure of blood plasma, its normal values and physiological role. Viscosity and relative density of blood, their determining factors, normal values and physiological role.

5. Acid-base state of blood. The active reaction (pH) of blood. Buffer systems of blood. Alkaline reserve. Acidosis, alkalosis, their kinds and the factors causing them.

6. Erythrocytes, their structure, properties, composition, amount. The functions of erythrocytes. Erytrocytosis. Anemia.

7. Hemoglobin, its structure, properties, compounds, functions and amount. Bonds of hemoglobin. Types of hemoglobin, their distinctive properties. The color index of blood.

8. Hemolysis and its kinds. The osmotic resistance of erythrocytes, its normal values and diagnostic importance. Erythrocyte sedimentation rate (ESR), its normal values and diagnostic importance. Factors increasing and decreasing ESR.

9. Leucocytes, their classification, features and functions. Leucocyte formula, its diagnostic significance. Leukocytosis, its kinds.

10. Thrombocytes, their structure, properties, amount and functions. Vascular platelet (initial, primary) hemostasis, its phases.

11. Secondary (coagulating) hemostasis. Plasma factors of blood coagulation. Blood-coagulation factors of formed elements. The phases of secondary hemostasis.

12. Fibrinolysis, its phases and determining factors. Blood anticoagulation system. Anticoagulants. The factors accelerating and decreasing blood coagulation.

13. Blood groups (types). The AB0 system. Factors determining blood groups. Direct, indirect and biological test. The Rh-factor. Anti-D-administration. Fundamentals and main principles of blood transfusion.

14. Regulation of the blood system and hemopoesis. Neuro-humoral mechanisms of regulation of erythropoiesis, leucopoiesis and thrombocytopoiesis.

15. Blood-substituting solutions and basic requirements for them. Salt solutions. Colloid solutions. Blood preparations (components). Their positive and negative properties.

16. Electrical phenomena in excitable tissues. Properties of excitable tissues. Active and passive transport of ions through the cell membrane. Classification of ion channels

of the cell membrane. Membrane-ionic theory of the origin of the resting membrane potential.

17. Membrane action potential and mechanism of its origin. Changes of excitability during excitation.

18. Laws of stimulation and assessment of excitability. Rheobase. Chronaxie, its value in clinical practice. Lability.

19. Physiology of nerve fiber. Laws of excitement conduction in nerve fibers. Mechanisms of signal formation and conduction in myelinated and unmyelinated fibers. Parabiosis by Vvedensky N.E.

20. Physiology of synapses. Synapse, its structure, properties, functional role. Classification of synapses. Mechanisms of signal transmission in chemical synapses (on the example of nerve-muscular synapses). Excitatory postsynaptic potential (EPP).

21. Skeletal muscles and their physiological properties. Forms and types of muscle contractions. Mode of muscle contractions. Single muscle contraction, its periods. Tetanic muscle contractions, types of tetanus. Optimal and pessimal rhythms of the work of muscles.

22. Strength and work of muscle fiber. Motor units, their classification by structure and by functional value. Muscle tonus. Muscle fatigue and its mechanisms. Hypertrophy and atrophy of muscles.

23. Structure of muscle fiber. Sarcomere. Theory of muscle contractions (sliding of filaments). Cross-bridge cycling.

24. Smooth (unstriated) muscles, features of their structure and properties. Types of smooth muscles. Plasticity of smooth muscles, its value.

25. Reflex activity of the nervous system. Reflex as basic mechanism of CNS reaction to changes of external and internal environment. The classification of reflexes. Reflex arc and its structure.

26. The concept of nerve centers. Properties of the nerve centers (summation of excitation, transformation of excitation rhythm, posttetanic potentiation, high fatigability, sensitivity to some chemical substances).

27. Main principles of excitation transmission in nerve centers (divergence, convergence, transmission of signals in one direction, slower transmission in the nerve centers, reverberation). Coordination of reflexes and its principles (the reciprocal principle, induction, feedback principle, the principle of the “final common pathway”, occlusion). Dominant and its properties.

28. Inhibition in the CNS and its role. Kinds of inhibition. Inhibition mechanisms. Post-synaptic and pre-synaptic inhibition. Inhibitory postsynaptic potential (IPP).

29. Spinal cord, its reflex activity and conduction functions. Spinal shock.

30. Medulla oblongata and pons varolii, their centers. Functions of the medulla and pons varolii.

31. Midbrain. Reflex and conduction functions. Reflexes of the brain stem. Decerebrate rigidity.

32. Cerebellum and its functions. Characteristics of cerebellar deficiency.

33. Reticular formation of the brain stem, its descending influence on the activity of spinal cord and ascending active influence on the cortex of cerebrum.

34. Thalamus, its functions. Nonspecific and specific nuclei. Participation of thalamus in formation of pain sensitivity.

