QUESTIONS
for preparing to normal (human) physiology examination

Chapter 1. Common physiology.

**Introduction to physiology.**

2. The main stages of physiology development.
3. The analytical and systemic approaches to the study of physiological functions. Conception about systemic function organization.
4. I.P. Pavlov and I.M. Sechenov role in the development of the physiology foundations.
5. Physiological functions. The main functions of the cells, tissues and organs.
6. Forms of physiological functions regulations (humoral, hormonal, nervous regulation).
7. Regulation according to the reflex principle (R. Descartes (Cartesius), J. Prochazka) and it development in I.P. Pavlov and I.M. Sechenov works. The main principles of the reflex theory.
9. Biological rhythms and their role.
10. Stress, definition, types of stress. The main stress stages and their characteristic.

**Excitable tissues physiology.**

2. 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. Ion gradients and their role in originating of cell electrical potentials.
4. Resting membrane potential (RMP) and it origin. Mechanisms of Resting membrane potential maintaining (selective membrane permeability, \( \text{Na}^+/\text{K}^+ \) pump etc.).
5. Action potential (AP) and it phases. Modern conception about mechanism and phases of action potential.
6. Local response (LR) and the action potential, their properties, phases and ionic mechanisms.
7. A ratio of the excitability periods with action potential phases.
8. The lows of excitable tissues reaction on irritation (low of force, duration, “all or nothing” etc.).
11. The relation between excitation, contraction and relaxation of skeletal muscle (electro-mechanical relation).
12. The relation between excitation, contraction and relaxation curves of skeletal muscle.
13. Types of muscle contraction. The single muscle contraction and its phases.
   The relation between the amplitude of skeletal muscle contraction and the strength of the stimulant. Tetanus, its types. Optimum and pessimum of contraction by N.E. Vvedensky.
   Peculiarities of motor units in different type of muscles. The role of motor units in regulation the strength of muscle contraction.
15. Strength and labor of muscle. The optional load and the rhythm of contraction. Low of average load.
17. Lability. The phases and mechanisms of the parabiosis by N.E. Vvedensky.
20. Forth – time curve or irritation. Reobase, chronaxy and their significance in medicine.

**Common Physiology of the Central Nervous System**
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 its role (A.A. Uchtomski).

**Endocrine Physiology**
1. General hormones characteristic and classification.
2. Regulation of hormone secretion. Interaction between endocrine glands and nervous system.
3. Hormone formation and secretion, their transport by blood. Autoregulation of endocrine system.
4. Mechanism of hormone action, primarily and secondary messengers conception.
5. Anterior pituitary gland (adenohypophysis) hormones, its functional connections with hypothalamus and participation in endocrine organs regulation.
6. Thyroid gland physiology and its role in the organism.
7. Posterior pituitary gland (neurohypophysis) hormones, their role and mechanism of action.
8. Endocrine role of pancreas and its role in metabolism.
9. Functional system which maintain optimal blood glucose level.
10. Pineal gland and thymus gland physiology.
12. Adrenal medulla hormones role in organism functions regulation.
15. Hypothalamus-hypophysis-adrenal axis and its role in stress and adaptation.
17. Prostaglandins and their role in the organism.

**Chapter 2. Special physiology fields.**

**Body fluids**
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 physico-chemical properties of the internal environment. Homeostasis.
4. Composition of blood. Hematocrit ratio. Physiological constants of blood (strict and labile constants) and mechanism of their regulation.
7. Acid-base balance of blood. Physical, chemical and physiological mechanisms which maintain constant blood pH. Acidosis and alkalosis. Functional system which provide constant blood acid-base balance.
9. Erythrocyte sedimentation rate (ESR) and factors which effect it.
10. Quantity of erythrocytes in the blood and methods of their count.
11. Hemoglobin, its characteristics and functions. Mean corpuscular hemoglobin.
12. Hemoglobin types and hemoglobin compounds, their physiological meaning.
13. Leukocytes (white blood cells), types of leukocytes, quantity, methods of count. Properties and functions of leukocytes.
17. Thrombocytes (platelets) and their functions.
20. Idea about hemostasis system. Initial (vascular-thrombocyte) and secondary (coagulation) hemostasis, their meaning.
21. Contemporary conception about main factors, which participate in blood coagulation. Stages of blood coagulation.
24. Basic roles of blood transfusion and transfusion of blood components. Transfusion solutions and requirements, which these solutions must fulfill. Classification of blood transfusion solutions according to their functions in organism.

