

**MINISTRY OF HEALTH UKRAINE
NATIONAL UNIVERSITY OF PHARMACY**



APPROVED

Chairman of the admission committee

professor. Alla KOTVITSKA

2023

**PROGRAM
of professional entrance test for admission to the educational program
«LABORATORY DIAGNOSTICS»**

**(for foreign citizens and stateless persons who have a bachelor's degree in the
specialty 224 «Technologies of medical diagnostics and treatment»)**

Specialty 224 «Technologies of medical diagnostics and treatment»

Area of knowledge 22 «Public Health»

Level of higher education - second (master's)

Educational degree - Master

Kharkiv, 2023

EXPLANATORY NOTE

The program is designed for persons who have a bachelor's degree in specialty 224 «Technologies of medical diagnostics and treatment» and enroll for a master's degree in the educational program «Laboratory Diagnostics» specialty 224 «Technologies of medical diagnostics and treatment».

The professional entrance test determines the level of basic theoretical knowledge of entrants in the following disciplines: clinical laboratory diagnostics, clinical biochemistry, basics of microbiology with immunology.

Testing is designed for two astronomical hours.

CONTENT

CLINICAL LABORATORY DIAGNOSTICS

Laboratory analytics

1. Basic theories of laboratory diagnostic information. The principles of unification and standardization of clinical laboratory methods. Basic rules of laboratory tests.
2. Workplace preparation and reagents. Washing-up. Preparation of reagents and test purity. Measurement of solutions, weighing, centrifugation.
3. SI units in clinical laboratory diagnostics. Basic SI units and examples of derived SI units.

Hematologic studies

4. Scheme of blood maturation. Blood composition and functions.
5. Blood taking for determination of the erythrocyte sedimentation rate, techniques, diagnostic value.
6. Determination of hemoglobin concentration by unified methods (by hemoglobincyanide method and on automatic hemoanalyzers). Diagnostic value.
7. Blood taking for counting of erythrocytes and leukocytes. The structure of the counting chamber and Goryaev's grid, filling technique. Determination of their number in the chamber and using automatic counters. The calculation of the average content of hemoglobin in a red blood cell, and the color index, diagnostic value.
8. Technique of making blood smears, their fixation and staining. Leukogram counting technique. Study of leukocyte morphology in norm and its changes at pathology: neutrophilic shifts, degenerative changes and anomalies.
9. The studying of erythrocyte morphology in the norm and its changes at pathology: degenerative changes, elements of pathological regeneration.
10. Determination of the number of reticulocytes. Features of taking and staining blood to determine the number of reticulocytes with methylene blue, azure I and II, brilliant cresyl blue. Counting of reticulocytes.
11. Determination of hematocrit number and osmotic resistance of erythrocytes, diagnostic value.

12. Determination of platelet count. Blood sampling for platelets. Production, fixation and staining of blood smears and platelet counting by the Fonio method, on automatic counters, phase contrast microscope. Study of the cells morphology of megakaryocytic lineage the size of platelets in smears (thrombocytogram). Determination of clotting time of capillary blood according to Sukharev's method and venous blood according to Lee-White method.
13. Determination of the bleeding duration according to the Duke method. Diagnostic value of indicators.
14. Examination of a bone marrow, its structure and function. Taking material and preparation the smears for microscopic examination.
15. Counting of myelogram, bone marrow indices and their evaluation.

