

APPROVED

Head of the Admissions Committee



I.S. Kozii

04 2024

**PROGRAM**  
**of the professional entrance examination**  
**for admission to study for the Master degree in the specialty**  
**183 "Environmental Protection Technologies"**

### 1 General provisions

The professional entrance examination in the specialty "Environmental Protection Technologies" for the Master's degree is conducted to assess the preparedness of applicants for obtaining a Master's degree in this specialty and their selection on a competitive basis.

The professional entrance examination includes the following sections: general ecology (and neo-ecology), environmental safety, basics of environmental protection technologies, basics of toxicology and regulation of anthropogenic load on the environment, methods of measuring environmental parameters, processes and devices of environmental technologies, environmental impact assessment, technoecology.

The professional entrance examination in the specialty 183 "Environmental Protection Technologies" is conducted in writing in a test form. The ticket structure includes 30 questions of 2 levels of difficulty. Written work is performed on specially prepared (stamped) forms - answer sheets. During the exam, the applicant must write down the answers to the test tasks in the answer sheet (Appendix A). The time allotted for the test is 80 minutes.

### 2 Typical questions from the sections covered in the exam

**General ecology (and neo-ecology):** Subject, objectives, basic concepts of ecology. Biosphere – a planetary ecosystem. Dynamics of ecosystems. Classification of environmental factors. Trophic structure of ecosystems. Populations, their existence. Forecasting in ecology. Anthropogenic impacts on the atmosphere. Pollution of water bodies. Environmental quality and its assessment

**Environmental safety:** The most important global problems of mankind, causes, and solutions. Environmental indicators characterizing the state of the geosystem. Classification of environmental situations, scheme of formation, factors taken into account in the assessment of environmental situations. Types of anthropogenic environmental pollution. Nature of occurrence, impact on the environment and humans. The role of economic sectors in the emergence of environmental problems. Environmental consequences of military operations. Environmental emergencies. The relationship between danger and security. Methodology of risk analysis and assessment. Environmental situations: types, general scheme of formation. Measures to prevent and overcome environmental emergencies.

**Fundamentals of environmental protection technologies:** Alternative energy sources. Biotechnology - the standard of waste-free production. Geotechnology. Purification of industrial emissions from acidic impurities ( $\text{CO}_2$ ,  $\text{H}_2\text{S}$ ,  $\text{SO}_2$ ,  $\text{NO}_x$ ). Methods and devices for cleaning gas emissions from solid particles. Environmental impacts of industries and methods of protection: oil and gas industry, transportation, chemical industry, energy. Mechanical methods of wastewater treatment (filtration, sedimentation). Methods of intensification of settling processes (coagulation, flocculation). Wastewater treatment by flotation and electroflotation. Electrochemical methods of wastewater treatment.

**Fundamentals of toxicology and regulation of anthropogenic load on the environment:** Main pollutants, consequences of their action. Assessment of environmental pollution hazard to human health. Parameters of xenobiotic hazard assessment. Criteria for determining the harmfulness of an ecotoxicant. Assessment of the degree of ecotoxicity. Ecotoxicokinetic and ecotoxicodynamic properties of the main groups of environmental pollutants. Normalization of anthropogenic load on the atmospheric air, hydrosphere. Dispersion of pollutants in the air. Maximum permissible concentration (MPC) of pollutants. General provisions of the permitting system in the field of waste management. Regulation of soil and food contamination.

**Methods of measuring environmental parameters:** Fundamentals of environmental metrology. Means of measuring equipment. Methods of preparation of calibration solutions. The law of light absorption, the law of emission, radiation sources, methods of obtaining atomic vapor: flame, "cold vapor". Characteristic mass, characteristic concentration. Ilkovich equation, half-wave potential. Atomic absorption spectrophotometers, flame liquid analyzers, photoelectrocolorimeters, polarographs, chromatographs, ionometers and pH meters, gas analyzers. Methods of concentration calculation. Methods for sampling precipitation, air, surface and groundwater, and soil. Quality control of drinking, natural and waste water, agricultural soils, food and feed, and atmospheric air.

**Environmental impact assessment:** Environmental impact assessment procedure. Timing and stages of the impact assessment procedure. Strategic environmental assessment. Methods for assessing the impact on ecosystem components (atmosphere, water resources, geological environment, soils, nature reserves).

**Processes and devices of environmental technologies:** Fundamentals of applied hydraulics. Separation of heterogeneous systems. Heat exchange processes. Evaporation and condensation. Mass transfer processes. Absorption. Adsorption. Ion exchange. Extraction. Membrane separation.