35. Hypothalamus and its nuclei. Hypothalamus as the superior subcortical vegetative center. Functions of the hypothalamus.

36. Limbic system of the brain. Its role in formation of biological motivations and emotions. The main functions of the limbic system.

37. Basal ganglia. Their participation in formation of muscle tonus and complex motor acts. Functions of corpus striatum, caudate nucleus.

38. Cortex of cerebrum. Morpho-functional characteristics of the cerebral cortex. Main regions of the cerebral cortex (sensory, motor and associative regions). Electrical activity of the cortex of the cerebrum. Electroencephalography (EEG). Functional asymmetry of the cerebral cortex.

39. Autonomic (vegetative) nervous system (ANS), its morpho-functional characteristics. Features of structure and functions of sympathetic and parasympathetic parts of the ANS. Classification of the vegetative ganglia.

40. Conduction of excitation in the synapses of the autonomic nervous system. Mediators of the autonomic nervous system. The effects of sympathetic and parasympathetic stimulation on different visceral functions. Vegetative reflexes. The axon - reflex. Levels of the regulation of the vegetative functions.

41. The concept of endocrine glands. Hormones, their chemical structure and properties. Classification of hormones. Transport of hormones with blood. The mechanisms of hormone action on target cells. Principles of interrelations (direct and feedback) in endocrine system.

42. Hormones of anterior lobe of the hypophysis (adenohypophysis) and their physiological role. Regulation of incretion of adenohypophysis. Role of hypothalamic releasing factors. Effects of hypo- and hypersecretion of certain hormones of adenohypophysis.

43. Hormones of intermediate and posterior lobes of the hypophysis and their physiological role. The effects of hypo- and hypersecretion of these hormones. Role of hypothalamus in regulation of neurohypophysis function.

44. Thyroid gland, its structure. Thyroid iodine-containing hormones (T_3 and T_4), their biosynthesis, transport by blood, physiological role. The main effects of thyroid hormones. Regulation of thyroid hormone production.

45. Hypo- and hyperthyroid states. Cretinism, myxedema. Graves' (Basedow's) disease. Physiological hyperfunction of thyroid gland. Endemic goiter and its prophylaxis.

46. Hormonal regulation of metabolism of calcium and phosphorus. Incretion of the parathyroid glands. Parathormone and its role in regulation of Ca and P metabolism. Regulation of function of parathyroid glands. Hypo- and hyperparathyroidism. Thyrocalcitonin, cells producing it, chemical structure of the hormone and physiological role.

47. Endocrine function of pancreas. Hormones of the pancreas and their role in regulation of metabolism of carbohydrates, proteins and fats. Hypo- and hyperglycemia. Diabetes mellitus. Regulation of endocrine function of pancreas.

48. Hormones of the cortex of adrenal glands and their role in regulation of functions of an organism. Regulation of endocrine function of the adrenal cortex. Effects of hypo- and hypersecretion of certain hormones of the adrenal cortex.

49. Hormones of the adrenal medulla (adrenaline and noradrenaline) and their physiological role. Regulation of endocrine function of the adrenal medulla. Effects of hypo- and hypersecretion of hormones of the adrenal medulla.

50. Incretion of the sex glands. Androgens and their physiological role. Estrogens and their physiological role. Hormone of corpus luteum - progesterone, its physiological role. Changes in the organism caused by the insufficient secretory function of the sex glands. Regulation of the activity of the sex glands. Hormones of the placenta.

51. The value of respiration for an organism. Consecution of processes of gas exchange. External and internal respiration. Adaptive features of lungs for realization of respiration. Non-respiratory functions of the lungs.

52. Respiratory movements. Inspiration and expiration mechanisms. Inspiration and expiration muscles. Types of respiration, its rate.

53. Intrapleural pressure, its genesis, physiological role and values during inspiration and expiration. Elastic recoil of lungs. Surfactant and its role in change of surface tension of alveoli. Pheumothorax.

54. Lung ventilation. Pulmonary volumes and capacities, their normal values. Spirographic record. Vital capacity of lungs, factors influencing it. Anatomic and physiologic (functional) dead space.

55. Gas exchange in the lungs. Partial pressure of O_2 and CO_2 in inhaled, alveolar and exhaled air. The partial pressure of gas in blood. The factors which determine the rate of gas diffusion between alveolar air and blood. Ventilation-perfusion coefficient.

56. Transport of O_2 by blood. Forms of O_2 transport. Oxygen capacity of blood. Analysis of oxyhemoglobin dissociation curve. Factors influencing dissociation and formation of oxyhemoglobin, their physiological value. The oxygen utilization coefficient.

