NORMAL PHYSIOLOGY EXAM QUESTONS (2026)

PHYSIOLOGY OF NERVES, SYNAPSES AND MUSCLES

1. The irritability and excitability, excitable and non-excitable tissues. Stimuli: definition, their types, characteristics. The laws of excitable tissues stimulation: The all-or-none law. The strength-duration curve (rheobase, chronaxie). Lability (functional mobility) of tissue, measure of lability. The excitable tissues accommodation to stimuli.
2. Ultrastructure of a biological membrane. The main functions of biological membranes. Transport function of the cell membrane. Movement of substances through the membrane. Types of membrane transport and its mechanisms.
3. Ion channels of cell membranes, structure and types of ion channels. The main groups of ion channels. Activation and inactivation of voltage-gated ion channels. General ideas about ion channel blockers.
4. Resting membrane potential: values in excitable tissues, mechanism of formation. Factors determining the resting membrane potential value. Electrotonic potential.
5. Local response as electrical potential, conditions of appearance, mechanism of generation, general characteristics, meaning and differences from the action potential. The concepts of "critical level of depolarization" and "threshold potential."
6. Action potential (AP): the mechanism of generation, the AP graph (phases) and after-potentials, the AP values.
7. Phase changes in the excitability of the tissue during action potential (AP) (graph, compared with the phases of AP), their mechanism.
8. Nerve fiber: structure and functions, the classification of nerve fibers. The mechanism of action potential propagation along myelinated and unmyelinated fibers.
9. The neuromuscular junction: its structural elements, the mechanism of signal transmission.
10. Chemical synapse, its ultrastructure. The mechanism of signal transmission in a chemical synapse. The mechanism of postsynaptic potentials generation. Ionotropic and metabotropic receptors.
11. A comparison of electrical and chemical synapses. Their physiological properties.
12. Skeletal muscle: the functional significance of structural components of the muscle fiber, the structural and functional unit of skeletal muscle, the classification of motor units.
13. The mechanism of contraction and relaxation of skeletal muscle: electromechanical coupling, calcium ions, sliding filament theory of contraction. The role of ATP.
14. Types of skeletal muscle contractions. Single twitch of an isolated muscle: its phases, factors affecting the strength of contraction. Tetanus: a complete and incomplete, mechanism, factors affecting the strength of tetanus.
15. Smooth muscle: the role in the organism, the functional unit, the difference between smooth and skeletal muscles in the resting potential and the action potential.

16. Smooth muscle contraction: mechanism, sources of calcium. Regulation of smooth muscle contractions
17. Comparison of physiological properties of smooth and skeletal muscles. Their principal differences.

CNS PHYSIOLOGY

1. Central nervous system. General design of the central nervous system, main divisions, their functions. Sensory and motor divisions, somatic and autonomic nervous systems.
2. Neuron: main parts and their characteristics. Neuron functions.
3. Types of membrane potentials of a neuron. Mechanisms and their origin.
4. Types of postsynapic potentials (EPSP and IPSP), their ionic mechanisms, properties, their role in the activity of the neuron.
5. The interaction of the processes of excitation and inhibition in the neuron. Spatial and temporal summation as the basis of the integrative function of the neuron.
6. Reflex principle of the central nervous system. Definition of reflex. A reflex arc, its components. Sensory (afferent), interneuron and motor (efferent) neurons. The scheme of the arc of the somatic reflex
7. Organization of the CNS from the neuron to the brain: the neuron - the neural circuit - the nerve center. Main types of neural circuits organization (convergence, divergence, the parallel after-discharge, reverberatory).
8. Definition and types of central inhibition. Main types of inhibitory neural circuits (feed-forward, lateral, recurrent, reciprocal). Mechanisms of presynaptic and postsynaptic inhibition.
9. Nerve center. Definition and basic physiological properties of nerve centers. The concept of the organization of nerve centers within one level of the central nervous system and at several levels of the central nervous system.
10. Functions of the central nervous system. The concept of coordination in the central nervous system. Hierarchical organization, the principle of subordination. Feedback principle. Interaction of antagonistic functions: the principles of the common final pathway, reciprocity, the feedback, the dominant nerve center and its properties.
11. Spinal Cord. Basic functional parts of the spinal cord. The principle of segmental innervation. The main functions of the spinal cord. Somatic reflex arc, its components and their functions.
12. Spinal organization of motor functions. Somatic reflexes of the spinal cord: myotatic reflex, Golgi tendon reflex. The role of muscle spindles and Golgi tendon organ in the maintenance of muscle tone. Knee-jerk reflex, skin reflexes.
13. Brain stem. The main parts, structures and centers of the brain stem. The main functions of the brain stem.
14. The autonomous nervous system, its organization, the parasympathetic and sympathetic divisions. The spinal, stem and hypothalamic centers of regulation of visceral functions.

