VILNIAUS UNIVERSITETO MEDICINOS FAKULTETAS

FACULTY OF MEDICINE, VILNIUS UNIVERSITY

The Entrance Examination

General information

In 2027 the entrance examination will be conducted on the following dates:

January 21, 2027 14:00 (EET, UTC+2);
February 18, 2027 14:00 (EET, UTC+2);
March 18, 2027 14:00 (EET, UTC+2);
April 15, 2027 14:00 (EET, UTC+3);
Examination dates in May, June and July will be published later.

The examination will be conducted online, via Zoom platform. An applicant must register for an examination and choose the suitable date (Registration form: https://forms.office.com/e/47P1djban6). An applicant can take an examination **only once** per one application period.
Entrance examination fee: 200 EUR. IMPORTANT! Entrance examination fee must be paid at least **48h prior to the examination time and is not refundable**!
Please note that **the last possibility for non-EU citizens to take the entrance examination is in May!**

The duration of an examination is 60 minutes. The examination will consist of mixed-type questions: 20 test-type questions (single choice questions (SCQ)/multiple choice questions (MCQ)) evaluated by 1 point each, 20 short open-ended questions evaluated by 1 point each and 5 essay-type questions evaluated by 2 points each.

Important! The identity of the applicant will be confirmed prior to the exam. The answers to the essay-type questions will be checked with the plagiarism detection software.

Examination will be considered as passed if an applicant scores at least 60% (30 out of 50 points). Examination will be considered as failed if an applicant scores 59% or lower and the application of such applicant will be declined. If an applicant scores 80% or over (40 points and over) he/she will be accepted to the study programme (considering he/she successfully passes other admission steps). Applicants scoring between 60% and 80% percent (30-39 points) will be placed on the waiting list and accepted depending on the number of places remaining (considering he/she successfully passes other admission steps).

The following conditions must be guaranteed for taking the entrance examination:

- Proper computer capable of successfully running the required software
- Good internet connection
- Zoom platform
- Good lighting to make sure the applicant is well visible
- Silent space/room where an applicant could take an exam undisturbed
- Valid passport

Topics

CHEMISTRY
1. Masses of atoms and molecules. Amount of substance. Mole calculations. Chemical formulations and chemical equations. Balancing chemical equations. 2. Solutions and concentration. Preparation of solutions. Percentage and molar concentrations. 3. Common types of chemical reactions: synthesis, decomposition, combustion, single replacement (displacement), double replacement (displacement), neutralization and precipitation reactions. 4. The Periodic table: physical and chemical properties of main and transition group elements. 5. Structure of molecules. Intermolecular forces. Electronegativity. Bond polarity and molecular polarity. 6. Types of chemical bonding: ionic, covalent, metallic bonding. 7. States of matter: the gaseous, the liquid, and the solid-state. 8. Acids and bases. Reactions between acids and bases. 9. Redox reactions. General principle. Redox and electron transfer. Oxidation numbers. Balancing chemical equations by oxidation numbers. 10. Structure of organic molecules: alkanes, alkenes, alcohols, esters, and carboxylic acids; aldehydes and ketones. Amines and amides. Functional groups and common classes of organic compounds. Naming organic compounds. Bonding in organic molecules. 11. Polymerization. Polymers: natural and synthetic macromolecules.
BIOLOGICAL MOLECULES
1. Carbohydrates. Describe the structure and function of the following: – Monosaccharides: glucose, galactose, fructose, ribose, deoxyribose. – Disaccharides: maltose, saccharose, lactose. – Polysaccharides: starch, glycogen, cellulose, chitin.
2. Lipids. Describe the structure and function of the following: – Fats: saturated fat, unsaturated fat. – Phospholipids. – Steroids: cholesterol, vitamin D, steroid hormones.
3. Protein: – Describe the structure of amino acids. – Define polypeptides. Describe the formation of peptide bond. Describe four levels of protein structure. – Describe enzyme action mechanism. Explain how changes in pH and temperature affect enzyme structure and function.

- Describe the process of denaturation.

4. Nucleic acids:
   - Describe the structure of nucleotides.
   - Describe the structure and function of DNA.
   - Describe the structure and function of RNA.

