

**FEDERAL STATE BUDGET EDUCATIONAL INSTITUTION OF HIGHER EDUCATION  
"ROSTOV STATE MEDICAL UNIVERSITY" OF THE MINISTRY OF HEALTH OF THE  
RUSSIAN FEDERATION**

FACULTY OF TREATMENT AND PREVENTION

Evaluation materials

in the discipline normal physiology

Specialty 05/31/01 General Medicine

**1. Scroll competencies, formed discipline (fully or partially)**

***general professional (OPK):***

Code and name general professional competence	Achievement indicator(s) general professional competence
OPK-5. Able to evaluate morphofunctional, physiological states and pathological processes in the human body to solve professional problems.	<p>ID 1 OPK-5 Proficient in clinical, laboratory and functional algorithms diagnostics when solving professional problems.</p> <p>ID 2 OPK-5 Able to evaluate the results of clinical, laboratory and functional diagnostics when solving professional problems.</p> <p>ID 3 OPK-5 Able to evaluate morphofunctional, physiological parameters and determine the presence of pathological processes in the human body based on clinical, laboratory, physical and instrumental research methods.</p> <p>ID 4 OPK-5 Able to determine the main indicators of the patient's physical development and functional state, taking into account anatomical and physiological characteristics and age of the patient</p>

**2. Kinds estimated materials V compliance With formed competencies**

Name competencies	Types of assessment materials	number of tasks <b>for 1 competency</b>
OPK-5.	Closed tasks	25 with sample answers
	Open type tasks: Situational tasks Interview questions Add-on tasks	75 with sample answers

OPK-5:

**Closed type tasks:**

Task 1. Instructions: choose one correct answer.

The inner surface of the cell membrane in relation to the outer surface at rest is charged:

1. Sometimes positive, sometimes negative;
2. Positively; 3. Same; 4. Negative.

*Sample answer:*4. Negative.

Task 2. Instructions: choose one correct answer.

Excitation in myelinated nerve fibers is carried out:

1. Using a mediator;
2. Jumping from an excited interception of Ranvier to a non-excited interception of Ranvier;
3. Along the entire membrane from the excited area to the adjacent non-excited area;
4. Continuously.

*Reference answer:* 2. Intermittently from excited interception Ranvier  
To Ranvier's unexcited interception.

Task 3. Instructions: choose one correct answer.

The main mediators that cause inhibition at CNS synapses are:

1. Acetylcholine and serotonin;
2. Norepinephrine and adrenaline;
3. Heparin and histamine;
4. Glycine and gamma-aminobutyric acid.

*Sample answer:*4. Glycine and gamma-aminobutyric acid.

Task 4. Instructions: choose one correct answer. An analyzer is a system that includes:

1. Sense organs;
  2. Conducting pathways and projection fields of the cerebral cortex;
  3. Receptor department and conduction department;
  4. Peripheral (receptor), conductive and cortical sections.
- Standard answer: 4. Peripheral (receptor), conductive and cortical sections.

Task 5. Instructions: choose one correct answer. Receptors of the vestibular analyzer are excited when:

1. Exposure to high frequency sounds;
2. Exposure to light;
3. Rectilinear or angular accelerations;
4. Exposure to low frequency sounds.

*Sample answer:*3. Linear or angular accelerations.

Task 6. Instructions: choose one correct answer. The function of the Eustachian tube is:

1. Equalization of pressure between the middle ear and nasopharynx;
2. Conducting a sound wave;
3. Equalizes pressure between the outer and inner ear;
4. Protective.

*Sample answer:*1. Equalization of pressure between the middle ear and nasopharynx.

Task 7. Instructions: choose one correct answer.

The vital nerve centers of the medulla oblongata include:

1. Cough and sneeze centers;
2. Centers for lacrimation and eyelid closure;
3. Vasomotor and respiratory centers;
4. Center of the gag reflex.

*Sample answer:*3. Vasomotor and respiratory centers.

Task 8. Instructions: choose one correct answer.

The main transmitter at the synapses of the autonomic ganglia of the autonomic nervous system is:

1. Adrenalin;
  2. Norepinephrine;
  3. Dopamine;
  4. Acetylcholine.
- Sample answer:*4. Acetylcholine.

Task 9. Instructions: choose one correct answer. The calcium-regulating hormone system consists of:

1. Adrenaline and thyroxine;
2. Vasopressin and natriuretic peptide;
3. Oxytocin, glucagon and insulin;
4. Calcitonin, parathyrin, calcitriol.

*Sample answer:*4. Calcitonin, parathyrin, calcitriol. Task 10.

Instructions: match.

1. Features of conditioned reflexes:	A) congenital, specific, permanent;
2. Features of instincts:	B) acquired, individual, changeable.

*Sample answer:*1.- B; 2 – A.

Task 11. Instructions: choose one correct answer.

The active blood reaction (pH) in a healthy adult is normally equal to:

1. 7.0-7.1;
2. 7.2-7.3;
3. 7.91-7.95;
4. 7.36-7.42.

*Sample answer:*4. 7.36 -7.42.

Task 12. Instructions: choose one correct answer.

The hematocrit in a healthy adult at rest is (%):

1. For men 30-33, women 70-72;
2. For men 50-55, women 50-53;
3. For men and women 55-60;
4. For men 44-48, women 41-44.

*Sample answer:*4. for men 44-48, women 41-44.

Task 13. Instructions: choose one correct answer. The ESR value in women is (mm/h):

1. 2-15;
2. 1-10;
3. 40-50;
4. 30-40.

*Sample answer:*1. 2-15.

Task 14. Instructions: choose one correct answer. The ESR value in men is (mm/h):

1. 2-15;
2. 1-10;
3. 40-50;
4. 30-40.

*Sample answer:*2. 1-10.

Task 15. Instructions: choose one correct answer.