**Heart and circulation physiology**

1. Overview of the circulation. Functions of the circulation and their meaning for organism functioning. Circulation as a component of different functional systems.
3. Action potential of typical cardiomyocyte (contracting heart muscle) and atypical cardiomyocyte (cells of specialized excitatory and conductive system of the heart).
4. Correlation between excitation, contractility and excitability of the heart in different phases of cardiac cycle. Reaction of heart muscle on additional stimulation. The extrasystole and its types.
5. The cardiac cycle and its phase structure. Sequence of phases and periods of cardiac cycle.
6. The heart as a pump. Changes in pressure and blood volume in heart chambers in different phases of cardiac cycle.
7. Systolic volume and cardiac output in rest and during physical exercises. Methods of their determination.
11. Levels of heart pumping regulation, and their characteristic.
12. Intrinsic regulation of heart pumping. Geterometric and gomeometric regulation (Frank-Starling, Anrep).
13. Humoral control of heart activity and of heart pumping.
14. Control of heart by the sympathetic and parasympathetic nerves and their mediators. Heart reflexes. Main reflexogenic zones and their meaning.
15. Exteroceptive and interoceptive heart reflexes.
16. The main hemodynamics laws and their utilization for explanation of circulation.
18. Factors, which provide blood flow through vessels. Aortic compressive chamber. Role of elasticity of vessel wall.
19. Velocity of volume and linear blood flow in different vascular zones and factors which regulate it.
25. Blood pressure as one of physiological constants of the organism. Analysis of central and peripheral components of the functional system of blood pressure regulation.

**Respiratory physiology**
1. Respiration and its main stages. Respiratory and nonrespiratory lung functions.
3. Airways physiology. Airways diameter regulation.
4. Intrapleural space pressure, its origin and role. Intrapleural space pressure changes in different respiratory cycle stages. Elastic properties of lungs and chest. Surfactant role.
5. Respiration disturbance during pneumotorax. Dangerous of chest penetrating wounds.
7. Convection and diffusion role in maintenance of relatively constant composition of alveolar air. Dead space conception.


13. Hemoglobin oxygen affinity and factors which determine it.


15. Conception about system and regional oxygen capacity. Oxygen utilization coefficient in rest condition and during physical exercises.

16. Intraerythrocyte system of hemoglobin oxygen affinity regulation.


22. Regulatory effects on respiratory center from higher brain structures (hypothalamus, limbic system, large cerebral hemispheres).


24. Functional system providing blood gas content constancy. Analysis of its peripheral and central components.


26. High altitude and underwater respiration (increased and decreased barometric pressure) and respiration at environmental air gas composition changes.

**Gastrointestinal Physiology**

1. Digestion, its functional meaning. Gastrointestinal tract functions. Digestion types depending from origin and localization of enzymes.

2. I.P. Pavlov as a founder of contemporary gastrointestinal physiology.

3. Experimental and clinical methods of gastrointestinal tract investigation.

5. Functional system providing nutrient constancy in the blood. Analysis of it central and peripheral parts.
6. Gastrointestinal conveyor, their functions (secretion, motility, absorption).
8. Endocrine function of gastrointestinal tract.
9. Digestion in the oral cavity. Mechanical and chemical food processing.
11. Digestion in the stomach. Composition and properties of gastric juice. Gastric secretion regulation. Gastric secretion phases.
12. Peculiarities of gastric secretion during proteins, lipids and carbohydrates digestion. Gastric secretion adaptation to different food types and diets. Motility and food evacuation from the stomach.
14. Composition and properties of pancreatic gland juice.
15. Role of the liver in digestion. Regulation of bile formation and secretion in duodenum.
16. Composition and properties of intestine juice. Regulation of intestine juice secretion.
19. Absorption in different parts of gastrointestinal tract. Types and mechanisms of substances absorption through biological membranes.

2. Direct and indirect calorimetry (energy metabolism investigation through complete and incomplete gas analysis). Respiratory quotient. Oxygen calorie equivalent.
5. Nitrogen balance, nitrogen equilibrium, nitrogen minimum and optimum.
7. Protein requirements depending from age, working activity type and organism condition (pregnancy, lactation etc.). Daily carbohydrate and fat requirement.
10. Contemporary approach to problem of different food allowance and diet types.

**Temperature regulation physiology**
1. Constant temperature of inner environment as necessary condition for normal metabolism process. Poikilo-, homoio- and heterothermal conditions.
2. Temperature of human organism and it daily fluctuations. Termometry. Temperature of different skin surface portions and inner organs.
5. Physiological mechanisms of temperature exchange (blood flow in skin vessels, sweating etc.). Behavioral termoregulation.
7. Peripheral and central termoregulation mechanisms. Functional system providing constant temperature of inner body environment.

**Excretion Physiology**
1. Excretion is as an important part of functional systems providing constancy of internal environment. Excretion organs and their participation in main internal environment parameters maintain.
2. Kidney role in acid-base balance, osmotic pressure, blood ion content, blood volume maintain, in blood pressure, blood cell formation, water-ion balance regulation. Incretion function of the kidney.
3. Peculiarities of kidney blood supply. Autoregulation of blood circulation in the kidney (Baylis-Ostroumov phenomenon).
4. The main mechanisms of urine formation: glomerular filtration, tubular reabsorption and secretion.
5. Primary urine formation, it volume and composition.
7. Countercurrent-multiplying renal system.
8. Neurohumoral regulation of urin formation.
9. Excretion function of skin, lungs and gastrointestinal tract.
10. Regulation of urine secretion and urination.
Particular Physiology of the Central Nervous System

2. Spinal cord mechanisms of muscle tone and muscle movement regulation.
3. Spinal shock, its mechanisms and its manifestations in different animal types. Spinal cord place in systemic hierarchy of CNS.
5. Mesencephalon (midbrain), its structural and functional organization. Main functions of the midbrain. The types of midbrain reflexes.
8. Cerebellum, its structural and functional organization. Consequences of the cerebellum removal.
10. Thalamus, medial and lateral geniculate bodies. Functional characteristic of thalamic nuclear groups.
12. The autonomic (vegetative) nervous system. Distinctive features of somatic and autonomic nervous system divisions.
13. 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.
15. Limbic system, peculiarities of its structural and functional organization. Main functions of the limbic system.
16. Basal ganglia (striatopallidal system) and their structural and functional organization. Main functions of the basal ganglia.
17. Role of the hypothalamus, limbic system, reticular formation and cerebral cortex in vegetative functions regulation.