57. Binding and transport of CO_2 by blood. Forms of CO_2 transport. Role of carbonic anhydrase.

58. Regulation of respiration. Respiratory center. Localization and structural organization of the respiratory center. Role of gas composition in the regulation of the respiratory center activity. Role of chemoreceptors in the regulation of respiration. Role of the pneumotaxic center in the regulation of respiration.

59. Receptors participating in regulation of respiration. Role of mechanoreceptors (stretch receptors), irritant receptors, proprioreceptors of respiratory muscles and the upper airway receptors in regulation of respiration. First inspiration of a newborn. Theories.

60. Features of respiration in different conditions. Respiration in the conditions of low atmospheric pressure. Mountain illness. Critical zones of hypoxia. Respiration in the conditions of high atmospheric pressure. Caisson disease.

61. Structure and properties of myocardium (cardiac muscle). Excitability, conduction, contraction. Automaticity of the heart. Action potential of the pacemaker cells. Conduction system of the heart, its functional features.

62. Relations of the excitability, excitation and contractions of the myocardium. Action potential of the contractile myocardium, its phases and ion mechanisms. Extrasystole. Classification, compensatory pause.

63. Electrical manifestation of cardiac activity. Electrocardiography (ECG) and its reading. The types of ECG leads. The formation of ECG components. The scheme of the ECG examination. Diagnostical significance of ECG.

64. Cardiac cycle. Sequence of the periods and phases of the cardiac cycle. Position of the valves of the heart in different phases of cardiac cycle.

65. Mechanical and sound manifestations of cardiac activity. Heart sounds, their genesis. Stroke volume and cardiac output. Cardiac index.

66. Regulation of cardiac activity. Intracardiac regulation. The extracardiac mechanisms of regulation. The influence of the parasympathetic (vagus) and sympathetic nerves on cardiac activity. Reflexogenic zones, their value in regulation of cardiac activity. Humoral regulation of cardiac activity.

67. Fundamentals of hemodynamics. Peripheral resistance, its functional value. Volume and linear types of the blood flow velocity in various areas of the blood vessels and their determining factors.

68. Blood pressure, its kinds and determining factors. Measurement methods.

69. Functional classification of the blood vessels. Factors ensuring blood circulation in the high pressure and low pressure blood vessels.

70. Arterial pulse, its nature and characteristics. Analysis of sphygmogram.

71. Blood flow in the low pressure blood vessels (veins), its determining factors. Central venous pressure. Venous pulse, its origin. Analysis of phlebogram.

72. Microcirculation. Capillary blood flow and its features. The types of capillaries. The mechanisms of exchange of fluids and substances in the capillaries between blood and tissues. Filtration and reabsorbtion of fluid in capillaries. Hydrostatic and oncotic pressure at level of microcirculation channels.

73. Regulation of the blood flow in the blood vessels. Neural reflex regulation of the vascular tone. The vasomotor center and its afferent and efferent connections. The most important reflexogenic zones.

74. Humoral regulation of the tone of blood vessels. Vasoconstriction and vasodilatation substances (hormones, renin-angiotensin-aldosterone system, kinin system, endothelial factors and other endogenous substrates). Substances with double action on the blood vessels. Local mechanisms of the regulation of vascular tone.

75. Physiological bases of hunger and satiety. The theories of the origin of the sensation of hunger. Satiety and its kinds.

76. Digestion in the oral cavity. Salivation. The secretory apparatus. Saliva, its amount, composition and properties. The physiological role of saliva. Regulation of salivation. Swallowing, its phases. Reflex character of swallowing.

77. Digestion in the stomach. Digestive and non-digestive functions of the stomach. Secretory activity of the stomach. The secretory apparatus of mucous membrane. Gastric juice, its composition and properties. The physiological role of hydrochloric acid of gastric juice.

78. Regulation of gastric secretion. Phases of gastric secretion and their regulation. Appetizing juice and its physiological value. Motor function of the stomach and its regulation.

79. Secretory (exocrine) activity of the pancreas. Pancreatic juice, its composition and properties. Regulation of pancreatic secretion.

80. Bile, its composition and participation in digestion. Functions of bile. Features of composition and properties of hepatic and cystic bile. Bile acids, their physiological role. Intestinal-hepatic circulation. Regulation of bile formation and biliary secretion.

81. Intestinal secretion. Composition of the juice of the small intestine. Distant (cavitary) and contact (parietal, membrane) digestion in the small intestine. Motor activity of the small intestine. Types of contraction and their functional value. Regulation of motor activity of the small intestine.

82. Digestion in the large intestine. Structure and properties of juice. The physiological role of the microflora of the large intestine: Motor activity of the large intestine. Defecation and its regulation.

83. Adsorption of substances in different parts of digestive tract. Transport of macro- and micro molecules. Mechanisms of absorption. Villi, their structure and role in processes of adsorption.

