

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

**FACULTY OF TREATMENT AND PREVENTION**

Assessment materials for the discipline

"Physical basis of diagnostics and therapy"

(appendix to the work program of the discipline)

Specialty 05/31/01 General Medicine

2023

**1. List of competencies formed by the discipline (in full or partially)\***

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

Code and name general professional competence	Indicator(s) of achieving general professional competence
OPK 4 Able to use medical devices provided for in the procedure for providing medical care, as well as conduct examinations of the patient in order to establish a diagnosis	ID1 OPK-4 Able to use medical devices during diagnostic studies provided for in the procedures for providing medical care  ID2 OPK-4 Able to apply diagnostic methods, including the use of instrumental methods, when examining a patient in order to establish a diagnosis

**2. Types of assessment materials in accordance with the competencies being developed**

Name competencies	Types of assessment materials	number of tasks <b>for 1 competency</b>
OPK-4	Closed tasks	25 with sample answers
	Open type tasks: Situational tasks Interview questions Add-on tasks	75 with sample answers

Task 1. Instructions: Choose**one**correct answer. The pitch of the sound depends on:

1. timbre
2. frequencies
3. acoustic spectrum
4. intensity

*Correct answer:* 2. frequencies

Task 2. Instructions: Choose**one**correct answer. The timbre of the sound depends on:

1. intensity level
2. frequencies
3. volume
4. acoustic spectrum

*Correct answer:* 4. acoustic spectrum

Task 3. Instructions: Choose**one**correct answer.

A person receives the bulk of the radiation dose throughout his life due to:

1. natural background radiation
2. occupational exposure

3. nuclear weapons testing
4. irradiation for medical purposes

*Correct answer:1*

Task 4. Instructions: Choose **one** correct answer. Name the bottleneck in the cardiovascular system:

1. aorta
2. arteries
3. capillaries
4. veins

*Correct answer:1*

Task 5. Instructions: Choose **one** correct answer.

What is the sign of the potential difference between the cytoplasm and the environment in an unexcited cell?

1. positive
2. negative
3. equal to zero

*Correct answer:2*

Task 6. Instructions: Choose **one** correct answer.

Compare the permeability of the membrane in the steady state for potassium ions and sodium ions:

1. the same
2. for potassium 25 times less than for sodium
3. for sodium 20 times more than for potassium
4. for potassium 25 times more than for sodium

*Correct answer:4*

Task 7. Instructions: Choose **one** correct answer.

X-ray radiation is attenuated more strongly (with the same thickness of the layer of substance) 1.

- phosphorus
- hydrogen
- lead
- water
- silver

*Correct answer:3*

Task 8. Instructions: Choose **one** correct answer.

An x-ray of the stomach or intestines is obtained by giving the patient barium salt, otherwise "barium porridge," in order to improve

- contrast
- digestion
- well-being
- photo effect

*Correct answer:1*

Task 9. Instructions: Choose **one** correct answer.

The non-systemic unit of measurement of exposure dose to ionizing radiation is:

1. glad
2. x-ray
3. gray
4. rem

*Correct answer:2*

Task 10. Instructions: Choose**one**correct answer. Radon waters serve as a source of ionizing radiation:

1. alpha
2. beta
3. gamma
4. X-ray

*Correct answer:1*

Task 11. Instructions: Choose**one**correct answer.

Of the listed tissues, the most resistant to radiation is

1. bone marrow
2. leather
3. testes
4. lens

*Correct answer:2*

Task 12. Instructions: Choose**one**correct answer.

Of the listed tissues, the least resistant to radiation is 1. bone marrow

2. leather
3. lungs
4. kidneys

*Correct answer:1*

Task 13. Choosesomecorrect answers. The viscosity of a liquid depends on:

1. temperature
2. flow speed
3. nature of the liquid
4. shapes of molecules
5. Pipe diameter

*Correct answer:1, 3, 4*

Task 14. Choosesomecorrect answers. Non-Newtonian (heterogeneous) liquids include: 1. glycerin

2. blood plasma
3. lymph
4. whole blood
5. cream

*Correct answer:4, 5*

Task 15. Choosesomecorrect answers. Which ions make the main contribution to the resting potential?

1. potassium
2. sodium
3. chlorine
4. calcium
5. magnesium

*Correct answer: 1, 2, 3*

Task 16. Choosesome correct answers.

Select fabrics that are good conductors of electric current: 1. dry skin

2. cerebrospinal fluid
3. bone
4. whole blood
5. muscles

*Correct answer: 2, 4, 5*

Task 17. Choosesome correct answers.