Sensory System Physiology
1. I.P. Pavlov conception about analyzer systems. Physiological role of different analyzer system portions. Sensory systems and sensory organs conception.


3. Conductory portion of the sensory system. Specific and nonspecific afferent systems. Subcortical structures participation in conduction and analysis of afferent stimuli.


5. Sensory systems adaptation, its peripheral and central mechanisms. Receptors classification according to the adaptation process velocity.


7. Theories of color vision (perception) (M. Lomonosof, H. Helmholtz etc.). The main forms of the color vision disturbance.

8. Physiological mechanisms of the accommodation processes of the eye. The visual sensory system adaptation, its mechanisms. The efferent stimuli role. The vision field and visual acuity.

9. Conductory portion of the visual sensory system. Peculiarities of optic chiasm.

10. Cortical portion of the visual sensory system. The optic image formation. The right and left cortical hemispheres role in visual perception.


12. Peculiarities of the conductory portion of the auditory sensory system. The theories of sound recognition (resonator theory by H. Helmholtz, traveling wave theory by Bekesi etc.).

13. The vestibular sensory system role in perception and estimation of body movements and body orientation with respect to gravity.

14. Tactile sensation and it role.

15. Thermal sensation role in perception of the temperature of the inner and external environment of the body. Functional peculiarities of different thermal sensory system portions, their role in temperature homeostasis.

16. Olfactory sensory system physiological characteristic.

17. Gustatory sensory system physiological characteristic.

18. Interoceptor sensory system role in maintaining of the constant composition of the internal body environment. The interoceptors classification and peculiarities of their functioning.

19. The biological role of the pain. The pain theories. Nociceptors, their classification, peculiarities of pain perception and transmission. The
cortical and subcortical structures and humoral factors role in the pain reactions formation.

20. Antinociceptive system. The neurochemical mechanisms of antinociception.

21. Opioid receptors and their ligands. The physiological basis of anesthetization and narcosis.

Higher 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 creation.

2. Inborn types of behavior (unconditioned reflexes and instincts), their role in adaptation forming activity.


4. Structural and functional basis of conditioned reflexes. Temporal connection, the mechanism of it formation.

5. The inhibition phenomenon in the higher central nervous system activity. Inhibition types. Contemporary conception about inhibition mechanisms.

6. The force relation law and it disturbances in higher central nervous system activity.


8. The structure of entire behavior act from the point of functional systems theory by P.K. Anochin.

9. The physiological mechanisms of excitation and inhibition processes propagation through the brain cortex large hemispheres during conditioned reflexes formation (irradiation, concentration, induction).

10. Requirements, motivations, their classification, mechanism of development, role of CNS portions and humoral factors.


12. The objective emotions signs. Emotional stress as a risk factor in psychosomatic pathology development.


14. Awakefullness and sleep. The sleep stages and types. The physiological functions during slow wave and rapid wave sleep. The physiological mechanism of sleep process. The slow wave and rapid wave sleep biological role. Age related sleep changes.

15. The I.P. Pavlov conception about 1 and 2 signal systems. Structural and functional basis of the 2 signal system, speech.
16. The I.P. Pavlov conception about higher central nervous system activity types in animals and humans, their classification, description and methods of determining.

17. The functional asymmetry of the brain cortex large hemispheres

18. The methods of higher central nervous system activity investigation. The conditioned reflex method and its role.

**The profile normal physiology questions for international faculty students**

1. The adult man life periods. Idea about the ageing processes.
2. Age related changes in the heart activity.
3. Age related changes in the hemodynamics.
5. The physiological predisposals of blood pressure disturbances and theoretical approaches for their correction. The risk factors.
6. The physiological predisposals of heart blood supply disturbance – ischemic heart disease and heart attack.
7. The emotions role in cardiovascular diseases development.
8. Age related changes in lung ventilation and gas exchange.
9. Respiration at high altitude (decreased barometric pressure) and at changes of environment air composition.
10. The underwater respiration (increased barometric pressure). Kesson disease.
11. Age related changes of digestion and absorption.
12. The physiological norms of nutrition depending on age, activity type and organism conditions. The changes of energy and substance exchange in people of different ages.
13. Peculiarities of thermoregulation in elderly and old people.
14. The physiological basis of hypothermia.
15. Aged related changes in urine formation and urination.
17. Age related changes of vision and hearing.
18. The higher central nervous system activity changes in elderly and old people.