84. Exchange of proteins and its regulation. Nitrogen balance and its kinds.

85. Exchange of fats and its regulation.

86. Exchange of carbohydrates and its regulation.

87. Energy metabolism. Energy balance. The sources and ways of energy transformation in the human body. Measurement of body energy consumption. Direct and indirect calorimetry. Respiratory quotient. Thermal equivalent of oxygen.

88. Basal metabolism. Factors determining basal metabolism. The values of basal metabolic rate. Methods and standard conditions for the determination of basal metabolism. Specific dynamic action of food. Working metabolism.

89. Body temperature and isothermia. Human body temperature and its daily variation. Mechanisms of thermoregulation. Chemical thermoregulation (heat production) and physical thermoregulation (heat loss).

90. Regulation of isothermia (nervous and humoral). The role of hypothalamus as the central integration center for thermoregulation. The concept about the “set point” of the temperature control mechanism. Hypothermia and hyperthermia. Fever.

91. Organs of excretion and their participation in the maintenance of homeostasis. Kidneys and their functions. Nephrons as morpho-functional units of the kidneys. Types of nephrons. Features of renal blood flow.

92. Uropoietic process. Filtration-reabsorption theory of urine formation. Glomerular filtration. The structural features of the filtrating membrane The effective filtration pressure .

93. Tubular reabsorption. The mechanisms of tubular reabsorption in different parts of the nephron. Threshold and non-threshold substances.

94. Osmotic dilution and the concentration of urine. Countercurrent multiplier system. Urea recycling. Neuro-humoral mechanisms of regulation of urine formation. The role of antidiuretic hormone (ADH, vasopressin) and aldosterone in regulation of urine formation.

95. Tubular secretion. Secretory and synthetic processes in renal tubules. Renal clearance. Amount, composition and properties of final urine. Urination and its regulation.

96. Homeostatic functions of kidneys. The role of the kidneys in the regulation of arterial pressure and acid-base balance.

97. The general principles of the constitution of the sensory systems. Properties of the analyzers Adaptation. Basic functions of the sensory systems. Classification of receptors. The mechanism of transformation of the stimulus energy in the receptors.

98. Visual system. Structure and functions of the optical device of the eye. Accommodation of lens and its mechanisms. Myopia, hyperopia and their correction. Eye pupil, pupillary reflex and its regulation.

99. Structure and functions of the retina. The receptor device of the retina and photochemical reactions in it at action of light. Electrical activity of the centers of the visual system. The electroretinogram (ERG). Conduction nerve pathways and central parts of the visual system.

100. Color vision. Theories of chromatic sensitivity. Color blindness (daltonism) and its types. Visual acuity. Visual field.

101. Auditory system. Structure and functions of the external, middle and internal ear. Conduction of sound vibrations along the cochlear ducts. Location and structure of the receptor cells of the spiral organ. Mechanisms of auditory reception.

102. Theories of sound perception. (H. Helmholtz, G. Bekeshi). Electrical phenomena in the cochlea. Conducting pathways and central parts of the auditory system. Auditory functions. Analysis of sound frequency. Auditory sensitivity. Sound tonality and loudness. Binaural hearing.

103. Vestibular system and its role in assessment of the spatial position of body and at its motion. Structure and functions of the receptors of the vestibular system. Complex reflexes connected with vestibular stimulation (vestibulospinal, vestibulovegetative, vestibulo-oculomotor reflexes). Conduction pathways and central parts of the vestibular system.

104. Pain reception. Biological value of pain, definition, classification. Components of pain reaction. The causes of pain origin. Pain receptors. Kinds of pain. Referred pain

(regions of Zakharin-Ged). Conduction pathways of pain sensitivity. Antinociceptive system. The structurally functional characteristic and neurochemical mechanisms. Methods of anesthesia.

105. Conditioned reflex as a form of the organism’s adaptation to environmental changes. The requirements for the formation of conditioned reflexes: Classification of conditioned reflexes Mechanisms of the formation of conditioned reflexes. Inhibition of conditioned reflexes. External (unconditioned) inhibition and internal (conditioned) inhibition.

106. Specific features of human higher nervous activity. Signal systems. I. P. Pavlov's doctrine about the first and the seconds signal systems. The centers of the second signal system (speech centers).

107. Types of higher nervous activity. I.P. Pavlov's doctrine about the types of higher nervous activity, their classification and characteristic.

108. Physiology of sleep. Kinds of sleep. Phases of sleep. Changes of electroencephalogram, somatic and vegetative functions during sleep. Hypotheses of sleep appearance.

109. Memory, its types. The role of various departments of the brain in perception, storage, and reproduction of information. Mechanisms of short-term and long-term memory.

110. Emotions, their biological role. Classifications of emotions. Vegetative and somatic components of emotions. Theories of emotions. Structures which participate in the formation of emotions. Negative emotions in genesis of psychosomatic diseases. Emotional stress.