15. The reflex arc of the autonomic nervous system and its difference from the somatic one. Localization of preganglionic and postganglionic neurons in the parasympathetic and sympathetic systems. The neurotransmitters of pre- and postganglionic neurons and receptors.
16. Effects of the autonomic nervous system (sympathetic and parasympathetic divisions) on innervated organs. Key differences in function of sympathetic and parasympathetic divisions, the interaction between them.
17. The intramural (metasympathetic) nervous system as the third division of the autonomic nervous system on the example of the enteric nervous system.
18. Hypothalamus and its functional organization. The concept of the internal environment of the body and homeostasis. Hypothalamus as the main regulator of homeostasis.
19. The role of the hypothalamus in the exerting control of the endocrine system (the hypothalamic-pituitary system).
20. Organization of movements. Functions of brain frontal cortex, basal ganglia, cerebellum, brain stem in motor control.

PHYSIOLOGY OF SENSORY SYSTEMS

1. General principles of the organization of sensory systems. Three main divisions of sensory system. The functions of sensory systems.
2. Sensory receptors, their types, principles of classifications and basic properties. Sensory transduction. Receptor potential, action potential occurrence.
3. General principles of sensory coding. Coding of stimulus modality and intensity, spatial coding.
4. Sensory pathways: main components, general principles of organization, functions. Receptive fields of sensory neurons. General somatic afferent pathways from the body.
5. The main of sensory areas of the cerebral cortex. The primary, secondary and associative areas of the cerebral cortex. Their functions.
6. The main structures of the eye and retina. The cells of retina, their functions. Optical system of the eye. Refractive disorders and their correction.
7. Sensory transduction in the visual system. Types of retinal photoreceptors, their localization and functions. Receptive fields of central and peripheral vision. Visual acuity.
8. Specific visual pathway. Pupillary reflexes. Reflex arcs of pupillary reflexes.
9. The outer, middle ear and inner ear. The main structures and their functions. Sensory transduction in the organ of Corti. Functions of external and internal hair cells.
10. Primary taste sensations. Taste encoding and perception.
11. Skin mechanoreceptors, types, characteristics.
12. The main types of proprioceptors, their localization. Somatosensory pathways.
13. Pain as a systemic reaction of the body. The physiological significance of pain. Pain threshold, pain perception. The nociceptors. Somatic and visceral pain.

HIGHER BRAIN FUNCTIONS

1. Higher Nervous Activity: concept, types of innate and learned behavior, the differences between them. The instincts. Conditioned reflexes, their types and differences from unconditioned. Verbal conditioning.
2. External inhibition of conditioned reflexes. Conditioned (internal) inhibition, its kinds.
3. The emotions: definition, the functions. The motivations: definition, the kinds. Limbic system as nervous substrate for generation of emotions and motivations.
4. Sleep as a biorhythm. The phases of sleep. The two types of sleep (REM and NREM). The functions of sleep. The mechanisms of sleep.