Systolic blood pressure in the great vessels in an adult healthy person at rest is equal (mm Hg):

1. 80-70;
2. 110-130;
3. 60-50;
4. 160-170.

*Sample answer:*2. 110-130.

Task 16. Instructions: choose one correct answer.

Diastolic blood pressure in the great vessels in an adult healthy person at rest is equal (mm Hg):

1. 120-110;
2. 140-150;
3. 80-70;
4. 100-90.

*Sample answer:*3. 80-70.

Task 17. Instructions: choose one correct answer.

The heart rate at rest in a healthy adult is (bpm):

1. 20-40;
2. 60-80;
3. 100-120;
4. 40-60.

*Sample answer:*2. 60-80.

Task 18. Instructions: choose one correct answer.

The resting respiratory rate of an adult per minute is:

1. 20-25;
2. 30-40;
3. 25-30;
4. 12-16.

*Sample answer:*4. 12-16.

Task 19. Instructions: choose one correct answer. Minute breathing volume is:

1. The volume of oxygen inhaled in 1 minute;
2. The volume of oxygen consumed in 1 min;
3. Maximum volume of air exhaled in 1 minute;
4. The product of tidal volume and respiratory rate.

*Sample answer:*4. The product of tidal volume and respiratory frequency. Task 20.

Instructions: match.

Enzyme	Activated:
1. Pepsinogen	A) trypsin;
2. Trypsinogen	B) bile;
3. Chymotrypsinogen	B) enterokinase;
4. Lipase	D) hydrochloric acid.

*Sample answer:* 1-G; 2-B; 3-A; 4-B.

Task 21. Instructions: match.

Enzymes	Affects:
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1. Amylase	A) proteins;
2. Lipase	B) fats;
3. Trypsin	B) carbohydrates;
4. Enterokinase	D) trypsinogen.

*Sample answer:* 1-B; 2-B; 3-A; 4-G.

Task 22. Instructions: match.

Gastrointestinal hormones	Stimulate:
1. Gastrin	A) secretion of hydrochloric acid in the stomach;
2. Secretin	B) secretion of water and bicarbonates by the pancreas;
3. Cholecystokinin	B) motility of the stomach and intestines;
4. Motilin	D) contraction of the gallbladder.

*Sample answer:* 1-A; 2-B; 3-G; 4-B.

Task 23. Instructions: match.

Type of heat exchange	Types of heat exchange support:
1. Heat generation	A) increased skin blood flow, shortness of breath, increased air movement, evaporation and radiation;
2. Heat dissipation	B) muscle work, specific dynamic food action, trembling.

*Sample answer:* 1. - B; 2. - A.

Task 24. Instructions: choose one correct answer. The formation of primary urine from blood plasma occurs in:

1. Renal corpuscle;
2. Distal convoluted tubules;
3. Proximal convoluted tubules;
4. Collecting tubes.

*Sample answer:* 1. Renal corpuscle.

Task 25. Instructions: choose one correct answer. Diuresis increases in patients with diabetes mellitus because:

1. The filtration speed increases;
2. The rate of reabsorption increases;
3. The speed of blood flow in the kidney increases;
4. Hyperglycemia leads to glycosuria and decreased water reabsorption.

*Sample answer:* 4. Hyperglycemia leads to glucosuria and decreased water reabsorption.

### Open type tasks:

Task 1. Solve a situational problem.

In medical practice, in order to warm up the extremities when they are frostbitten, ultra-high frequency (UHF) currents are used, but no contractions are observed.

muscles. Name the universal law of tissue irritation, according to which muscle contraction does not occur.

*Sample answer:*the law of “strength-duration”, according to which excitation does not occur due to the duration of the stimulus being less than chronaxy.

Task 2. Solve a situational problem.

In experimental and clinical neurophysiology, direct current is used to influence the functional state of nervous system structures. What changes in the excitability of nerve structures will develop under the anode and cathode? How will they change depending on the duration of the current?

*Sample answer:*under the anode, with short-term action, the excitability of the nervous structures decreases, with long-term action, it increases. Under the cathode, with short-term exposure, the excitability of the nervous structures increases, and with prolonged exposure, it decreases.

Task 3. Solve a situational problem.

In surgery, in order to anesthetize the patient during appropriate manipulations, a nerve conduction blockade is used with the help of local anesthetics (Novocaine, etc.). What is the reason for the cessation of excitation along the nerve due to the use of local anesthetics? What phenomenon develops in the nerve fiber? Name its phases.

*Sample answer:*When local anesthetics are administered, Na<sup>+</sup> channels are inactivated, therefore, action potentials are not generated and excitation does not occur. This phenomenon is called parabiosis. Phases of parabiosis: 1) equalizing; 2) paradoxical; 3) braking.

Task 4. Solve a situational problem.

Local irritation of the motor points of the muscles of the palmar surface of the forearm in a person causes the flexion of only one finger of the hand.

Why don't neighboring fingers bend? What law of conduction of excitation along the nerve fiber ensures this phenomenon?

*Sample answer:*neighboring fingers do not bend, due to the fact that the excitation occurs in isolation, since the nerve fibers are covered with a myelin sheath. Law of isolated conduction of excitation.

Task 5. Solve a situational problem.

It is known that after death, rigor mortis develops with severe skeletal muscle rigidity. What is the mechanism for the development of this phenomenon?

*Sample answer:*the cell ceases to produce ATP energy, necessary for the process of opening the head of the myosin bridge from the active center of actin, as well as for the return of calcium ions to the sarcoplasmic reticulum.

Task 6. Solve a situational problem.

In clinical practice, when performing surgery on the organs of the chest cavity, patients undergo muscle relaxation of the respiratory muscles with the help of curare-like substances, transferring the patient to artificial ventilation. What is the mechanism for the development of muscle relaxation of the respiratory muscles under the influence of curare-like substances?

*Sample answer:*curare-like substances are competitive blockers of H-cholinergic receptors in skeletal muscles, thereby preventing the conduction of excitation at the neuromuscular synapse.