The corpuscular type of ionizing radiation includes:

1. alpha radiation
2. beta radiation
3. X-ray radiation
4. gamma radiation
5. neutrons

*Correct answer: 1, 2, 5*

Task 18. Establish a correspondence between the device and its purpose:

1. Tonometer	A. Measuring blood oxygen saturation
2. Pulse oximeter	B. Determination of blood pressure
3. Electroencephalograph	B. Registration of electrical activity of the brain

*Correct answer: 1-B, 2-A, 3-B.*

Task 19. Establish a correspondence between a diagnostic device and a device for collecting medical and biological information:

1.Rheograph	A. Sensor
2. Electroencephalograph	B. Electrodies
3. Pulse oximeter	
4. Spirograph	

*Correct answer: 1-B, 2-B, 3-A, 4-A.*

Task 20. Establish a correspondence between the device and its purpose:

1.Luxmeter	A. Diagnosis of hearing acuity
2. Audiometer	B. Determination of illumination
3. Sphygmograph	B. Registration of pulse curves of various vessels

*Correct answer: 1-B, 2-A, 3-B.*

Task 21. Establish a correspondence between the names of physical quantities that describe sound waves:

1. Frequency 2. Volume 3. Intensity level and their units of measurement:  
 A. decibels  
 B. backgrounds

V. hertz

*Correct answer: 1-B, 2-B, 3-A*

Task 22. Establish a correspondence between active transport systems and the function:

1. Sodium-potassium pump	A. Relaxation
2. Calcium pump	B. Cell energy
3. Proton pump	B. Nervous excitement

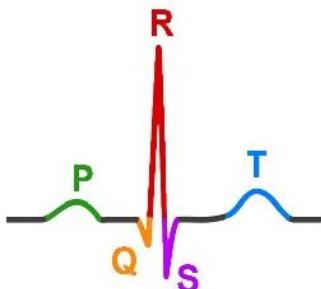
*Correct answer: 1-B, 2-A, 3-B*

Task 23. Establish a correspondence between the numbers of standard ECG leads and points on the surface of the human body:

eleven	A. Between the left arm and left leg
2.2	B. Between right hand and left hand
3.3	B. Between the right arm and left leg

*Correct answer: 1-B, 2-B, 3-A*

Task 24. Establish a correspondence between the ECG waves and their genesis.



1.P	A. Atrial depolarization
2.QRS	B. Ventricular repolarization
3.T	C. Ventricular depolarization

*Correct answer: 1-A, 2-B, 3-C*

Task 25. Establish a correspondence between doses of ionizing radiation and system units of their measurement:

1. Absorbed dose	A. Sv
2.Exposure dose	B. Gr
3. Equivalent dose	C. C/kg

*Correct answer: 1-B, 2-B, 3-B*

**Add-on task**

1. Instructions. Instead of a dash, enter only one word:

The fundamental tone of a complex sound vibration has a \_\_\_\_\_ frequency.

**Correct answer:the smallest**

2. Instructions. Instead of a dash, enter only one word:

A sphygmomanometer is a device for measuring \_\_\_\_\_ blood.

**Correct answer:pressure**

3. Instructions. Instead of a dash, enter only one word:

In their natural state, biological membranes have \_\_\_\_\_ structure.

**Correct answer:liquid crystal**

4. Instructions. Instead of a dash, enter only one word:

The property of a liquid that is the inverse of viscosity is called \_\_\_\_\_.

**Correct answer:fluidity**

5. Instructions. Instead of a dash, enter only one word:

The ion concentration gradient between the inner and outer surfaces of a biological membrane supports \_\_\_\_\_ transport.

**Correct answer:active**

6. Instructions. Instead of a dash, enter only one word:

The myelin sheath of the nerve fiber contributes to \_\_\_\_\_ the speed of propagation of excitation **in10once**.

**Correct answer:increase**

7. Instructions. Instead of a dash, enter only one word:

A method for diagnosing the function of external respiration: determining the tidal volume, the value of the reserve volume of inhalation and exhalation, vital capacity of the lungs and other quantitative parameters of the condition of the lungs, called \_\_\_\_.

**Correct answer:spirometry**

8. Instructions. Instead of a dash, enter only one word:

The natural radioactive background in equivalent dose rate units is approximately \_\_\_\_ mrem/year.

**Correct answer:125**

9. Instructions. Instead of a dash, enter only one word:

Radioprotectors are substances that \_\_\_\_\_ the effects of radioactive radiation on the body.