PHYSIOLOGY OF HEART AND HEMODYNAMICS

1. The general structure of the systemic and pulmonary circulation. Pumping function of the heart. Stroke volume, cardiac output. Endocrine function of the heart.
2. The cardiac cycle. The phases of cardiac cycle. Aortic pressure, left ventricular pressure and volume changes during the cardiac cycle. The work of the valves of the heart, their meaning.
3. Electrophysiological heterogeneity of the myocardium: working and atypical cardiomyocytes (pacemakers and Purkinje cells), their brief physiological characteristics.
4. The physiological properties of the heart muscle: excitability, automaticity, conductivity, contractility. Physical properties: elasticity and extensibility.
5. The action potential in working cardiomyocyte, the phases, their ionic mechanisms. Excitability changes during action potential and their mechanism. The significance of a long absolute refractory period.
6. The cardiac conduction system, its structure and physiological role. Gradient of cardiac automaticity. Factors determining the velocity of conduction. The velocity of conduction in different parts of the heart.
7. Contractility of cardiomyocytes. The mechanism of contraction in working cardiomyocytes compared with skeletal muscle contraction.
8. The mechanism of the excitation-contraction coupling in the myocardium. The role of calcium for the processes of excitation and contraction of cardiomyocytes.
9. The action potential of the cardiac pacemaker (SA node), the phases, their ionic mechanism.
10. The regulation of cardiac activity. The intracardiac and extracardiac types of regulation of the heart.
11. Intracardiac regulation of heart activity (nervous and myogenic). Heterometric and homeometric regulation. Intracardiac nervous system.
12. Myogenic regulation types: Frank- Starling law, Anrep effect, force-frequency relationship (rhythmoinotropic dependence; Bowditch effect). Manifestations, value, mechanisms.
13. Extracardiac innervation of the heart. Effects of stimulation of sympathetic and parasympathetic nerves: chronotropic, dromotropic, bathmotropic and inotropic. Features of influences of the right and left vagus nerves.

14. The influences of the vagus on the heart excitability and automaticity. Mechanism of parasymphathetic neurotransmitter action on working cardiomyocyte and pacemaker.
15. The sympathetic effects on the heart excitability and automaticity. Mechanism of sympathetic neurotransmitter action on working cardiomyocyte and pacemaker.
16. Structure and physiological characteristics of elastic, resistance, exchange and capacitance blood vessels. A comparison of their extensibility and tonus, effects on hemodynamic parameters. Precapillary sphincters, shunting vessels and their physiological role.
17. The circulating blood volume. Venous return. Factors affecting the venous return. Central venous pressure (CVP), its importance for the activity of the heart.
18. The blood flow and linear blood flow velocity, their physiological value, units of measurement.
19. Vascular resistance, its dependence on radius, vessel length and blood viscosity (Poiseuille's law). The total resistance of the vessels in their serial and parallel arrangements. The change in resistance in different parts of the vascular bed. The equation for calculating the total peripheral resistance with using blood flow and pressure gradient.
20. Rheological properties of blood as a factor affecting hemodynamics. The viscosity in vessels with different diameters. The Fahraeus-Lindqvist effect. Shear rate. Laminar and turbulent flows in vessels.
21. Blood pressure, units, and physiological significance. Dynamics of changes in pressure from the aorta to the vein. The values of systolic, diastolic and pulse pressure in the arteries. Mean arterial pressure. Factors determining the blood pressure.
22. Changes in hemodynamic parameters (pressure, vascular resistance, cross-sectional area of vessels, linear blood flow velocity, blood flow) in different parts of the vascular system. The formula of the basic hemodynamic equation relating blood pressure, blood flow (Q) and vascular resistance (R).
23. Vascular tone, mechanism of occurrence. Nature of vascular basal tone. Changes in vascular tone under the action of vasoconstrictor and vasodilators. Autoregulation of organ blood flow.
24. Effect of hormones and other vasoactive humoral factors on vascular tone. Endothelial factors causing dilation and constriction. Arterioles as the most important target of vasoactive factors.
25. Vasomotor center, its localization, functional structure (pressor, depressor, cardioinhibiting areas). The baroreceptor reflex.
26. Sympathetic vasoconstriction. The vasoconstrictor effect of the sympathetic nervous system on resistance and capacitance vessels. The localization of alpha and beta adrenergic receptors in the vessels of body, the effects of activation of these receptors.
27. The division of regulatory processes of systemic hemodynamics, based on the speed of development of adaptive processes. Fast regulatory mechanisms of systemic hemodynamics: baroreceptor and chemoreceptor reflexes, intracardiac regulation, action of epinephrine

