Normal Physiology Program Questions

Topic “Blood Physiology”

1. Body fluids (blood, lymph, interstitial fluid, intracellular fluid, cerebrospinal fluid etc.) and their distribution in the organism.
2. Stability of the chemical composition and physicochemical properties of the internal environment. Homeostasis.
3. Blood. Properties and functions of the blood. Idea about blood system.
4. Composition of blood. Hematocrit ratio. Plasma and it composition. Serum. Plasma proteins and electrolytes.
5. Blood osmotic pressure, it regulation.
6. Formed Elements of the Blood. Erythrocytes (red blood cells), their function and peculiarities. Hemolysis and it types.
7. Hemoglobin, it types and hemoglobin compounds.
8. Leukocytes (white blood cells), types of leukocytes. Leukocyte formula. Leukocytosis and leucopenia. Thrombocytes (platelets).
9. Functional systems which provide constancy of main homeostatic constants: blood composition, blood osmotic pressure, acid-base balance etc.
10. Main parameters of general blood analysis. Hemogram. Physiological estimation of blood analysis results. Diagnostic meaning of general blood analysis.
11. Hemostasis system. Initial (vascular-thrombocyte) and secondary (coagulation) hemostasis. Stages of blood coagulation. Fibrinolysis. Anticoagulant factors.
12. Blood group systems ABO, Rh. Basic principles of donor blood selection. Transfusion of blood and blood components.

Topic “Heart Physiology”

1. Physiological properties and peculiarities of heart muscle.
2. Action potential of typical cardiomyocyte (contracting heart muscle) and atypical cardiomyocyte (self-excitatory cells).
3. The cardiac cycle and it phase structure.
4. The heart as a pump. Systolic volume and cardiac output in rest and during physical exercises.
5. Heart sounds and their origin.
6. Electrocardiogram (ECG). Formation of ECG components. ECG leads. Characteristics of the normal ECG. Role of ECG interpretation in medicine.
7. Levels of heart pumping regulation. Intrinsic regulation of heart pumping. Heterometric and homeometric regulation (Frank-Starling, Anrep).
8. Control of heart by the sympathetic and parasympathetic nervous and their mediators.
9. Humoral control of heart activity.

Topic “Circulatory System Physiology”

1. Overview of the circulation. Functions of the circulation.
2. Factors, which provide blood flow through vessels. Aortic compressive chamber. Role of elasticity of vessel wall.
3. Velocity of linear blood flow in different vascular zones.
4. Blood pressure and it types. Blood pressure in different vascular zones. Factors, which determine arterial and venous blood pressure.
5. Vascular tone and it types.
6. Humoral control of vascular tone. Role of the endothelium (hormones, renin-angiotensin-aldosterone system, kinins, prostaglandins, nitric oxide, endothelins, metabolites, O_2, CO_2).
7. Neuro-reflectory control of vascular tone.
8. Vasomotor center and it efferent effects. Afferent stimulation of vasomotor center.
9. Capillary fluid exchange and it peculiarities. Microcirculation and it role in fluid exchange between blood and tissues.
10. Lymphatic system. Mechanism of lymph formation and lymph flow. Functions of the lymph.

Topic "Excitable Tissues Physiology"

1. Modern conception about biological membranes structure and functions. Active and passive transport of different substances across membranes. Ion channels, ion pumps and their mechanism of action.
2. Resting membrane potential (RMP) and it origin.
3. Action potential (AP) and it phases. Modern conception about mechanism and phases of action potential.
4. Local response (LR) and the action potential, their properties, phases and ionic mechanisms.
5. The lows of excitable tissues reaction on irritation (low of force, duration, "all or nothing" etc.). Action of direct electrical current on excitable tissues.
6. The relation between excitation, contraction and relaxation of skeletal muscle (electro-mechanical relation).
7. Types of muscle contraction. The single muscle contraction and it phases. Tetanus, its types. Optimum and pessimum of contraction by N.E. Vvedensky.
8. Motor units, types and functional features. Strength and labor of muscle. The optional load and the rhythm of contraction. Low of average load.
9. Functional characteristic of smooth muscles.
10. Mechanisms of conducting excitations along nerve fibers. Excitability and lability of nerve fibers.
11. Forth – time curve or irritation. Rheobase, chronaxy and their significance in medicine.

12. Common physiological characteristic of junctions. Junction classification. Functional properties of chemical junction. Structure-functional organization of neuromuscular junction.