**Correct answer:weaken**

10. Instructions. Instead of a dash, enter only one word:

X-ray tomography is a method of radiography of individual \_\_\_\_\_ of the human body.

**Correct answer:layers**

### **Interview Questions**

1.What is the Doppler effect?

**Correct answer:In changes in the frequency of vibrations perceived observer, due to the relative motion of the wave source and the observer.**

2. Application of the Doppler effect in medicine.

**Correct answer:Used to determine the speed of blood movement, red blood cells, heart valves, etc.**

3. What is auscultation?

**Correct answer:A method for examining internal organs based on listening to sounds arising from the physiological activity of organs.**

4. What instruments are used to perform auscultation? **Correct answer: Auscultation is performed using a phonendoscope and stethoscope.**

5. Why is it necessary to lubricate the surface of the patient's body with gel during ultrasound examination or ultrasound therapy?

**Correct answer:**To remove air gaps and leveling acoustic resistance.

6. What is measured by the Korotkoff method?

**Correct answer:**Systolic and diastolic pressure.

7.What does it mean: the quality factor of alpha radiation is 20?

**Correct answer:**With the same absorbed dose,  $\alpha$ -radiation is 20 times more radiation hazardous than X-rays or gamma radiation.

8. List the types of passive transport through a biological membrane.

**Correct answer:**Simple diffusion, protein channel and facilitated diffusion.

9. List the general functions of biological membranes.

**Correct answer:**Barrier, mechanical, matrix

10. What is the direct task of electrography?

**Correct answer:**Find out the mechanism of occurrence of the electrogram.

11. What is the inverse problem of electrography?

**Correct answer:**In determining the characteristics of the electrical activity of an organ based on measured potentials on the surface of the body.

12. Explain the principle of equivalent electrical generator underlying electrography methods.

**Correct answer:**The organ under study, consisting of many cells, excited at different times are replaced by a model of an equivalent generator.

13. What type of X-ray is used for medical diagnosis?

**Correct answer:**Bremsstrahlung X-ray radiation.

14. Explain what contrast agents and for what purpose are used in diagnostic methods using x-rays.

**Correct answer:**Elements with high charge numbers, such as barium and iodine. Such substances strongly absorb x-rays and create a contrasting boundary between tissues in the image.

15. What determines the nature of percussion sound?

**Correct answer:**From the amount of air in the organ, from the elasticity of tissues.

16. Use of percussion.

**Correct answer:**Based on the nature of the sound, the doctor determines the topography of the internal organs and their physical condition.

17. What air ions have a beneficial effect on the human body? **Correct**

**answer:Negative.**

18. What method can be used to determine external respiration parameters? **Correct answer:Spirometry.**

19. Which tissues heat up more strongly during UHF therapy? **Correct answer:Dielectrics.**

20. Which tissues warm up more strongly during microwave therapy? **Correct answer:Electrolytes.**

21. The principle of physiotherapeutic influence.

**Correct answer:The principle of nervism.**

22. What is the electrical conductivity of biological tissues?

**Correct answer:The ability of tissues to pass electric current under exposure to an electric field.**

23. What ensures the electrical conductivity of biological tissues?

**Correct answer:The presence of free ions.**

24. Factor affecting the patient during galvanization.

**Correct answer:direct electric current**

25. What factors affect the patient during electrophoresis.

**Correct answer:Drug ions and direct current.**

26. Which field is used in MRI diagnostics?

**Correct answer:magnetic**

27. What diagnostic method allows you to measure the blood supply to organs and tissues?

**Correct answer:**Rheography

28. How does the electrical resistance of tissues change with increasing blood supply?

**Correct answer:**Decreases

29. Which sensor is used in a pulse oximeter to measure saturation?

**Correct answer:**Photoelectric.

30. What is resting potential?

**Correct answer:**Potential difference between the cytoplasm and the environment in an unexcited cell.

31. What is membrane potential?

**Correct answer:**Potential difference between internal and external membrane surfaces.

32. Indicate the reasons for the existence of membrane potentials.

**Correct answer:**Different concentrations of ions on both sides of the membrane and unequal permeability of the membrane for various substances.

33. What factor affects the patient during inductothermy?

**Correct answer:**Alternating magnetic field.

34. What phenomenon underlies the ultrasonic echolocation method?

**Correct answer:**Reflection from the interface between media with different acoustic resistance.

35. Define action potential.

**Correct answer:**Electrical impulse associated with propagation along nerves and waves of excitement to the muscles.

36. What explains the development of the action potential?

**Correct answer:**When excited, the permeability of the membrane for sodium ions.

37. What is called a lead in electrocardiography?

**Correct answer:**Potential difference between two points on a surface bodies.

38. Define ionizing radiation.

**Correct answer:**Ionizing radiation is electromagnetic waves and streams of particles that can ionize atoms and molecules of matter.