28. Humoral mechanisms of blood pressure regulation: renin-angiotensin system, the effect of vasopressin, atrial natriuretic peptide on the vessels. Changes in the fluid exchange across capillaries.
29. The effect of physical activity on hemodynamic parameters.
30. Mechanisms of blood pressure recovery after bleeding.
31. The key clinical indices of cardiac pump function – cardiac output, end-diastolic, stroke (systolic) and end-systolic cardiac volumes, the heart sounds (auscultation).
32. Electrocardiography (ECG). Its significance for estimation of heart activity. ECG leads: standard (I, II, III), augmented (aVR, aVL, aVF), precordial (V1—V6). Typical ECG curve for lead II. The main ECG elements: intervals, segments, waves. Origin of the waves (P, QRS, T). Concept of the integral vector as an indicator of the electric field of the heart. Concept of the cardiac electrical axis.

BLOOD

1. Characteristics of body fluids, differences in intracellular, extracellular and intravascular fluids. The concept of the blood system. Features of the blood as a liquid tissue of the body. Blood functions.
2. Quantitative characteristic of the formed elements. Hematocrit. The ionic composition of the plasma. Erythrocyte sedimentation rate. Plasma proteins, main fractions, their functional characteristic and functions. Key homeostatic blood variables.
3. Red blood cells (erythrocytes), quantitative characteristic, functional significance. Regulation of the total mass of red blood cells. Normal hemoglobin forms. Oxygen transport by hemoglobin.
4. Leukocytes, general characteristics. Leukocyte blood count. Types and functional significance of leukocytes. Physiological and reactive leukocytosis.
5. Platelets, their number, functional characteristic. The role of platelets in hemostasis.
6. Blood types. The system of antigens A, B, 0, the origin of plasma agglutinins. Rh system groups. Rules of blood transfusion.
7. Vascular-platelet hemostasis. Functional significance and the main stages.
8. Plasma coagulation factors. The concept and stages of the coagulation process.
9. Mechanisms for prevention of blood clotting in the normal circulatory system. Anticoagulant system of blood.
10. The concept of primary and secondary (products of coagulation) anticoagulants. Fibrinolysis system. Antifibrinolytic system.

RESPIRATION

1. The essence of the process of respiration. Respiratory system, the general characteristics of the individual components. Basic respiratory processes. Inhaled lung function.

2. Pulmonary ventilation. Respiratory tract and gas exchange surface of the lungs. Nonrespiratory areas (dead space) and alveolar ventilation. Lung volumes and capacities, their characteristics

3. Lung compliance. "Pressure - volume" curve for the lungs. The physiological role of surfactant, its nature.

4. The mechanism of inhalation. Resistance of the respiratory tract, the factors that determine the resistance of the airways. Exhalation mechanism.

5. Ventilation of the lungs, alveolar ventilation. The role of external respiration in the maintenance of constancy of gas partial pressures in arterial blood. Characteristics of the components of external respiration: ventilation, diffusion and perfusion.

6. Compositions of inhaled, exhaled and alveolar gas mixtures (the content of O_2 and CO_2). Gas exchange in the lungs and diffusion of gases, the factors that determine it. Partial pressures of gases in the alveolar gas and blood. Ventilation-perfusion relationships in the lungs.

7. Forms of oxygen transport in the blood. Blood O_2 content, its transport. Oxygen blood capacity.

8. Forms of hemoglobin: methemoglobin, carboxyhemoglobin, oxyhemoglobin, carbaminohemoglobin. Oxygen transport by hemoglobin. Quantitative characteristics. The oxygen–hemoglobin dissociation curve, the value of its horizontal and inclined sections. Shifts of dissociation curve due to changes in temperature, pH and pCO2, their physiological significance.

9. Forms of carbon dioxide transport by blood and its content in arterial and venous blood. Saturation curve for carbon dioxide, its shift due to a change in the partial pressure of oxygen. The physiological significance of this shift.