Urine examination

1. Studying of the physical properties of urine: quantity, color, transparency, odor, reaction, relative density. Physical properties of urine in norm and their changes at pathology.
2. Methods of studying the functional state of the kidneys: Zimnitskiy's test.
3. Technique of Zimnitskiy's test, diagnostic value.
4. Chemical examination of urine. Pathological components of urine. Proteinuria, causes and types (renal, adrenal, extrarenal). Determination of the presence of protein in the urine with sulphosalicylic acid, Geller's test with nitric acid, Larion's reagent and rapid tests.
5. Quantitative determination of protein in urine by the method of dilution by Brandberg-Roberts-Stolnikov and with sulphosalicylic acid on photoelectronic colorimeter. Determination of Bence-Jones protein.
6. Glucosuria, causes and types (pathological and physiological).
7. Determination of the presence of glucose in the urine using the Gaines-Akimov test, rapid tests.
8. Determination of glucose concentration in the urine by colorimetric method on on photoelectronic colorimeter (modified Althausen method). The connection between carbohydrates and fats metabolism: ketonemia and ketonuria. Determination of ketone bodies in urine by Lange reaction, Lestrade reaction, rapid tests.
9. Causes and types of hematuria. Hemoglobinuria, hemosiderinuria, porphyrinuria, myoglobinuria, melaninuria. Determination of hemoglobin in urine using amidopyrine test, rapid tests.
10. Elements of organized urine sediment: erythrocytes, leukocytes, epithelium, cylinders. Elements of unorganized urine sediment: acidic, alkaline pathological urine.
11. Changes in urine during infectious-inflammatory processes in the bladder, urethra, prostate.
12. Changes in urine with kidney disease: pyelonephritis, renal tuberculosis, glomerulonephritis, nephrotic syndrome, acute renal failure, renal amyloidosis, urolithiasis, kidney damage in syphilis.

Examination of feces

1. Macroscopic study of feces: quantity, color, consistency, odor, shape, reaction, undigested food residues, mucus, blood, helminths, stones.
2. Chemical study of feces: blood and the importance of meatless and apochlorotic diet in this study.
3. Determination of blood in the feces with amidopyrine sample, express method; the bilirubin concentration – with Fouche's reagent; the stercobilin concentration – with Schmidt's sample; the protein and mucin – with Tribula-Vyshnyakov reaction.
4. Microscopic examination of feces. The preparation of smears – native, with Lugol's solution, methylene blue, acetic acid. Elements of the intestinal mucosa, food, crystals, microflora.
5. General properties of feces and coprogram in different states of the digestive system: in normal digestion, indigestion in the stomach, insufficiency of the pancreas, bile failure, indigestion in the small and large intestine.

Examination of sputum

1. The structure and function of the respiratory tract. The studying of sputum. Rules for working with sputum.
2. Disposal of waste material; processing of laboratory glassware.
3. Determination of physical properties of sputum: quantity, odor, color, character, texture, shape, pathological admixtures. Microscopic examination of sputum.
4. The preparation of native smears and staining for the detection of hemosiderin (Perls reaction), Mycobacterium tuberculosis, cytological examination. Microscopic examination of native and stained swears.
5. Physical properties of sputum: quantity, color, transparency, reaction, relative density. The value of detecting fibrinous film. Chemical study of cerebrospinal fluid: protein determination, reactions of Pandi and Nonne-Apelt; colloidal reactions – Lange, Takata-Ara and Friedman. Diagnostic value of biochemical research. Microscopic examination: determination of cytolysis in the Fuchs-Rosenthal chamber and the number of erythrocytes, morphological characteristics of cerebrospinal fluid cells. The preparation and staining of smears for cytogram, detection of Mycobacterium tuberculosis.

CLINICAL BIOCHEMISTRY

The organization of clinical and biochemical laboratories

1. The purpose, tasks, structure of the course, its features in relation to the tasks of laboratory diagnostics. The place of clinical biochemistry in the system of the discipline. Principles of laboratories organization which perform biochemical analyzes.
2. The main directions (stages) of biochemical laboratories. The concept of biochemical parameters complex, screening, biochemical constellations, biochemical studies at dispensary observation.
3. Methods of biochemical research used in the work of diagnostic laboratories. System of unification of biochemical methods in medical practice. International System of Units.

4. Material for biochemical analysis. Rules of its receipt, storage and transportation.
5. Examples of practical using of diagnostic schemes on the basis of data of biochemical researches at the most widespread diseases.
6. Analysis of the causes and prevention of mistakes in laboratory diagnostics.

Clinical and biochemical criteria of proteins metabolism in norm and pathology

1. The structure of the protein molecule. Enteral and intermediate metabolism of simple and complex proteins.
2. Blood protein system. Biochemical parameters that characterize the state of proteins metabolism in the body.