Task 7. Solve a situational problem.

With a sharp blow to the elbow area, a person experiences discomfort and pain spreading to the hand. What is this type of pain called and what causes it?

*Sample answer:*projected pain, in which it spreads to areas innervated by the ulnar nerve.

Task 8. Solve a situational problem.

The patient consulted a local doctor with complaints of pain in the left shoulder blade, left shoulder and elbow joints. In connection with these complaints, the patient was referred for examination to a cardiologist. What is this type of pain called and what causes it?

*Sample answer:*referred pain. Cutaneous pain afferents and pain afferents coming from the heart converge on the same projection interneuron of the dorsal horn of the spinal cord. As a result, pain occurs in areas of the skin (Zakharyin-Ged zone).

Task 9. Solve a situational problem.

In a patient, when a warm solution was instilled into the external auditory canal, ocular nystagmus was detected. What is ocular nystagmus? What group of vestibular reflexes does ocular nystagmus belong to? What is the mechanism of development of ocular nystagmus in this situation?

*Sample answer:*nystagmus - involuntary, rhythmic, spasmodic, two-component movement of the eyeballs; This is a vestibulo-oculomotor reflex. Under the influence of heat, endolymph moves in the horizontal semicircular canal, which is accompanied by excitation of vestibuloreceptors.

Task 10. Solve a situational problem.

While traveling along a mountain serpentine road, the passenger experienced a feeling of nausea, palpitations and sweating. The development of which group of vestibular reflexes led to this phenomenon?

*Sample answer:*vestibulovegetative reflexes.

Task 11. Solve a situational problem.

With unilateral hearing loss, patients cannot determine the position of the sound source in space. What hearing function is this associated with?

*Response standard:* binaural hearing. The basis is the ability of the neurons of the auditory system to evaluate interaural (inter-ear) differences in the time of arrival of sound to the right and left ear and the intensity of sound on each ear.

Task 12. Solve a situational problem.

To examine the fundus of the eye, an ophthalmologist instills a solution of atropine (an M-cholinergic receptor blocker) into the conjunctiva of the patient's eye. How and why does this change the diameter of the pupil? What eye function will be impaired in the patient during the action of atropine?

*Sample answer:*the pupil diameter will increase. Atropine causes a disruption in the transmission of excitation to the ciliary muscle and limits the accommodation of the eye when examining close objects.

Task 13. Solve a situational problem.

When determining the refractive power of the optical system of the eye using an eye refractometer, myopia was detected in the subject. What is myopia? What lenses should be used to correct myopia?

*Sample answer:*myopia (myopia) is one of the types of refractive error of the eye, in which rays from a distant object are focused not on the retina, but in front of it, in the vitreous body. To correct myopia, biconcave (diverging) lenses are used.

Task 14. Solve a situational problem.



When determining the refractive power of the optical system of the eye using an eye refractometer, the subject was found to have hypermetropia. What is hypermetropia? What lenses should be used to correct hypermetropia?

*Sample answer:*hyperopia (farsightedness) is one of the types of refractive error of the eye, in which rays from a distant object are focused not on the retina, but behind it. To correct hypermetropia, biconvex (convex) lenses are used.

Task 15. Interview question.

Name the types of spinal cord motor neurons, indicate their location and function.

*Sample answer:*The motor neurons of the spinal cord include: alpha and gamma motor neurons, which are located in the anterior horns of the spinal cord segments. Alpha motor neurons innervate extrafusal muscle fibers, causing muscle contraction. Gamma motor neurons innervate intrafusal muscle spindles (a type of proprioceptor), maintaining their sensitivity.

Task 16. Solve a situational problem.

In order to assess the reflex function of the nervous system in people of different ages, a study of the plantar reflex was carried out. In this case, line irritation of the surface of the foot in newborns was accompanied by dorsiflexion of the foot, extension of the toes and their fan-shaped divergence, and in people of mature age - plantar flexion of the foot and toes. Do the subjects have any deviation from the norm? What explains this difference in the nature of the plantar reflex?

*Sample answer:*there is no deviation from the norm. Differences in response are associated with insufficient development (myelination) of the corticospinal (pyramidal) tracts in the newborn baby.

Task 17. Solve a situational problem.

The patient complains of unsteady gait. The examination revealed decreased muscle tone, asynergy during arm movements, and tremors of the hands, which intensified with purposeful movements (intention tremor). What brain structure can be expected to be impaired in the patient? List the main functions of this brain structure.

*Sample answer:*a cerebellar disorder may be suspected. The main functions of the cerebellum include: regulation of posture and muscle tone; correction of targeted movements and their coordination with posture maintenance reflexes; adaptation-trophic.

Task 18. Addition task.

When the red nuclei of the midbrain are damaged, an increase in muscle tone is observed

\_\_\_\_\_ *Sample answer:*extensors.

Task 19. Addition task.

The main transmitter in the endings of sympathetic postganglionic fibers is

\_\_\_\_\_ *Sample answer:*norepinephrine.

Task 20. Addition task.

Regulatory enzymes V adrenergic synapses, influencing on decaycatecholamines are \_\_\_\_\_,

*Sample answer:*catechol-O-methyltransferase (COMT) and monoamine oxidase (MAO).

Task 21. Addition task.

The main transmitter in the endings of parasympathetic postganglionic fibers is \_\_\_\_\_

*Sample answer:*acetylcholine.

Task 22. Addition task.

A regulatory enzyme in cholinergic synapses that affects the breakdown of the transmitter is\_  
*Sample answer:*acetylcholinesterase

Task 23. Solve a situational problem.

The development of a pain reaction is accompanied by a negative emotional state. In this case, the person develops tachycardia and increased blood pressure. Activation of which part of the autonomic nervous system causes these visceral effects? What changes will there be in terms of pupil diameter, bronchial lumen, secretory and motor activity of the digestive organs?