**Technoecology:** Environmental consequences of biosphere pollution. Geotechnology. Environmental impacts of industries and methods of protection: oil and gas industry, transportation, chemical industry, electricity, metallurgy and machine-building, construction materials, forestry, woodworking and pulp and paper industry, light industry, housing and utilities. Low-waste and zero-waste production.

### 3 Structure of examination tasks

Each version of the task contains 20 questions of the first level of difficulty and 10 questions of the second level of difficulty. The questions include topics on the sections specified in paragraph 2. The number of answer choices is 4. There is one correct answer. The correct answer must be marked in the answer sheet (Appendix A). Corrections should be avoided, as their number affects the overall grade.

A sample of the examination task is given in Appendix B.

#### 4 Criteria for evaluating answers

The Commission evaluates the applicant's written answers to the test tasks on a 100-200-point scale. Applicants who score less than 100 points receive an unsatisfactory grade and are not allowed to participate in the competitive selection process. Applicants with 100 or more points are allowed to participate in the competitive selection.

To obtain a positive score in the professional exam, an applicant must pass the minimum test threshold of 30% of the total number of test points.

Test points are awarded for each correct answer to a task, and 0 points are awarded for an incorrect answer. The obtained test scores for the professional exam are converted to a 100-200 point scale (rounded to the nearest whole, according to the rules of mathematical rounding) according to the following algorithm:

$$O = O_{\min} + k \cdot (N - r \cdot T), \text{ where}$$

- $O$  – score from a professional entrance examination on a scale of 100-200 points;  
 $O_{\min}$  – minimum score from the professional entrance examination on a scale of 100-200 points, at which the applicant is allowed to participate in the competitive selection;  
 $k$  – the coefficient of conversion of test scores to a scale of 100-200 points, where:

$$k = 100 / (T \cdot (1 - r))$$

- $r$  – minimum permissible test threshold with an accuracy of 0.01, which is set in the range from 0 to 1, but not less than 0.10;  
 $T$  – the total number of test points that an applicant can receive during a professional entrance examination;  
 $N$  – the number of test points that the applicant received during the professional exam.

Provided that if the number of test scores received by the applicant during the professional exam ( $N$ ) is "0", the applicant receives an unsatisfactory grade and is not allowed to further participate in the competitive selection.

#### Calculating test points

Each correct answer to a Level 1 test question is worth 3 points. Each correct answer to a Level 2 test question is worth 4 points. An incorrect answer is worth 0 points.

The total number of test points ( $T$ ) that an applicant can receive during the professional exam is 100 test points.

The number of test points for the professional exam ( $N$ ) is calculated as the sum of test scores excluding test scores taken off for corrections in the answer sheet (if provided by the program).

#### Corrections policy

For each correction, 1 test point is deducted from the total number of test points ( $T$ ) that an applicant can receive at the professional exam.

## 5 References

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Approved at the meeting of the Admissions Committee.

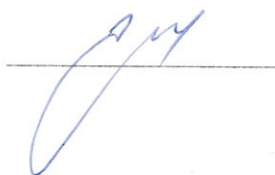
Protocol № 11 dated 08 квітня 2024.

Responsible Secretary  
of the Admissions Committee



Ihor ROY

Head of the Professional Attestation  
Committee



Artem YEVTUKHOV

APPENDIX A  
SUMY STATE UNIVERSITY

Code \_\_\_\_\_

**ANSWER SHEET**  
of the professional entrance examination  
for admission to study for the Master degree in the specialty  
183 “Environmental Protection Technologies”

Variant № \_\_\_\_\_

**Level 1**

№ question	A	B	C	D	№ question	A	B	C	D	№ question	A	B	C	D
1.1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.15	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.16	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.17	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.11	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.18	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.12	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.19	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.13	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.20	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1.14	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					

**Level 2**

№ question	A	B	C	D	№ question	A	B	C	D	№ question	A	B	C	D
2.1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2.5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2.8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2.6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2.9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2.7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	2.10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>										

ATTENTION!!! The tasks have several answers, among which only one is correct. Choose the correct option in your opinion and mark it as shown in the sample. The number of corrections affects the overall evaluation of the work!

A	B	C	D
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Number of correct answers of the level 1 - \_\_\_\_\_: Number of points for them - \_\_\_\_\_:

Number of correct answers of the level 2 - \_\_\_\_\_: Number of points for them - \_\_\_\_\_:

Number of corrections - \_\_\_\_\_: Points deducted for corrections - \_\_\_\_\_:

Total points

including deductions \_\_\_\_\_: **Score** - \_\_\_\_\_  
(by number and spelling)

Head of Committee

\_\_\_\_\_  
(signature)

\_\_\_\_\_  
(last name, initials)

Members of Committee

\_\_\_\_\_  
(signature)

\_\_\_\_\_  
(last name, initials)

\_\_\_\_\_  
(signature)

\_\_\_\_\_  
(last name, initials)

APPENDIX B

An example of an examination task

SUMY STATE UNIVERSIT

APPROVED

Head of the Admissions Committee

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..... 20.....