10. The respiratory center of the brain stem, its main components, their connections with each other, afferent inputs and efferent outputs of the respiratory center

11. The reflex control of respiration: receptors (localization and types), the main afferent pathways, the main parts of the central nervous system involved in the regulation of respiration, the efferent nerves of the respiratory system (somatic and autonomic), effectors.

12. The main humoral regulators of respiration - p_aO_2, p_aCO_2, pH. Experiments proving the humoral regulation of respiration.

13. Peripheral and central chemoreceptors affecting the activity of the respiratory system. Location, reflexes, comparative significance for regulation of lung ventilation.

14. Reflex control of respiration. The main reflex zones. Chemical irritants of the respiratory system.

15. The types of mechanoreceptors of the lungs. Hering-Breuer reflex. Protective reflexes of the respiratory system. Reflexes from intercostal muscles and their significance.

METABOLISM

1. General principles of metabolism. Catabolism and anabolism, their definitions and functions. The ratio of the processes of anabolism and catabolism in living systems.
2. Energy and substances metabolism, their interrelations. Nutrients (proteins, fats, carbohydrates) as energy and structural substrates.
3. Carbohydrates. Chemical characteristics, sources of carbohydrates and their role in the body. Carbohydrate metabolism (glucose absorption, synthesis, release into the blood and uptake from the blood). Carbohydrate storage, glycogen.
4. Regulation of carbohydrate metabolism: the effects of adrenaline, glucocorticoids, glucagon, insulin, somatotropin. The concept of anti-insulin hormones. Blood glucose maintenance: hypothalamic and pancreatic systems, principal metabolic pathways (glycogenesis, glycogenolysis, gluconeogenesis, glycolysis).
5. Lipids. Chemical characteristics and classification of lipids. Sources and functions of different lipids in the body. Functions of adipose tissue. Lipid metabolism (absorption, lipoproteins, release into the blood and uptake from the blood). Lipid storage.
6. Proteins. Chemical characteristics. Sources of proteins in the body, their role. The requirement of proteins. Features of protein metabolism.
7. The functions of proteins. Regulation of protein metabolism. Action of insulin, glucocorticoids, growth hormone, testosterone, thyroid hormones.
8. Nitrogen balance. Reasons for negative and positive nitrogen balance. The minimal and optimal amount of dietary protein. Complete and incomplete proteins.
9. Liver. The metabolic function of the liver is participation in protein, carbohydrate and fat metabolism.
10. Energy balance. The relationship between income and energy expenditure. Types of released energy. Hess's Law. Direct calorimetry.
11. Total metabolism (daily energy expenditure), its components: basal metabolic rate, working activity, thermic effect of food. The basal metabolic rate, the factors determining its value, the conditions for its measurement. Rubner 's surface law.
12. Indirect calorimetry. Caloric coefficient of nutrients. Respiratory quotient, caloric equivalent of oxygen and their determining factors.
13. Homeothermy of the human body. The core and the shell of the body. The significance of the stable internal body temperature. The temperature of the human body and its daily fluctuations. Temperature differences between different skin areas of a person (temperature map).
14. Body temperature as a result of the balance of heat production and heat exchange. The role of individual organs in heat production. Mechanisms of heat production increase: contractile and non-contractile thermogenesis. Thermogenesis in adults and newborns.
15. Heat exchange. Types of heat exchange, their physical and physiological features. Regulation of heat exchange.

16. Principal mechanisms of thermoregulation. Thermoregulatory center. Temperature “set point”. Behavioral, autonomic and endocrine responses to changes in external and skin temperature. Temperature adaptation.