*Sample answer:*The activity of the sympathetic division of the autonomic nervous system increases. The diameter of the pupil increases, the lumen of the bronchi increases, the secretory and motor activity of the digestive organs decreases.

Task 24. Solve a situational problem.

In the practice of an endocrinologist, there are diseases associated with a decrease in the secretion of hormones from the zona glomerulosa of the adrenal cortex. What hormone is synthesized in the zona glomerulosa of the adrenal cortex? What changes in water-electrolyte balance, acid-base status and blood pressure can occur with a deficiency of this hormone?

*Sample answer:*Aldosterone (mineralocorticoid) is synthesized in the zona glomerulosa of the adrenal cortex. With a lack of aldosterone, a decrease in circulating blood volume (hypovolemia), hyponatremia, hyperkalemia, acidosis, and a decrease in blood pressure is observed.

Task 25. Solve a situational problem.

It is known from clinical practice that patients with hyperthyroidism experience changes in heart rate (HR). Under the influence of which thyroid hormones do changes in heart rate occur? Indicate the direction and reason for these changes.

*Sample answer:*under the influence of iodine-containing thyroid hormones (triiodothyronine, thyroxine). Heart rate increases due to the reactogenic effect (increased sensitivity) on beta-1 adrenergic receptors of atypical cardiomyocytes (pacemaker cells, pacemakers).

Task 26. Addition task.

Blood glucose level under the influence of insulin\_\_\_\_\_

*Sample answer:*goes down.

Task 27. Addition task.

Blood glucose level under the influence of glucagon\_\_\_\_\_

*Sample answer:*rises

Task 28. Addition task.

With hyperfunction of the thyroid gland, the level of basal metabolic rate\_\_\_\_\_

*Sample answer:*rises.

Task 29. Addition task.

Controls the first half of the menstrual cycle \_\_\_\_\_  
adenohypophysis hormone.

*Sample answer:* follicle-stimulating.

Task 30. Addition task.

The second half of the menstrual cycle is controlled by the hormone \_\_\_\_\_  
adenohypophysis hormone.

*Sample answer:* luteinizing.

Task 31. Solve a situational problem.

In three subjects, the characteristics of the processes of excitation and inhibition were determined. It was established that in the first of them the nervous processes were characterized by high strength, balance and mobility, in the second - by high strength, balance, but inertia, in the third - by high strength, but imbalance. What types of higher nervous activity (HNA) according to I.P. Are these subjects related to Pavlov? What types of temperament according to Hippocrates do they correspond to?

*Sample answer:* the first subject is a "living" type of GNI, corresponds to the sanguine temperament type; the second subject - the "calm" type of GNI corresponds to the phlegmatic type of temperament; the third subject - the "unrestrained" type of GNI corresponds to the choleric type of temperament.

Task 32. Interview question. List the functions of blood.

*Sample answer:* respiratory (gas transport), nutritional (trophic), excretory, maintaining the acid-base state, osmotic and oncotic pressures, immune, hemostatic, regulatory.

Task 33. Solve a situational problem.

A 55-year-old patient complained of swelling of the lower extremities. A biochemical blood test revealed that the total protein content in the blood plasma was 40 g/l. Specify the reference (physiological) values of total protein in blood plasma. What is the likely cause of the patient's edema?

*Sample answer:* reference (physiological) limits for total protein content in blood plasma are 60-80 g/l. The observed decrease in total protein in the blood plasma leads to a decrease in oncotic pressure. In this case, water ceases to be retained in the vascular bed and passes into the tissues, causing swelling.

Task 34. Solve a situational problem.

A healthy resident of the lowland region came to the highlands.

How will his blood viscosity change in high altitude conditions? What is the physiological basis for changes in blood viscosity at high altitudes?

*Sample answer:* in high altitude conditions, blood viscosity increases, since atmospheric pressure and, accordingly, the partial pressure of oxygen in the air (pO<sub>2</sub>) are reduced. This leads to hypoxemia, which stimulates the production of erythropoietin, which acts on erythroid precursor cells, which leads to an increase in the number of red blood cells and blood viscosity.

Task 35. Solve a situational problem.

During heart surgery, a cardiopulmonary bypass machine (ACB) is used to maintain blood flow and oxygenation. Under these conditions, blood enters the vascular bed not from the heart, but from the atrial cord, the inner surface of which is not identical to the endocardium and endothelium. In this regard, what can happen to red blood cells when using AIC? What is the normal number of red blood cells in men and women?

*Sample answer:* Mechanical hemolysis may occur due to the contact of red blood cells with the inner wall of the device. The normal content of erythrocytes in men is  $4.5-5.0 \cdot 10^{12} /l.$ , in women, respectively -  $3.8-4.5 \cdot 10^{12} /l.$

Task 36. Solve a situational problem.

For the purpose of a preventive examination, the patient was prescribed a general clinical blood test. The patient had breakfast before donating blood. What blood parameters can be changed in this patient?

*Sample answer:* This patient has an increased number of leukocytes (nutritional leukocytosis) in the general clinical blood test. Dietary leukocytosis occurs after eating: the number of leukocytes increases, there is no shift in the leukocyte formula to the left.

Task 37. Solve a situational problem.

The results of a general clinical blood test of a pregnant woman showed that the normal erythrocyte sedimentation rate (ESR) was 23 mm/hour. What is the normal value of ESR in women? Explain the reason for the increase in ESR during physiological pregnancy.

*Sample answer:* The normal ESR value in women is 2-15mm/h. An increase in ESR during pregnancy is associated with an increase in fibrinogen content in the blood plasma.

Task 38. Solve a situational problem.

To organize a blood transfusion, patient M.'s blood type was determined using monoclonal antibodies (coliclones anti-A and anti-B). In this case, no erythrocyte agglutination reaction was detected. What blood group according to the ABO system does patient M. have?