39. List diagnostic methods in medicine using X-rays.

**Correct answer:**radiography, fluorography, computer X-ray tomography.

40. Explain the physical basis for the use of x-rays in diagnostics.

**Correct answer:**X-rays are absorbed differently in the human body, and at the exit the flow becomes non-uniform. This heterogeneity is converted into an image.

41.What does protection from ionizing radiation by distance mean?

**Correct answer:**Maximum distance from the radiation source.

42. What is radioactivity?

**Correct answer:**The process of spontaneous decay of atomic nuclei

43. Composition of radioactive radiation. **Correct answer:**

**alpha, beta and gamma radiation.**

44. Which radiation has the highest quality factor? **Correct**

**answer:**alpha radiation

45.What does protection from ionizing radiation by a material mean?

**Correct answer:**The use of substances that strongly absorb this type radiation.

46. What does time protection against ionizing radiation mean?

**Correct answer:**Reducing the time spent under the influence of ionizing agents radiation.

47.What is radionuclide diagnostics?

**Correct answer:** Radiation method research functional And  
morphological state of organs due to With help compounds labeled  
radionuclides.

48. What are sensors used for in medicine?

**Correct answer:**To convert a non-electrical signal into electric.

49. Application of electrodes in medicine.

**Correct answer:**For picking up an electrical signal in diagnostics and transmitting influences - in therapy.

50. Application of ultrasound in medicine.

**Correct answer:**1. Diagnostics: echolocation and Dopplerometry. 2. Therapy 3. Surgery.

51. What is protective grounding of medical devices?

**Correct answer:** Method of ensuring electrical safety by electrical connection of the metal body of the device to the ground.

52. What are the basic requirements for electrodes used in diagnostics and therapy.

**Correct answer:** No impact on biological tissue, easy to attach, easy to remove, durable.

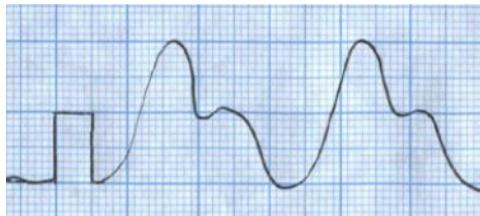
### **Situational tasks**

Task 1. During ultrasonic echolocation, the signal reflected from the object of study was received by the sensor 65  $\mu$ s after emission. At what depth is the boundary from which the reflection occurred if the speed of ultrasound in tissue is 1540 m/s? **Correct answer: 5 cm**

Task 2. The intensity of heart sounds perceived through a stethoscope is equal to  $10 \text{--} 11 \text{W/m}^2$ . What is the intensity level of heart sounds in this case? The threshold sound intensity is  $10 \text{--} 12 \text{W/m}^2$ .

**Correct answer: 10 dB**

Task 3. Determine the duration of the rheographic cycle from the fragment shown in the figure. Recording a rheogram on graph paper. The tape pulling speed is 25 mm/s.



**Correct answer: 1 s**

Task 4. A narrowing of the vessel has occurred. Explain how the speed will change blood flow.

**Correct answer:** The speed of blood flow increases.

Problem 5. When recording an electrocardiogram on graph paper at a speed of 25 mm/s RR, the interval turned out to be 22 mm. Determine the heart rate in units of beats/min.

**Correct answer:** 68 beats/min

**Task 6.** When recording an electrocardiogram on graph paper, the height of the R wave turned out to be equal to 14 mm. Determine the amplitude of the R wave in mV if the calibration signal with an amplitude of 1 mV has a height of 10 mm.

**Correct answer:** 1.4 mV

**Task 7.** Determine the amplitude of the carotid artery rheogram using the presented fragment. Calibration signal 0.05 Ohm.



**Correct answer:** 0.1 ohm

**Task 8.** The figure shows a fragment of an electrocardiogram. Calibration signal 1 mV.



Determine the amplitude of the Q and R waves. *Correct answer: Q-0.3 mV, R-1.1 mV.*

**Problem 9.** What percentage of radioactive iodine nuclei with a half-life of 8 days will decay in 16 days?

**Correct answer:** 75%

**Problem 10.** A rabbit weighing 4 kg was irradiated with electrons with an energy of  $10^{12}$  eV. Determine the absorbed dose if the animal's body absorbs  $10^{12}$  electrons. Give your answer in system units of absorbed dose.