**EXAMINATION TASK**  
**of the professional entrance examination**  
**for admission to study for the Master degree in the specialty**  
**183 “Environmental Protection Technologies”**

Variant № .....

**Level I**

I.1 Physical methods of investigation are not:

- A. chromatographic
- B. optical
- C. luminescent
- D. radiometric analysis

I.2 Strategic environmental assessment differs from environmental impact assessment:

- A. objects to be assessed
- B. absence of public consultation procedures
- C. determination of transboundary impacts
- D. the absence of a report preparation stage

I.3 Succession is:

- A. stressful, catastrophic changes in an ecosystem that lead to its destruction
- B. long-term, gradual restructuring of ecosystems in the process of self-regulation
- C. maintaining a dynamic equilibrium in the ecosystem
- D. achieving the maximum capacity of the natural environment

I.4 Which method is not used for bacteriological analysis:

- A. chromatographic
- B. membrane
- C. luminescent
- D. gravimetric

I.5 The yield of liquid products of waste rubber pyrolysis is the highest at the temperature, °C:

- A. 450-550
- B. 500-600
- C. 700-800
- D. 800-900



1.6 The sediments that make up a river bed are:

- A. alluvium
- B. alluvium
- C. kolluvium
- D. cone of deposition

1.7 Large reinforced concrete tanks in which wastewater mixed with activated sludge is oxygenated by blowing air through them are called ...

- A. aeration tanks
- B. digesters
- C. sand traps
- D. settling tanks

1.8 The main measures used to protect surface waters from pollution include:

- A. creation of water protection zones
- B. cleaning of gas and dust emissions
- C. refusal from water consumption
- D. wastewater treatment

1.9 Electrostatic precipitators are the best at cleaning

- A. coarse dust
- B. high-resistance dust
- C. fine dust
- D. medium resistivity dust

1.10 A part of the ocean/sea that cuts deeply into the land:

- A. tributary
- B. gulf
- C. cape
- D. shoreline

1.11 Organisms that break down organic compounds into minerals are called:

- A. consumptives
- B. secondary consumers
- C. reducers
- D. producers

1.12 The surface area of a heat exchanger is found from Equation of:

- A. heat conduction
- B. heat balance
- C. material balance
- D. heat transfer

1.13 The maximum value of biomass is characteristic of:

- A. mixed forests
- B. forest-steppe
- C. steppe
- D. tropical rainforest

1.14 Give an example of an indirect impact of a planned activity on vegetation cover:

- A. deforestation
- B. farming areas covered with vegetation
- C. change in the water table
- D. afforestation of the territory

1.15 The light industry (knitting, fur, leather, etc.) is the most polluting:

- A. the air basin
- B. water environment
- C. soil
- D. groundwater

1.16 Technological risk depends on:

- A. the number of deaths
- B. the number of accidents
- C. the number of protected areas at risk
- D. the total number of weeks in a year

1.17 Background concentration is the concentration of impurities:

- A. at a certain time in a certain area
- B. is equal to the clarke
- C. corresponds to the data of the sanitary protection zone
- D. is equal to the MPC

1.18 Environmental security is a problem:

- A. global
- B. state problem
- C. regional
- D. local

1.19 The source of hydrogen sulfide in aquatic ecosystems, such as the Black Sea, is:

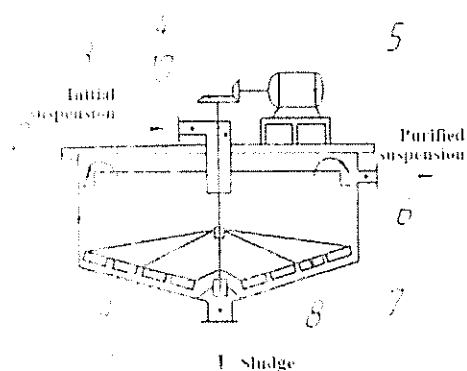
- A. excess sulfur-containing fertilizers in soils
- B. acid rain
- C. activity of sulfate-reducing bacteria
- D. industrial runoff from land

1.20 For purification from gas impurities ( $\text{SO}_2$ ,  $\text{NO}_x$ ,  $\text{CO}$ , etc.) use:

- A. fiber and ceramic filters
- B. adsorbers and absorbers
- C. electrostatic precipitators and mist eliminators
- D. recuperators and splash traps