*Sample answer:* Patient M. has the first I (O)  $\alpha, \beta$  blood group according to the ABO system.

Task 39. Solve a situational problem.

Before performing a blood transfusion, the doctor determined the patient's blood group and Rhesus status, and selected donor blood of the same name. What tests need to be performed before starting blood transfusion? What manifestations during these tests will indicate incompatibility of the transfused blood?

*Sample answer:* it is necessary to conduct a test for individual compatibility of the blood of the donor and recipient according to the ABO system, Rh factor and a biological test. The appearance of agglutination during a test for individual compatibility of the blood of the donor and recipient indicates their incompatibility and the inadmissibility of transfusion of this donor blood. A decrease in blood pressure, increased heart rate and respiration, facial flushing, cold sweat, pain in the lumbar region during a biological test indicate incompatibility between the blood of the donor and the recipient.

Task 40. Solve a situational problem.

It is known that in humans, during intense physical activity or acute pain, blood clotting increases. Explain the mechanism of changes in blood coagulation in this case. Name the stages of hemostasis. Specify the normal blood clotting time according to Sukharev.

*Sample answer:* intense physical activity or acute pain leads to an increase in the tone of the sympathetic division of the autonomic nervous system and the release of catecholamines (norepinephrine and adrenaline) into the blood. At the same time, the Hageman factor is activated, and the formation of apoprotein III, a component of thromboplastin, is also enhanced, which helps to accelerate the formation of prothrombinase, blood clotting and reduce clotting time. Stages of hemostasis: vascular-platelet hemostasis, coagulation hemostasis, fibrinolysis. The normal blood clotting time according to Sukharev is: the beginning of coagulation is 30-120 seconds, the end is 3-5 minutes.

Tasks 41. Solve a situational problem.

A patient with a chest injury on the right developed pneumothorax. At the same time, he had impaired ventilation of the right lung. What is pneumothorax? What is the cause of impaired ventilation in pneumothorax?

*Sample answer:* pneumothorax is the entry of air into the pleural cavity, collapse of the lung associated with equalization of pressure in the pleural cavity with atmospheric pressure.

Tasks 42. Solve a situational problem.

Two practically healthy men aged 25 years with identical anthropometric data were examined using spirometry. In one of them, the vital capacity of the lungs (VC) was 4.0 l, in the other - 5.5 l. Define vital capacity and indicate its standards for mature people depending on gender? Which subject has greater lung compliance?

*Sample answer:* Vital capacity is the maximum volume of air that can be exhaled after a maximum inhalation. Vital capacity in men is 3500-5000 ml, in women 3000-4000 ml. The compliance of the lungs is higher in the second examined person, because his vital capacity is higher.

Tasks 43. Solve a situational problem.

During a spirographic study of a 50-year-old man, it was found that the vital capacity of the lungs (VC) was 3000 ml. What lung volumes are included in vital capacity? Do men's vital capacity indicators correspond to the norm?

*Sample answer:* Vital capacity includes tidal volume, inspiratory reserve volume, and expiratory reserve volume. The vital capacity of a man does not correspond to the physiological norm.

Tasks 44. Solve a situational problem.

Two athletes with the same anthropometric data and indicators of external respiration function competed for the duration of stay under water. The first of them dived under the water after preliminary voluntary hyperventilation of the lungs, the second - after taking one deep breath. Which of them will stay under water longer and why?

*Sample answer:* an athlete who has hyperventilated will stay under water longer, since the partial tension of CO<sub>2</sub> in the blood decreases, leading to a decrease in the excitability of the neurons of the respiratory center.

Tasks 45. Solve a situational problem.

When a person is poisoned by carbon monoxide, the oxygen capacity of the blood decreases. In these cases, a treatment method with pure oxygen under high pressure (hyperbaric oxygenation) is used. Why does carbon monoxide poisoning cause a decrease in the oxygen capacity of the blood? Indicate the forms of oxygen transport.

*Sample answer:* The oxygen capacity of the blood decreases because hemoglobin forms a strong bond with carbon monoxide, which prevents hemoglobin from binding to oxygen. Oxygen is transported in the form of oxyhemoglobin and in dissolved form in the blood plasma.

Tasks 46. Solve a situational problem.

In clinical practice, the patient is given to breathe a gas mixture - carbogen, consisting of oxygen with the addition of 5% carbon dioxide. From the perspective of understanding the mechanisms of regulation of pulmonary ventilation, explain why carbon dioxide is added to this mixture?

*Sample answer:* to increase the partial tension of carbon dioxide (pCO<sub>2</sub>) in the blood, since CO<sub>2</sub> excites the neurons of the respiratory center.

Task 47. Interview question.

Name the main regulatory effects of the sympathetic division of the autonomic nervous system on the heart. Specify the mediator and receptor.

*Reference answer:* positive chronotropic Effect (increase heart rate); positive bathmotropic (increase excitability); positive

dromotropic effect (increased conductivity); positive inotropic (increased contraction force). The mediator is norepinephrine, which interacts with beta1-adrenergic receptors of the cardiomyocyte membrane.

Task 48. Interview question.

Name the main regulatory effects of the parasympathetic division of the autonomic nervous system on the heart. Specify the mediator and receptor.

*Sample answer:* negative chronotropic effect (decreased heart rate); negative bathmotropic (decreased excitability); negative dromotropic effect (decreased conductivity); negative inotropic (decreased contraction force). The mediator is acetylcholine, which interacts with M-cholinergic receptors of the cardiomyocyte membrane.

Task 49. Interview question.

Name the main intracardiac intracellular regulatory mechanisms. Define them and indicate the factors activating these mechanisms.

*Sample answer:* The main mechanisms include heterometric (Starling's heart law) and homeometric mechanisms. Heterometric mechanism (Starling's law of the heart) - the force of myocardial contraction is directly proportional to the end-diastolic length of the myocardial fibers. Homeometric mechanism - the strength and speed of myocardial contractions changes regardless of the initial length of the myocardial fibers. The activator of the heterometric mechanism is the preload on the heart (input load, volume load), the activator of the homeometric mechanism is the afterload on the heart (output load, resistance or pressure load).