PHYSIOLOGY OF DIGESTIVE SYSTEM

1. General principles of digestion. The final result of digestion processes. Types of digestion. Conveyor principle of the digestive tract. The parts of the digestive tract and their main functions.
2. General characteristics of the digestive and non-digestive functions of the gastrointestinal tract.
3. Motor function of the gastrointestinal tract. Types of motility and their purpose. Gastrointestinal sphincters. The role of the muscle cells of the gastrointestinal tract, enteric nervous system and autonomic nerves in the formation and regulation of gastrointestinal motility. Peristaltic reflex.
4. The secretory function of the digestive tract. General characteristics of the digestive tract glands. Secreted substances. Mechanisms and regulation of secretion.
5. Absorption in the gastrointestinal tract: sites, general principles and mechanisms of transport.
6. Location and mechanisms of absorption of proteins, lipids and carbohydrates and their breakdown products. Location and mechanisms of absorption of water and electrolytes.
7. Digestion of proteins, carbohydrates and nucleic acids: the sequence and stages of digestion in different parts of the gastrointestinal tract.
8. The processes of lipid digestion: steps, digestion in different parts of the gastrointestinal tract, emulsification, the formation of micelles.
9. Regulation of gastrointestinal functions. Nervous regulation: autonomic nerves and enteral nervous system. Intramural plexus of the enteric nervous system, their function.
10. Basic gastrointestinal hormones. The concept of the diffuse endocrine system (APUD) in the gastrointestinal tract.
11. Hunger and satiety mechanisms. The role of the lateral and ventromedial hypothalamus in the regulation of eating behavior.
12. Oral cavity. Composition, quantity, functions, mechanism of saliva production and regulation of salivary secretion. Conditioned salivary reflex.
13. The act of swallowing: the main structures that provide swallowing, the sequence and phases of swallowing. The passage of food through the pharynx and esophagus.
14. The stomach. The regions of the stomach. The digestive functions of the stomach. Gastric glands and their secretions. Functions of the components of gastric juice. The distinguished features of different regions of the stomach.
15. Basal and stimulated gastric juice secretion. Phases of gastric secretion. Regulation of the secretion of hydrochloric acid: the role of local and systemic nervous and humoral factors. Factors that inhibit the secretion of hydrochloric acid. Regulation of pepsinogen secretion.

16. Motor function of the stomach. Types of motility. Sphincters and their activity. Receptive relaxation. Evacuation of chyme in the duodenum: sequence, mechanisms, regulatory factors.
17. Digestion and absorption in the stomach. The composition of gastric juice. The role of hydrochloric acid. Non-digestive functions of the stomach.
18. Digestion in the duodenum and its role in the digestive process.
19. Pancreas. Composition, pH and properties of pancreatic juice, the effect of its enzymes on fats, proteins and carbohydrates. Activation of proenzymes. The role of trypsin inhibitor and enterokinase. Parenchymal and ductal secretion.
20. Phases of secretion of the pancreas. Regulation of pancreatic secretion - parasympathetic nerves, secretin, cholecystokinin.
21. Composition and function of bile. Bile secretions (parenchymal and ductal secretion). Regulation of bile secretion. Reflex mechanisms of bile secretion. Regulation of the deposit and release of bile. Secretin and cholecystokinin, their secretion and main functions.
22. The jejunum and ileum. Motor function: types of motility and their regulation. Secretory function: the composition of intestinal juice, regulation of its secretion, intestinal glands and enzymes.
23. Distant (in the cavity) and contact digestion. Digestion and absorption in different parts of the small intestine.
24. Large intestine. Secretory and motor functions of the colon. The autonomic innervation of the colon. Bacterial intestinal flora and its physiological role. Formation of feces. Retention of feces and defecation.
25. Periodic motor activity of GIT. Main physiological processes in GIT during the inter-digestive and digestive periods. The migrating myoelectric (motor) complex, its function.

VARIABLES OF THE INTERNAL ENVIRONMENT. EXCRETION

1. The internal environment of the body, its main components. Homeostasis. The value of homeostasis. The main indicators of the steady state of the internal environment. The principles of maintaining homeostasis. The functions of kidney in maintaining the essential blood variables.
2. Acid-base balance. The significance of stable pH. The range of normal pH values and the concept of its possible deviations. The blood parameters of acid-base balance: pH, p_aCO_2, bicarbonate concentration (AB and SB), BB, BE. Systems that maintain a stable pH.
3. The principle of the buffer systems. The composition of the buffer systems. Buffer capacity. Buffer systems of the body, their composition and functional significance. The special role of bicarbonate buffer system. Excretory systems, their function in maintaining pH.
4. Acidic and alkaline substances entering the blood, and ways of their elimination. Respiratory and metabolic (non-respiratory) acidosis and alkalosis. The blood parameters of acid-base balance: pH, p_aCO_2, bicarbonate concentration (AB and SB), BB, BE. Primary and compensatory changes of these parameters with changes in blood pH.