Clinical and biochemical criteria of carbohydrates metabolism in norm and pathology

1. Classification of carbohydrates. Enteral and intermediate metabolism of carbohydrates.
2. Biochemical parameters of carbohydrate metabolism in liquid biological media of the body.

Clinical and biochemical criteria of fats metabolism in norm and pathology

1. Definition and classification of lipids. Enteral and intermediate lipid metabolism.
2. Cholesterol, biological role and methods of determination.

The role of enzymes in laboratory diagnosis. Clinical and biochemical criteria in the disease of cardiovascular and respiratory systems

1. Classification of enzymes. Enzymes are the most common in diagnosis.
2. Enzyme diagnostics in diseases of the cardiovascular system.
3. Biochemical parameters in diseases of the respiratory system.

Clinical and biochemical criteria of liver disease and diseases of gastrointestinal tract

1. Biochemical studies in diseases of the pancreas.
2. Disorders of metabolic processes in liver diseases and basic biochemical parameters.

Clinical and biochemical criteria of kidney disease and urinary tract

1. The kidneys: anatomy and functions. Mechanisms of urine formation The value of the components of the residual nitrogen system in the diagnosis of kidney disease.
2. Biochemical constellations in the most common kidney diseases.
3. The composition of urine in physiological norm and pathology.
4. Diagnosis of urolithiasis using biochemical studies.

Clinical and biochemical criteria of connective tissue pathology, endocrine regulation and diseases of the endocrine system

1. The structure of connective tissue of different localization. Biochemistry of its different types.
2. Collagen, proteoglycans, glycosaminoglycans, glycoproteins.

3. Features of bone and cartilage metabolism.
4. Biochemical studies in diseases of the endocrine system.

BASICS OF MICROBIOLOGY WITH IMMUNOLOGY

Introduction to Microbiology

1. Microbiology as a science. Medical microbiology.
2. History of microbiology development in Ukraine.
3. Advances in microbiology in overcoming infectious diseases, immunodeficiency virus and oncogenic viruses.
4. Working with a microscope. Rules for working with the immersion system.

Morphology and physiology of microorganisms

1. The concept of classification and taxonomy of microorganisms. Morphology of bacteria. Morphology of microorganisms. Morphology of bacteria. Polymorphism. The structure of the bacterial cell.
2. Microscopic method of research and its significance.
3. Brief morphological characteristics of fungi, spirochetes, protozoa, rickettsiae, viruses and prions, chlamydia and mycoplasmas.
4. The concept of chemical composition of microorganisms. Nutrition, respiration, growth and reproduction of bacteria.
5. Characteristics of nutrient media. The concept of cultural and biochemical properties.
6. Toxins, their practical significance.
7. Simple and complex methods of staining smears. Staining of the drug by a simple method and by the Gram method. Study of the main forms of macroorganisms using the immersion system of the microscope.
8. Introduction to nutrient media. Demonstration of growth of microorganisms on nutrient media: liquid, semi-liquid, whole.
9. Technique of sowing on nutrient media with a loop, tampon, spatula.
10. Demonstration of His color series (if possible).

Microbes and the environment

1. Normal microflora of the human body and its significance.
2. Eubiotics, their application.
3. Influence of physical, chemical and biological factors on microbes.
4. Sterilization, disinfection. The concept of antiseptics and asepsis.

Genetics and variability of microorganisms. Bacteriophages. Antibiotics

1. The concept of genotypic and phenotypic variability, its practical use.
2. Bacteriophage, its nature and practical application. Types of interaction of a veil with a sensitive cell.

3. The concept of antibiotics, their nature, mechanism of action. Influence of bacteriophage and antibiotics and variability of microorganisms. Side effects of antibiotics and methods of overcoming it.
4. Antiviral chemotherapeutic drugs. Antiseptics.

The doctrine of infection. The doctrine of immunity

1. Definitions of "infection", "infectious process", "infectious diseases".
2. Characteristics of microorganisms that cause infectious diseases. The concept of pathogenicity, virulence, toxigenicity, specificity, organotropicity.
3. Reservoirs and sources of infection.
4. Mechanism and ways of penetration of microbes into a macroorganism. Factors of the infectious process.
5. Dynamics of the infectious process. Forms of infection.
6. The concept of nosocomial infection.
7. Principles of treatment and prevention of infectious diseases. Modern methods of microbiological diagnosis of infectious diseases.