Task 50. Solve a situational problem.

In clinical practice, patients with reduced cardiac output are prescribed a group of drugs that improve myocardial contractile function.

What ions in the cardiomyocyte do these drugs increase in concentration? Indicate the role of these ions in the electromechanical coupling of the myocardium.

*Sample answer:* These drugs help increase  $Ca^{2+}$  ions. With an increase in the intracellular  $Ca^{2+}$  concentration, tropomyosin is displaced between actin filaments, and areas on the actin filaments open with which myosin cross bridges can interact. The displacement of tropomyosin is caused by a change in the conformation of the troponin C protein molecule upon binding of  $Ca^{2+}$ .

Task 51. Solve a situational problem.

In the experiment, the gastrocnemius muscle and myocardium of the frog were irritated with an electric current of a threshold value and increasing in frequency. In this case, the gastrocnemius muscle contracted in a tetanic mode, and the myocardium contracted in a single contraction mode. Explain the differences in the modes of muscle contraction of the gastrocnemius muscle and the myocardium. *Sample answer:* differences in the modes of muscle contraction of the gastrocnemius muscle and myocardium, explained duration refractory period. Reduction(systole) of the myocardium, in contrast to the gastrocnemius muscle, approximately coincides in time with general refractoriness.

Consequently, during systole, the myocardium is normally unable to respond to stimuli. This prevents the development of tetanus.

Task 52. Solve a situational problem.

In order to determine the initial autonomic tone by analyzing the heart rate variability of the subject, an ECG was recorded. An ECG analysis revealed an increase in the delay time of excitation in the atrioventricular node. Specify the ECG sign reflecting the delay in the atrioventricular node, and its duration is normal. What physiological significance does the delay in the atrioventricular node have?

*Sample answer:* The ECG sign is the PQ interval, the normal duration of which is 0.12-0.20 s. The delay in the atrioventricular node ensures coordinated (sequential) contraction of the atria and ventricles.

Task 53. Solve a situational problem.

When palpating the pulse of an unconscious patient, the doctor discovered a rapid and soft pulse. Specify the characteristics of the pulse that can be determined by palpation. What does a soft pulse indicate?

*Sample answer:* symmetry, rhythm, frequency, tension, content. A soft pulse indicates decreased tone of the arterial vessel wall and a decrease in blood pressure.

Task 54. Solve a situational problem.

In a patient with complaints of headaches and sensations of pulsation in the head, the doctor discovered high blood pressure (BP) and tachycardia. To lower blood pressure, he prescribed vasodilator drugs. However, blood pressure did not change significantly. Name the types of blood pressure. What are the main factors that determine the value of blood pressure? What hemodynamic parameters should be influenced by medications in order to normalize blood pressure in this patient?

*Sample answer:* The main factors include minute volume of blood flow (MVR) and total peripheral vascular resistance (TPVR). In turn, IOC depends on heart rate and systolic blood volume (SBV), and OPSS depends on the radius, length of vessels and blood viscosity. In this case, it is necessary to normalize the patient's heart rate.

Task 55. Solve a situational problem.

In clinical practice, for rapid massive blood replacement or long-term transfusion therapy, puncture of the subclavian vein is performed. At the same time, at the moment of connecting the transfusion system, the patient is asked to hold his breath. For what purpose and at what phase of the respiratory cycle does the patient need to hold his breath?

*Sample answer:* in order to prevent air embolism, which may occur due to negative pressure, i.e. below atmospheric pressure in the veins of the chest cavity during inspiration. Therefore, the patient must hold his breath as he exhales, since the blood pressure in the veins of the chest cavity becomes higher than atmospheric pressure. This prevents air from entering the vein cavity during puncture.

Task 56. Solve a situational problem.

In order to study the mechanisms of sympathetic regulation of the heart and vascular tone, selective pharmacological blockade of alpha and beta adrenergic receptors of the cardiomyocyte membrane and the membrane of vascular smooth muscle cells is used. What changes in blood pressure (BP) are expected when using blockers: 1) alpha-1-adrenergic receptors, 2) beta-1-adrenergic receptors, 3) beta-2-adrenergic receptors? Describe the cause-and-effect relationship of changes in blood pressure with the use of each of these selective adrenergic blockers.

*Sample answer:* 1) when alpha-1 adrenergic receptors are blocked in the membrane of vascular smooth muscle cells, vasodilation occurs (vasodilation), a decrease in total peripheral vascular resistance (TPVR) and, as a result, a decrease in blood pressure; 2) when beta-1 adrenergic receptors of the cardiomyocyte membrane are blocked, there is a decrease in the frequency of heart contractions, the force of myocardial contraction and, as a result, a decrease in blood pressure; 3) with the blockade of beta-2 adrenergic receptors in the membrane of vascular smooth muscle cells, vasoconstriction occurs (vasoconstriction), an increase in peripheral vascular resistance and, as a consequence, an increase in blood pressure.

Task 57. Solve a situational problem.

Specify the reason for the development of B12-folate deficiency anemia after surgery to remove the stomach (gastrectomy).

*Sample answer:* Vitamin B12 comes from food, is absorbed in the small intestine and is absorbed after binding to intrinsic factor, produced by the cells of the gastric mucosa. After gastrectomy, Castle factor is not produced and the absorption of vitamin B12 is impaired.

Task 58. Interview question.

Name the gastrointestinal hormone that promotes the secretion of bile during digestion.

*Sample answer:* cholecystokinin, because it increases contractions of the gallbladder, improving its emptying.

Task 59. Solve a situational problem.

It is known that overflow of the duodenum causes closure of the pylorus (pylorus) of the stomach. What is the mechanism by which this reflex occurs?