Topic “Central Nervous System Physiology”

1. Neuron as a structural and functional unit of the CNS. Functional properties of neurons. Connections between neurons and glial cells.
2. Peculiarities of excitation conduction in CNS synapses. Excitatory and inhibitory synapses and their mediator mechanisms.
3. The main principles and peculiarities of excitation propagation in CNS (divergence, convergence, reverberation, facilitation etc.).
4. Inhibition in CNS (I.M. Sechenov), it types and role. Contemporary conception about mechanism of central inhibition.
5. The main principles of coordination CNS activity. Dominant and it role (A.A. Uchtomski).
6. Reflex arch and reflex loop. Feedback connection and it role. Reflex classification.
7. Nervous center. Functions of nervous centers and their properties (space and time summation, excitation rhythm transformation, plasticity, nervous centers exhaustion).
8. Spinal cord, it structural and functional organization. Main functions of the spinal cord. Spinal cord mechanisms of muscle tone and muscle movement regulation. Spinal shock.
9. Medulla oblongata and pons, their structural and functional organization and main functions.
10. Mesencephalon (midbrain), it structural and functional organization. Main functions of the midbrain. Decerebrate rigidity and mechanisms of it development. Midbrain and medulla oblongata role in regulation of skeletal muscle tone.
11. Cerebellum, it structural and functional organization. Consequences of the cerebellum removal.
12. Reticular formation of the brain stem. Upward and downward facilitatory and inhibitory effects of reticular formation. Participation of reticular formation in integral activity of the organism.
13. Thalamus. Functional characteristic of thalamic nuclear groups.
14. Hypothalamus. Participation of the hypothalamus in vegetative (autonomic) function regulation, emotion and motivation formation.
15. The autonomic (vegetative) nervous system. Distinctive features of somatic and autonomic nervous system divisions.
16. Physiology of the sympathetic and parasympathetic divisions of autonomic nervous system. Comparative description of the sympathetic and parasympathetic nervous systems, synergism and relative antagonism of their effects.
17. Limbic system, peculiarities of it structural and functional organization. Main functions of the limbic system.

18. Basal ganglia and their structural and functional organization. Main functions of the basal ganglia.
19. Structural and functional organization and contemporary conception about functions localization in cerebral cortex.

Topic “Respiratory System Physiology”

1. Respiration and its main stages. Respiratory and nonrespiratory lung functions. Respiratory cycle.
2. Inspiration and expiration mechanisms. Inrapleural space pressure, it origin and role. Surfactant role.
3. Respiratory resistance and it types.
4. Convection and diffusion role in maintenance of relatively constant composition of alveolar air. Dead space conception.
5. Respiratory volumes and capacities, lung ventilation parameters. Spirometry, spirography, pneumotachometry.
6. Blood gas transport. Oxyhemoglobin dissociation curve and it characteristics. Carbon dioxide blood transport. Carboanhidrase significance.
7. Tissue gas exchange. Tension of O_2 and CO_2 in interstitial fluid and cells. Indices of O_2 and CO_2 tension and concentration in arterial and venous blood. Oxygen and carbon dioxide blood transport conjunction.
8. Respiratory center. Regulatory effects on respiratory center from higher brain structures (hypothalamus, limbic system, large cerebral hemispheres). Humoral regulation of respiration. Central and peripheral chemoreceptors. Carbonic acid significance.
9. Functional system providing blood gas content constancy. Conception about blood gas transport system. It functional goal and positive adaptive results. Organism functional reserves in gas exchange.

Topic “Energy and Substance Metabolism. Thermoregulation. Nutrition”

1. Metabolism in organism. Primarily and secondary heat. Assimilation and dissimilation. Plastic and energetic role of nutrients.
2. Direct and indirect calorimetry (energy metabolism investigation through complete and incomplete gas analysis). Respiratory quotient. Oxygen calorie equivalent.
3. Basal metabolism, it value and factors which determine it. Energy loss in basal metabolism conditions. Basal metabolism determination role. Working supplement. Energy loses during different type of working activity. Specific dynamic action of nutrients.
4. Protein, carbohydrate and fat metabolism.
5. Constant temperature of inner environment as necessary condition for normal metabolism process. Poikilo-, homeo- and heterothermic conditions. Temperature of human organism and it daily fluctuations. Thermometry.

6. Chemical thermoregulation. Metabolism as a source of heat formation. Contractile and non-contractile thermogenesis.
7. Physical thermoregulation. Heat exchange types (radiation, heat conduction, convection, evaporation). Heat balance. Heat balance equation.
8. Peripheral and central thermoregulation mechanisms. Functional system providing constant temperature of inner body environment.

Topic "Gastrointestinal Physiology"

1. Digestion, it functional meaning. Gastrointestinal tract functions. Digestion types depending from origin and localization of enzymes.
2. Experimental and clinical methods of gastrointestinal tract investigation.
3. Feeding center. Feeding motivation. Physiological basis of hunger and satiety. Functional system providing nutrient constancy in the blood.
4. Principles of gastrointestinal system regulation. Role of reflex, humoral and local mechanisms of regulation.
5. Endocrine function of gastrointestinal tract.
6. Digestion in the oral cavity, stomach, duodenum, small and large intestine.
7. Nutrients hydrolysis in the gastrointestinal tract lumen and membrane hydrolysis in different small intestine parts.
8. Absorption in different parts of gastrointestinal tract. Types and mechanisms of substances absorption through biological membranes.