**Correct answer:** 0.25 Gy

**Problem 11** The figure shows a fragment of an electrocardiogram on graph paper. The tape pulling speed is 25 mm/s. Determine the duration of the RR interval in seconds.



***Correct answer:0.72 s***

Problem 12. The system consists of two unlike charges located at a distance of 1. 10-10 m. The absolute value of each charge is equal to the elementary charge 1.6. 10-19 Grades Find the dipole moment of such a system.

***Correct answer:1.6.10-29 Kl.m***

Problem 13 The speed of action potential propagation along an unmyelinated nerve fiber is 20 m/s. How long will it take for it to spread over a distance of 10 cm? Express the answer in milliseconds.

***Correct answer:5 ms******CRITERIA for assessing competencies and rating scales***

<b>Grade "unsatisfactory" (not accepted) or absence formation competencies</b>	<b>Grade "satisfactorily" (passed) or satisfactory (threshold) level of development competencies</b>	<b>Rated "good" (passed) or sufficient level development competencies</b>	<b>Excellent rating (passed) or high level development competencies</b>
failure to student on one's own demonstrate knowledge when solving assignments, lack independence in application of skills. Absence availability confirmation formation competencies indicates negative development results academic discipline	student demonstrates independence in application of knowledge skills and abilities to solve educational tasks in full According to sample given teacher, by tasks, solution of which there were shown teacher, it should be considered that competence formed on satisfactory level.	student demonstrates independent application of knowledge, skills and abilities when deciding assignments, tasks similar samples that confirms Availability formed competencies for higher level. Availability such competence on sufficient level indicates sustainable fixed practical skill	student demonstrates ability to full independence in choosing a method solutions non-standard assignments within disciplines with using knowledge, skills and skills, received as in development progress of this discipline, and adjacent disciplines should count competence formed on high level.

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

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

When grading tasks with multiple correct answers, one error is allowed.

***Interview assessment criteria:***

<b>Mark</b>	<b>Descriptors</b>		
	<b>strength of knowledge</b>	<b>ability to explain (introduce) the essence of phenomena, processes, do conclusions</b>	<b>logic and subsequence answer</b>
Great	strength of knowledge, knowledge of basic processes subject matter being studied areas, the answer differs in depth and completeness disclosure of the topic; possession terminological apparatus; logic and consistency answer	high skill explain the essence phenomena, processes, events, draw conclusions and generalizations, give reasoned answers, give examples	high logic and subsequence answer
Fine	solid knowledge of the basic processes of the studied subject area, differs in depth and completeness of the topic; possession terminological apparatus; free mastery of monologue speech, but one or two inaccuracies in the answer are allowed	ability to explain 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 subsequence answer
satisfactory really	satisfactory process knowledge subject matter being studied areas, answer, different insufficient depth and completeness of the topic; knowledge of basic theoretical issues. Several are allowed errors in content answer	satisfactory ability to give reasoned answers and provide examples; satisfactorily formed analysis skills phenomena, processes. Several are allowed errors in content answer	satisfactory logic and subsequence answer
will not satisfy really	poor knowledge of the subject area being studied, shallow opening Topics; poor knowledge basic theoretical issues, poor analysis skills	inability to give reasoned answers	absence logic and sequences answer

	phenomena, processes. Serious errors in content answer		
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***Criteria for assessing situational tasks:***

Mark	Descriptors			
	understanding <b>Problems</b>	analysis <b>situations</b>	skills <b>solutions</b> <b>situations</b>	professional <b>thinking</b>
Great	complete implication problems. All requirements, submitted to adania, completed	high benefit analyze situation, draw conclusions	high benefit select method solutions problems, faithful solution skills situations	high level professional thoughts
Fine	complete implication problems. All requirements, submitted to adania, completed	benefit analyze situation, draw conclusions	benefit select method solutions problems faithful solution skills situations	residual level professional thoughts. drops one or two precision in the answer
satisfactory really	astastic implication problems. majority requirements declared to adania, completed	satisfactory 1st ability analyze situation, draw conclusions	satisfactory e skills solutions situations, falsity with choosing a method solutions to the problem	residual level professional thoughts. falls more a bunch of inaccuracies in answer or there is an error in the sequence solutions
will not satisfy really	misunderstanding problems. legs requirements, submitted to I hope not completed. No Tvetka. Did not have experiments to solve hello	izkaya benefit analyze situation	insufficient solution skills situations	missing