*Sample answer:* the passage of food through the pylorus causes its closure, because irritation of the chemo- and mechanoreceptors of the duodenum causes contraction of the pyloric sphincter.

Task 60. Solve a situational problem.

During a conversation, when mentioning sliced lemon slices, the interlocutors felt an increase in the amount of saliva in the mouth.

Explain the observed phenomenon from the standpoint of regulation of the salivation process. Indicate the location of the salivary center.

*Sample answer:* the conditioned reflex mechanism of salivation is triggered by the sight, smell or idea of food. When receptors are irritated, impulses enter the cortical sections of the analyzers, from there to the cortical representation of the food center, and then to the medulla oblongata, to the center of salivation.

Task 61. Solve a situational problem.

Some medicinal substances with resorptive action are administered to patients using microenemas (30-100 ml). What function of the colon ensures that substances administered through microenemas enter the bloodstream? Name the main functions of the large intestine.

*Sample answer:* the drug enters the bloodstream due to the absorption function of the colon; its main functions, in addition to those indicated, are: secretory, motor, reservoir, synthetic (synthesis of vitamins K and group B by intestinal microflora).

Task 62. Solve a situational problem.

Before instrumental examination of the colon, the subject is recommended to have a cleansing enema with a volume of 1.0-1.5 liters of water at room temperature (200-250C). Why does this speed up the evacuation of colon contents? How can we explain the lack of absorption of a given volume of water in the colon?

*Sample answer:* acceleration of the evacuation of the contents of the colon is due to the activation of motor function by a large volume of water and an increase in pressure in it to 40-50 mm Hg. Art. There is practically no absorption of water at room temperature; isotonic and isothermal solutions are absorbed from the colon.

Task 63. Solve a situational problem.

During duodenal intubation, two portions of bile were obtained: first, golden-yellow, freely flowing through the probe in an amount of 30 ml. After intraduodenal administration of egg yolk, 15 ml of viscous brown bile was obtained. What portions of bile were obtained from the subject? Explain the physiological mechanism of changes in the composition of gallbladder bile.

*Sample answer:* First, bile was obtained from the duodenum, portion "A," and then gallbladder bile, portion "B." Bile entering the gallbladder from the liver is concentrated due to the absorption of water, which causes its viscosity and brown color.



Task 64. Solve a situational problem.

It is known that at the same air temperature, a person freezes faster in high air humidity than in dry weather. Explain this fact from the perspective of thermoregulation. Name the main methods of heat transfer.

*Sample answer:* When the air humidity is high, its thermal conductivity is greater compared to dry air. In a humid atmosphere, heat transfer occurs faster, as a result of which a person freezes. The main methods of heat transfer: heat radiation, heat conduction, convection, evaporation through sweating.

Task 65. Solve a situational problem.

It has been noticed that after a heavy lunch, blood flow in the skeletal muscles decreases, and a person's performance decreases. It takes him some time to restore his previous activity. What is the reason for this phenomenon? Define the regulatory vascular phenomenon of blood circulation regulation that underlies it.

*Sample answer:* the reason for this phenomenon is the redistribution of blood into the vessels of the gastrointestinal tract, which is actively functioning during digestion, from the vessels of other regions, in particular, skeletal muscles. The phenomenon of blood circulation regulation is functional hyperemia.

Task 66. Solve a situational problem.

In a patient complaining of frequent excessive urination and thirst, a urine analysis revealed a decrease in its specific gravity and an increase in daily diuresis. The glucose content in blood plasma was 4.4 mmol/l. Give a rationale for the most likely cause of increased diuresis and thirst?

*Sample answer:* The cause of increased diuresis is a decrease in the synthesis of antidiuretic hormone in the hypothalamus and its secretion by the neurohypophysis. This is accompanied by the release of a large amount of weakly concentrated urine, an increase in the osmotic pressure of the blood and stimulation of the thirst center in the hypothalamus.

Task 67. Solve a situational problem.

Under conditions of a chronic experiment, the animal developed hypofunction of the adrenal cortex, in particular, its zona glomerulosa. How will sodium reabsorption and potassium secretion in the nephron tubules change?

*Sample answer:* sodium reabsorption and potassium secretion will decrease, since aldosterone (mineralocorticoid) is synthesized in the zona glomerulosa of the adrenal cortex, which increases sodium reabsorption and potassium secretion in the distal nephron.

Task 68. Solve a situational problem.

When examining the urinary function of the patient's kidneys, a disturbance in the processes occurring in the nephron tubules was found, which was accompanied by a shift in blood pH to the acidic side. Name the processes occurring in the nephron tubules. Specify the reasons for the shift in blood pH.

*Sample answer:* processes occurring in the nephron tubules include reabsorption and secretion. The pH shift is associated with impaired reabsorption of bicarbonates and insufficient secretion of hydrogen protons.

Task 69. Solve a situational problem.

When examining the patient, the doctor discovered that he had high blood pressure (BP). After Doppler examination of the renal vessels, the patient was diagnosed with insufficient blood supply. Give a physiological basis for the increase in blood pressure in this patient.

*Sample answer:* insufficient blood supply to the kidneys leads to activation of the juxtaglomerular apparatus, increased synthesis and secretion of renin into the blood, which

accompanied by activation of angiotensin and an increase in aldosterone concentration. There is an increase in vascular tone and an increase in the volume of circulating blood, which leads to an increase in blood pressure.

Task 70. Solve a situational problem.

In order to increase diuresis in patients with an increased level of circulating blood volume, so-called "loop diuretics" are used, which affect reabsorption processes in the ascending limb of the loop of Henle.

Explain the mechanism of increased diuresis when using "loop diuretics". Reference *answer:* loopback diuretics reduce reabsorption sodium And chloride Vascending limb of the loop of Henle. This is accompanied by a decrease in water reabsorption in the descending limb and collecting ducts. Decreased water reabsorption leads to increased diuresis.