Topic "Excretory Physiology"

1. Kidney role in acid-base balance, osmotic pressure, blood ion content, blood volume maintain, in blood pressure, blood cell formation, water-ion balance regulation.
2. Incretory function of the kidney.
3. Excretion function of skin, lungs and gastrointestinal tract.
4. Peculiarities of kidney blood supply. Autoregulation of blood circulation in the kidney (Baylis-Ostroumov phenomenon).
5. The main mechanisms of urine formation: glomerular filtration, tubular reabsorption and secretion. Primary urine formation, it volume and composition.
6. Reabsorption of different substances in nephron tubules and loop of Henle. Secretion and excretion processes in nephron tubules.
7. Countercurrent-multiplying renal system.
8. Neurohumoral regulation of urine formation.

Topic "Endocrine System Physiology"

1. General hormones characteristic and classification.
2. Hormone formation and secretion, their transport by blood.

3. Mechanism of hormone action, primarily and secondary messengers conception. The main directions of hormone action.
4. Methods of endocrine gland investigation.
5. Regulation of hormone secretion. Interaction between endocrine glands and nervous system. Hypothalamus participation in hormonal functions regulation.
6. Anterior and posterior pituitary gland hormones.
7. Endocrine role of pancreas and it role in metabolism. Functional system which maintain optimal blood glucose level.
8. Gonads (ovaries and testes). Male and female sexual hormones and their physiological role. Placenta endocrine function. Hormonal regulation of female reproductive function.
9. Thyroid gland physiology and it role in the organism. Parathyroid gland. Hormonal regulation of calcium metabolism in the organism.
10. Adrenal gland physiology. Adrenal cortex and medulla hormones role in organism functions regulation.
11. Pineal gland and thymus gland physiology.
12. Prostaglandins and their role in the organism. Idea about regulatory peptides.
13. Stress, definition, types of stress. The main stress stages and their characteristic. Stress-realizing and stress-limiting systems.

Topic “Sensory Systems Physiology”

1. I.P. Pavlov conception about analyzer systems. Physiological role of different analyzer system portions. Sensory systems and sensory organs conception.
2. Receptor, conductor and cortical portions of the sensory system. Receptors classification and functional properties. Specific and nonspecific afferent systems. Cortical processing of sensory information.
3. Tactile and thermal sensation and their role.
4. Interoreceptor sensory system role in maintaining of the constant composition of the internal body environment. The interoreceptors classification and peculiarities of their functioning.
5. The biological role of the pain. The pain theories. Nociceptors, their classification, peculiarities of pain perception and transmission. Antinociceptive system. Opioid receptors and their ligands. The physiological basis of anesthetization and narcosis.
6. Visual sensory system description. Receptory apparatus. Theories of color vision (M. Lomonosov, H. Helmholtz etc.). The main forms of the color vision disturbance. Physiological mechanisms of the accommodation processes of the eye. The vision field and visual acuity. Conductor portion of the visual sensory system. Cortical portion of the visual sensory system.
7. Auditory sensory system. Sound-receptive and sound-conducting apparatus. Receptor portion of the auditory sensory system. Mechanism of receptor potential generation in hair cells of the organ of Corti. Conductor portion of the auditory sensory system. The theories of sound

recognition (resonator theory by H. Helmholtz, traveling wave theory by Bekesi etc.).

8. The vestibular sensory system role in control of body movements and body orientation with respect to gravity.
9. Olfactory and gustatory sensory systems physiological characteristic.

Topic “Integrative Nervous System Physiology”

1. Higher central nervous system activity definition. The I.M. Sechenov and I.P. Pavlov role in conception of the higher central nervous system functions.
2. Inborn types of behavior (unconditioned reflexes and instincts), their role in adaptation forming activity.
3. Conditioned reflex. Regularity of conditioned reflexes formation and manifestation. The main differences between conditioned and unconditioned reflexes. Conditioned reflexes classification. Structural and functional basis of conditioned reflexes. Temporal connection, the mechanism of it formation.
4. The inhibition phenomenon in the higher central nervous system activity. Inhibition types. Contemporary conception about inhibition mechanisms.
5. Analytical and synthetic activity of the brain cortex large hemispheres. Dynamic stereotype. Conditioned reflex switching.
6. Emotions, their classification and role. Theories of emotions formation. Structural and functional basis of emotions. The objective emotions signs.
7. Memory, it role. Classification of memory stages and types. The mechanisms of short-term and long-term memory. Age related memory changes.
8. Awakefullness and sleep. The sleep stages and types. The physiological mechanism of sleep process. The slow wave and rapid wave sleep biological role. Age related sleep changes.
9. The I.P. Pavlov conception about 1 and 2 signal systems. Conception about higher CNS activity types.
10. The functional asymmetry of the brain cortex large hemispheres
11. Age-related peculiarities of endocrine, sensory and higher CNS functions.