Specific immunoprophylaxis of infectious diseases and immunotherapy

1. Drugs to create active and passive immunity.
2. Classification of vaccines.
3. Discontinuation of vaccine and toxoids.
4. Vaccination methods. Revaccination. Eubiotics. Apply them.
5. Serum immune drugs, immunoglobulins. Diagnostic drugs. Application and storage.
6. Specific prevention of infectious diseases and immunotherapy.

Allergies and anaphylaxis

1. The concept of allergy, its main forms.
2. Anaphylaxis. Anaphylactic shock. The phenomenon of anaphylactic condition in humans and its prevention.
3. Serum disease, its prevention.
4. Diagnostic allergic reactions and their significance.
5. Pathogenic cocci.

Pathogenic cocci

1. General characteristics of the group. Taking material for research in diseases caused by staphylococci, streptococci, pneumococci, meningococci, gonococci.
2. Safety precautions when taking and transporting material to the laboratory. Methods of laboratory diagnosis of coccal infections.

Family of intestinal bacteria

1. General characteristics of intestinal bacteria. Brief information about Escherichia coli, Salmonella, Shigella, Vibrio cholerae.
2. Features of taking the material and transporting it to the laboratory.
3. Rules for working with pathogens of especially dangerous infections.

4. The main stages of laboratory diagnosis of intestinal infections. Medical ethics and deontology.
5. Sowing feces on nutrient media Endo, Ploskireva, EMC. Demonstration of growth of *Escherichia coli*, *Salmonella*, *Shigella* on nutrient media.
6. Statement of agglutination reaction on glass. Vidal's reaction (demonstration), RIGA (demonstration.)
7. *Mycobacteria of tuberculosis*.

Mycobacteria of tuberculosis

1. Morphology, brief information about the biological properties of the pathogen of tuberculosis.
2. Toxic substances. Pathogenesis of tuberculosis. Immunity.
3. Rules of sputum collection, disinfection of spittoons. Safety measures during work.
4. Laboratory diagnosis of tuberculosis. Mantoux test.
5. Specific prevention.

Pathogens of zoonotic infections

1. Pathogens of zoonotic infections.
2. General characteristics. Taking material and safety measures when working with pathogens of especially dangerous infections.
3. Features of laboratory diagnosis of plague, tularemia, brucellosis, anthrax.
4. Allergy tests. Specific prevention.
5. Pathogenic clostridia.

Pathogenic clostridia

1. General characteristics of the group.
2. Features of laboratory diagnostics of wound anaerobic infection of gas gangrene, tetanus, botulism
3. Features of taking material for research and safety measures.

Pathogenic spirochetes

1. General characteristics of the group.
2. General information about the causative agent of syphilis. Pathogenesis of syphilis.
3. Features of taking material for research in different periods of the disease.
4. Safety measures during work.

Rickettsia. Viruses

1. General characteristics of rickettsiae.
2. General information about the causative agent of typhus. Immunity. Material taking and safety measures.
3. Laboratory diagnostics.
4. Specific prevention.
5. Principles of classification and general characteristics of viruses. Interaction of the virus with the host cell, features of viral infections.
6. The concept of virological research methods.

7. Taking material and safety precautions when working with material containing viruses. Features of the study.
8. Brief information about RNA-, DNA-genomic and unclassified viruses - orthomyxoviruses (influenza); paramyxoviruses (measles, mumps or mumps), rhabdoviruses (rabies), picornaviruses (polio); hepatitis viruses, ECHO, Cocksackievirus; poxviruses (smallpox), retroviruses (HIV); oncoviruses.