Task 71. Solve a situational problem.

A patient with dysfunction of the hypothalamic-pituitary region experienced an increase in the secretion of antidiuretic hormone (ADH). Indicate the possible consequences of increasing the level of ADH in the body.

*Sample answer:* Excess ADH leads to increased water reabsorption, increased circulating blood volume, vasoconstriction, and increased blood pressure.

Task 72. Solve a situational problem.

When assessing a general clinical urine test in a patient with impaired renal function, proteinuria was detected. What is proteinuria? Which part of the nephron is affected by the development of proteinuria?

*Sample answer:* proteinuria - the presence of protein in the urine. The development of proteinuria is possible when the filtration membrane of the renal corpuscle is damaged.

Task 73. Interview question.

What determines the level of glomerular filtration in the renal corpuscle? Standard answer: the level of glomerular filtration depends on the effective filtration pressure, which is calculated as the difference between the hydrostatic pressure of the blood and the sum of the oncotic pressure of blood plasma proteins and the hydrostatic pressure of the ultrafiltrate in the glomerular capsule.

Task 74. Solve a situational problem.

Two patients experienced a decrease in circulating blood volume. To restore it, one of them was injected with a plasma-substituting solution, and the other with a physiological solution. Which solution will be more effective in restoring circulating blood volume? Justify your answer.

Standard answer: plasma replacement solution, since due to the presence of proteins in the solution, oncotic pressure increases and, as a result, filtration pressure decreases.

Task 75. Interview question

Name the main processes of urine formation and give them a definition. Sample answer: 1. Glomerular ultrafiltration is the process of transfer of protein-free fluid from blood plasma into the glomerular capsule.

2. Tubular reabsorption - reabsorption of water and substances from the lumen of the nephron tubules into the blood. 3. Tubular secretion is the transition of substances from the blood, or substances synthesized in the epithelium of the tubules, into the lumen of the nephron tubules.

### CRITERIA for assessing competencies and rating scales

Grade "unsatisfactory"(not accepted) or absence competence development	Grade "satisfactorily"(passed) or satisfactory (threshold) level of competence development	Rating "good" (passed) or sufficient level of mastery competencies	"Excellent" grade (passed) or high level of development competencies
<p>Inability of the learner to learn independently demonstrate knowledge when solving tasks, lack of independence in using skills. Absence confirmation of the availability of competence indicates negative results in mastering the academic discipline.</p>	<p>The student demonstrates independence in applying knowledge, skills and abilities to solve educational tasks in full accordance with a sample given by the teacher for tasks whose solutions were shown teacher, it should be considered that the competence formed at a satisfactory level.</p>	<p>The student demonstrates independent application of knowledge, skills and abilities in solving tasks similar samples, which confirms the presence of competencies at a higher level. Availability of such competence at a sufficient level indicates sustainable fixed practical skill.</p>	<p>The student demonstrates ability to complete independence in choosing a solution non-standard assignments within the discipline using knowledge, skills and abilities, received both during the development of this discipline and related disciplines should be considered competence formed at a high level.</p>

***Criteria for assessing test control:***

percentage of correct answers	Marks
91-100	Great
81-90	Fine
70-80	satisfactorily
Less than 70	unsatisfactory

*Criteria for assessing situational tasks of addition tasks:*

Mark	Descriptors			
	understanding the problem	analysis of the situation	skills solutions to the situation	professional thinking
Great	full understanding of the problem. All requirements for the task completed	high ability to analyze the situation, draw conclusions	high ability to choose a solution method for problems, sure situation solving skills	high level of professional thinking
Fine	full understanding of the problem. All requirements for the task completed	ability to analyze a situation, draw conclusions	ability to choose a solution method for problems sure situation solving skills	sufficient level of professional thinking. One or two inaccuracies in the answer are allowed
satisfactory	partial understanding of the problem. Most of the requirements presented for the task, completed	satisfactory strong ability to analyze a situation, draw conclusions	satisfactory advanced situation-solving skills, difficulties with choosing a method for solving a problem	sufficient level of professional thinking. More than two inaccuracies in the answer or an error in solution sequences
unsatisfactory	misunderstanding of the problem. Many requirements for the task were not completed. No answer. Did not have attempts to solve the problem	low ability to analyze the situation	insufficient situation solving skills	absent

***Interview assessment criteria:***

<b>Mark</b>	<b>Descriptors</b>		
	<b>strength of knowledge</b>	<b>the ability to explain (represent) the essence of phenomena, processes, do conclusions</b>	<b>logic and consistency answer</b>
Great	strength of knowledge, knowledge of the basic processes of the subject being studied areas, the answer differs in depth and completeness disclosure of the topic; possession terminological apparatus; logic and response sequence	high ability to explain the essence, phenomena, processes, events, draw conclusions and generalizations, give reasoned answers, give examples	high logic and consistency of the answer
Fine	strong knowledge of the basic processes of the subject area being studied, distinguished by the depth and completeness of the topic; possession terminological apparatus; free proficiency in monologue speech, but is allowed one or two inaccuracies in the answer	the ability to explain the essence, phenomena, processes, events, draw conclusions and generalizations, give reasoned answers, give examples; however, one or two inaccuracies in the answer are allowed	logic and response sequence
satisfactory	satisfactory knowledge of the processes of the subject area being studied, the answer differs insufficient depth and completeness of the topic; knowledge of the basic issues of theory. Several are allowed errors in the content of the answer	satisfactory the ability to give reasoned answers and give examples; satisfactorily developed skills in analyzing phenomena and processes. Several are allowed errors in the content of the answer	satisfactory logic and response sequence
unsatisfactory	poor knowledge of the subject area being studied, shallow disclosure Topics; poor knowledge of basic theoretical issues, poor skills in analyzing phenomena and processes. Serious errors in the content of the answer are allowed	inability to give reasoned answers	absence of logic and response sequences