CELLS

1. Prokaryotic cell:
   - Describe the structure and function of the following subcellular components: plasma membrane, cell wall, capsule, nucleoid, plasmid, ribosomes, fimbriae, flagella.

2. Eukaryotic cell:
   - Animal cell. Describe the structure and function of the following subcellular components: plasma membrane, nucleus, endoplasmic reticulum, ribosomes, Golgi apparatus, lysosome, mitochondrion, centrosome.
   - Plant cell. Describe the structure and function of the following subcellular components: plasma membrane, cell wall, nucleus, endoplasmic reticulum, ribosomes, Golgi apparatus, mitochondrion, chloroplast, central vacuole.

MOVEMENT ACROSS THE MEMBRANE

1. Membrane:
   - Describe the structure and function of cell membrane.
   - Explain main functions of membrane proteins.

2. Passive transport:
   - Define diffusion, facilitated diffusion.
   - Define osmosis. Explain isotonic, hypotonic, hypertonic solutions effect on animal and plant cells.

3. Active transport:
   - Explain active transport through membrane transport proteins.
   - Define exocytosis.
   - Define endocytosis.

THE CELL CYCLE

1. Cell cycle:
   - Describe phases of the cell cycle.
   - Describe the process of replication.

2. Mitosis:
   - Describe phases of mitosis.
   - Describe mitosis role in growth, repair and regeneration of tissues, reproduction.

3. Meiosis:
   - Describe phases of meiosis.
   - Describe meiosis role in sexual reproduction.

GENETICS

1. Autosomal inheritance:
   - Interpret and depict monohybrid and dihybrid crosses.
   - Interpret and depict family trees. Distinguish between autosomal recessive and dominant inheritance.

2. Sex linked inheritance:
   - Interpret and depict monohybrid and dihybrid crosses.
   - Interpret and depict family trees. Distinguish between X-linked dominant and X-linked recessive inheritance.

3. Mutations:
   - Define gene mutations.
   - Define mutations with abnormal chromosome number.
   - Distinguish between mutations with alterations of chromosome structure: deletion, duplication, inversion, translocation.
   - Distinguish between the types of small scale mutations: nucleotide-pair substitution, nucleotide-pair insertion or deletion.

4. Genetic code:
   - Define characteristics of the genetic code: universal, degenerate.
   - Interpret genetic code based on the codon table.

DIGESTIVE SYSTEM

1. Oral cavity, esophagus:
   - Describe the structure and function.
   - Describe the importance of salivary glands to digestion of food.
   - Describe the process of peristalsis.

2. Stomach:
   - Describe the structure and function.
   - Describe the function of pepsin.
   - Describe the importance of hydrochloric acid.

3. Small intestine:
   - Describe the structure and function
   - Describe the digestion of carbohydrates, protein and fat in the small intestine.
   - Describe the importance of pancreas and liver.
   - Describe absorption of nutrients.

4. Large intestine:
   - Describe the structure and function
   - Describe the importance of gut microbiome.

CARDIOVASCULAR SYSTEM

1. Heart:
   - Describe the structure and function of the atria, ventricles, main arteries and veins of the heart.
   - Describe the heart cycle.

2. Blood vessels:
   - Describe the structure of arteries, veins and capillaries.
   - Describe the functional difference between arteries and veins.
   - Describe blood flow in veins.
   - Describe the function of capillaries.
   - Explain how interstitial fluid forms

3. Circulation:

- Describe pulmonary circulation.
- Describe systemic circulation.
- Explain changes in blood pressure and blood flow velocity in relationship to type of blood vessels.
- Define systolic and diastolic blood pressure.

4. Lymphatic system:
   - Describe the function of lymphatic vessels in the tissues.
   - Describe how lymph forms.

5. Blood:
   - Describe the blood composition.
   - Describe the function of erythrocytes, thrombocytes, lymphocytes.
   - Explain how changes of erythrocyte, thrombocyte and lymphocyte levels would affect the organism.
   - ABO and Rh blood types

RESPIRATORY SYSTEM

1. Airways:
   - Describe the structure and function of larynx.
   - Describe the structure and function of trachea and bronchi.
   - Explain the difference in structure between trachea and bronchi.
   - Describe airway epithelium. Describe how it protects from potential pathogens.

2. Lungs:
   - Describe the structure of alveoli
   - Explain the process of gas exchange in the lungs.
   - Describe adaptations of the alveoli for more effective gas exchange.