5. Osmosis and osmotic pressure. Factors determining the osmotic pressure of the solution. Indicators of the osmotic state of the solution: osmotic pressure, osmolarity, osmolality and tonicity, their relationship. Isotonic, hypertonic and hypotonic solutions. Intracellular osmolarity and extracellular osmolarity. Plasma osmolarity. Shifts of water between body fluid compartments.
6. Water balance. The significance of salts and osmotic pressure for maintenance of water balance. Mechanisms of blood volume regulation (volume receptors, renin-angiotensin-aldosterone system, atrial natriuretic peptide).
7. Hypothalamic centers of osmoregulation. Localization of osmoreceptors, volume receptors and baroreceptors, their role in maintaining osmotic pressure.
8. The maintenance of blood volume: the role of volume and baroreceptors, pressor diuresis. Hormones involved in the regulation of blood volume.
9. The exchange of fluid across capillaries. The difference between filtration and diffusion. Filtration and absorption equilibrium in the tissues. Filtration and absorption driving forces. Oncotic (colloid) pressure, its normal value and role. Net filtration pressure in the systemic and pulmonary circulation.
10. Renal regulation of blood concentrations of potassium, calcium, and phosphate. Potassium secretion mechanisms. The calcium and phosphate reabsorption and its regulation. Effects of aldosterone, parathyroid hormone and calcitonin on the kidneys. The physiological role of calcium. Calcium storage. The maintenance of blood calcium levels.
11. Organs performing the excretory function. Excretory function of the kidneys. Non-excretory kidney functions.
12. Types of nephrons. Structure and divisions of the nephron. Functions of different parts of the nephron. Glomerular filtration: process, the filtration membrane. Factors, determining filtration rate in a nephron.
13. The structure of the renal corpuscles. Filtration driving forces. Net filtration pressure. The main factor determined by the filterability of substances. The composition and amount of ultrafiltrate. Maintaining the constancy of the GFR (glomerular filtration rate): tubuloglomerular feedback.
14. Tubular transport. Types of tubular transport - reabsorption and secretion, their ratio. The obligatory and facultative reabsorption. The renal threshold. The reason for the existence of the threshold concentration of a number of substances in the blood. The most important threshold substances.
15. Renal blood flow. Mechanisms to maintain the constant renal blood flow: (the role of autoregulation in the renal vessels, the juxtaglomerular complex and the renin-angiotensin system). Juxtaglomerular complex, its localization and main components. The mechanism of the tubuloglomerular feedback
16. Proximal tubule. Processes of transport in the proximal tubule: reabsorption and secretion. The main mechanisms of transport in the proximal tubule.

17. The mechanism of water reabsorption. The role of the proximal tubule. Countercurrent multiplier. Mechanisms for creating a hyperosmolar medium (hyperosmolality) in the interstitium of the medulla of the kidney (the role of the loop of Henle). The mechanism of formation of hypoosmolar and hyperosmolar urine. The role of ADH. Range of daily water and osmotic load. The ability of the kidneys to maintain water-osmotic balance: the limiting values of daily diuresis and daily urine osmolarity (in comparison with plasma osmolarity).
18. Renin-angiotensin-aldosterone system (its components and steps of activation, mechanisms of stimulation of renin release - macular, intrarenal baroreceptor, sympathetic), effects. Biological significance.
19. Renal regulation of blood bicarbonate concentration depending on the acid-base state of the body. Reabsorption of bicarbonate in the proximal tubule and the formation of a new bicarbonate in the distal tubule. Urine buffers: phosphate and ammonia, their origin and significance.
20. The physiological role of sodium and its balance maintenance in the blood. The role of the kidneys. Reabsorption of sodium and chloride in proximal and distal part of nephron. The role of the aldosterone and atrial natriuretic hormone: site of secretion, stimulus for secretion, effects, mechanisms of action.