RECOMMENDED REFERENCES

Clinical and laboratory diagnostics

1. Fishbach F. T., Dunning M. B. A Manual of Laboratory and Diagnostic Tests (Manual of Laboratory & Diagnostic Tests): 8th Edition. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins, 2009.
2. Kathleen Morrison Treseler. Clinical Laboratory and Diagnostic Tests: Significance and Nursing Implications (3rd Edition). Publisher: Prentice Hall, 1994. 704 p.
3. Lothar Thomas. Clinical Laboratory Diagnostics: Use and Assessment of Clinical Laboratory Results. Frankfurt/Main, Germany: TH-Books Verlagsgesellschaft, 1998, 1727 p.
4. Van Leeuwen A. M., Bladh M. L. Davis's Comprehensive Manual of Laboratory and Diagnostic Tests with Nursing Implications (Davis's Comprehensive Handbook of Laboratory & Diagnostic Tests With Nursing Implications): 8th Edition. Publisher: F. A. Davis Company, 2019. 1440 p.
5. Zalubovskaya O. I., Zlenko V. V., Litvinova O. N. et al. Drugs Influence of laboratory Indices. NFAU, Kharkiv, 2014. 100 p.

Clinical biochemistry

1. Basten Graham. Introduction to clinical biochemistry. Interpreting blood results. Publisher: Ventus Publishing ApS, 2011. 53 p.
2. Carl A. Burtis, David E. Bruns. Fundamentals of Clinical Chemistry. Publisher: Saunders Elsevier, 2008. 952 p.
3. Carl A. Burtis, David E. Bruns. Fundamentals of Clinical Chemistry and Molecular Diagnostics. Publisher: Elsevier Health Sciences, 2014. 1104 p.
4. Marshall William J., Lapsley Marta, Bangert S. K. Clinical chemistry. Publisher: Mosby Ltd., 2012. 378 p.

Basics of microbiology with immunology

1. Anthony Strelkauskas; Angela Edwards; Beatrix Fahnert; Greg Pryor; Jennifer Strelkauskas. Microbiology: a clinical approach. Publisher: Garland Science, 2015. 560 p.
2. Stevens Dorresteyn C. Clinical Immunology & Serology: A laboratory perspective. Publisher: F. A. David Company, 2017. 545 p.

EVALUATION CRITERIA

Each examination card contains 32 test tasks: 1-20 closed-type tests (one correct answer), 21-30 closed-type tests (more than one correct answer), 31-32 – open-type test tasks (task or structural-logical scheme).

For each closed-ended test task (one correct answer) the entrant receives:

- 4 points, if the answer is correct,
- 0 points if the selected incorrect answers or answers are not provided.

For each closed-ended test task (more than one correct answer – two correct answers) the entrant receives:

- 8 points, if the answer is complete, correct (2 correct answers are selected),
- 4 points, if only 1 correct answer is selected;
- 0 points if the selected incorrect answers or answers are not provided.

For open-ended test tasks, which include situational tasks or structural-logical schemes, the entrant receives:

- 20 points (maximum score) – the task is complete and correct; clearly and competently received the correct answer and explained the sequence of their actions;
- 17-19 points – the task is performed correctly, but inaccuracies are assumed, the irrational way of solving the task is chosen;
- 13-16 points – at least half of the task is completed, while no significant mistakes were made in writing the answer;
- 9-12 points – completed at least half of the task, with significant mistakes in obtaining results;
- 5-8 points – less than half of the task is completed, mistakes in the nomenclature and calculation formulas are revealed;
- 1-4 points – much less than half of the task is completed, with mistakes,
- 0 points – did not begin to make the task.

For 32 tasks the entrant can get a maximum of 200 points. For closed-ended tasks (one correct answer) 80 points ($20 \times 4 \text{ points} = 80$), for closed-ended tasks (more than one correct answer – two correct answers) 80 points ($10 \times 8 \text{ points} = 80$); for 2 open-ended test tasks – 40 points ($20 \text{ points} \times 2 = 40$).

Entrants who received 120 points or more according to the test results are allowed to participate in the competition.

The program is considered and approved at the meeting of the Admissions Committee
Protocol № 7 of April, 14, 2023.

**Chair of the Subject Commission,
professor**



Rymma YEROMENKO

**Executive secretary
of Admissions Committee,
associate professor**



Stanislav POGORELOV