3. Breathing:
   - Explain the mechanism of inspiration.
   - Explain the mechanism of expiration.

IMMUNE SYSTEM

- Describe how lymphocytes act in recognition of antigen and production of antibodies.
- Explain the difference between primary and secondary immune response.
- Explain the process of vaccination and formation of active immunity after vaccination.
- Explain why bacterial infections can be treated with antibiotics and viral cannot.
- Explain antibiotic resistance in bacteria based on natural selection.

EXCRETORY SYSTEM

1. Kidneys:
   - Describe the structure and function of nephron.
   - Explain how urine is formed: filtration, reabsorption, excretion.
   - Explain water reabsorption in the nephron.

2. Urinary tract:
   - Describe the structure and function of ureter, urinary bladder, urethra.

HOMEOSTASIS

1. Osmoregulation: – Describe the role of hypothalamus and pituitary gland in osmoregulation. – Describe the action mechanism of antidiuretic hormone (ADH). – Explain the changes in urine based on changes in blood osmolarity.
2. Blood glucose regulation: – Explain insulin effect on high blood glucose levels. – Explain glucagon effect on low blood glucose levels.
3. Thermoregulation: – Describe the structure of the skin. – Describe the role of hypothalamus in thermoregulation. – Describe how muscles, sweat glands, skin blood vessels respond to temperature changes
NERVOUS SYSTEM
1. Neurons: – Describe the structure and function of sensory, motor neurons and interneurons. – Describe the role of sodium and potassium ions in the generation of an action potential. – Describe signal transmission across a chemical synapse
2. Reflexes: – Define reflexes. Describe parts of the reflex loop. – Describe the difference between unconditioned and conditioned reflexes
3. Nervous systems: – Define peripheral and central nervous systems. – Describe functions of central nervous system: cerebrum, diencephalon, midbrain, pons, medulla oblongata, cerebellum, spinal cord.

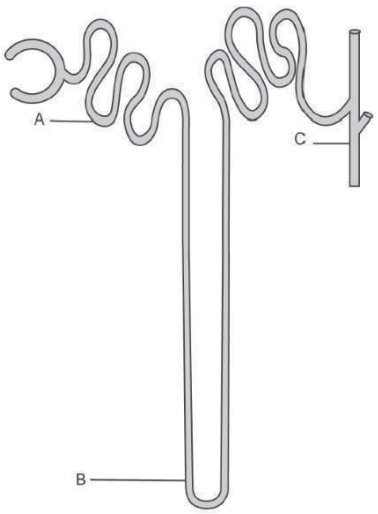
Recommended books

- Campbell Biology (Pearsons from 9th edition)
- Mary Jones, Richard Fosbery, Jennifer Gregory and Dennis Taylor. Cambridge International AS and A Level Biology (Cambridge from 4th edition)
- Introduction to general and organic biochemistry / Morris Hein, Susan Arena.

Example Questions for the Vilnius University Entrance Examination

Biology part:

The figure shows the structure of a nephron.



1. Which organ produces urea? (1 point)
   A. bladder
   B. kidney
   C. liver
   D. pancreas

2. What process takes place in the part of the nephron marked with the letter A? (1 point)
   A. Reabsorbtion
   B. Filtration
   C. Respiration
   D. Secretion

3. Name the structure marked with a letter B. (1 point)

4. Name one substance that is too large to pass through the filtration barrier of Bowman's capsule. (1 point)

5. Antidiuretic hormone (ADH) plays a crucial role in maintaining the body's homeostasis. Describe the effect of this hormone on the part of the nephron marked with the letter C and its overall impact on homeostasis. (2 points)

Chemistry part:

SCQ test question example:

1. Indicate the oxidation number of sulfur in H_2SO_3:
    a. +1
    b. +2
    c. -2
    d. +4
    e. -4
    f. +6

2. Which type of bond can be formed when the electronegativity difference between two or more atoms is between 0.4 and 1.6?

    a. nonpolar covalent bond
    b. ionic bond
    c. hydrogen bond
    d. polar covalent bond
    e. metallic bond

Open-ended question example:

Indicate the type of the reaction:
$Fe(s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu(s)$

According to IUPAC rules, what is the name of the molecule shown in the picture below?