## Level 2

2.1 Which device is shown in the figure??



- A. Filter
- B. Sump
- C. Separator
- D. Cyclone

2.2 The full refined model of the range of pollutant propagation in the surface air layer in the area of emissions to the atmosphere from a point stationary source, depending on the factors of influence, is calculated by the formula:

A.  $L = (H \cdot F \cdot T \cdot P) = 30 \cdot H \cdot (5 - F) \cdot (1 + \Delta T / 75) \cdot P_i / P_o$ ,

where H – height of the emission source

F – coefficient of the rate of substance settling in the air

ΔT – characterization of the emission temperature in relation to atmospheric air

P<sub>i</sub> – wind recurrence in the i-th direction

P<sub>o</sub> – wind repeatability at a circular wind angle

B.  $L = T(H, \Delta T, P)$ ,

where H – height of the emission source

ΔT – characterization of the emission temperature in relation to atmospheric air

P – repeatability of wind in a given direction

C.  $L(H, F) = 30 \cdot (5 - F) \cdot H$ ,

where H – height of the emission source

F – coefficient of the rate of substance settling in the air

D.  $L(H, \Delta T) = 30 \cdot H \cdot (5 - F) \cdot (1 + \Delta T / 75)$ ,

where H – height of the emission source

F – coefficient of the rate of substance settling in the air

ΔT – characterization of the emission temperature in relation to atmospheric air

2.3 The efficiency of removal of any contaminant by the equipment in use is evaluated as ...

A. the ratio of the concentrations of the substance at the inlet and outlet of the apparatus

B. the ratio of the temperatures of the substance at the inlet and outlet of the apparatus

C. the ratio of the cross-sectional area at the inlet and outlet of the apparatus

D. ratio of velocity at the inlet and outlet of the apparatus

2.4 Assess the sanitary condition of the water reservoir in terms of the summation effect if the water contains nitrates of 8 mg/L (MPC = 10 mg/L) and toluene of 0.41 mg/L (MPC = 0.5 mg/L). The effect of the total action of these substances is as follows:

A. 1.12

B. 1.6

C. 1.74

D. 1.32

2.5 Determine the complex pollution index of the atmosphere formed by substances present simultaneously in the atmosphere with the following concentrations: inorganic dust 0.4 mg/m<sup>3</sup> (MPC = 0.05 mg/m<sup>3</sup>), carbon monoxide 6 mg/m<sup>3</sup> (MPC = 3 mg/m<sup>3</sup>), sulfur dioxide 0.1 mg/m<sup>3</sup> (MPC = 0.05 mg/m<sup>3</sup>), formaldehyde 0.002 mg/m<sup>3</sup> (MPC = 0.003 mg/m<sup>3</sup>). The constant for reducing the degree of harmfulness of a substance to the harmfulness of sulfur dioxide is: inorganic dust, sulfur dioxide - 1, carbon monoxide - 0.9, formaldehyde - 1.3. Round the answer to the nearest tenth.

A. 12.5

B. 2.9

C. 5.4

D. 8.7

2.6 The main methods of CO<sub>2</sub> removal from waste gases are:

A. absorption with water, interaction with an aqueous solution of monoethanolamine, adsorption with solid absorbers

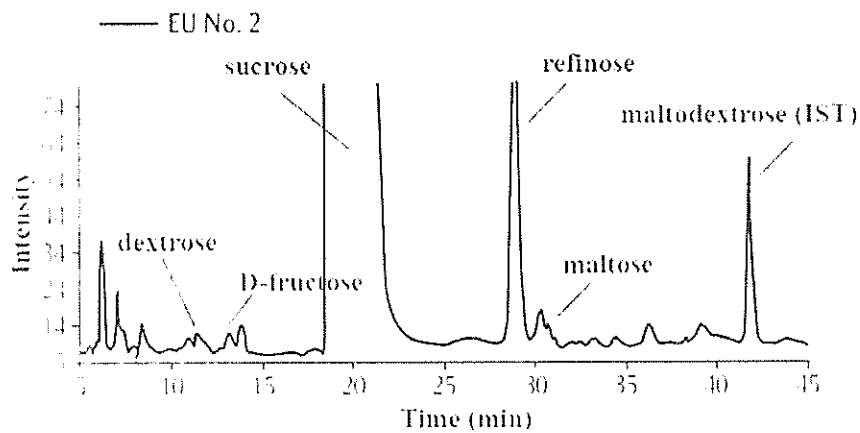
B. absorption with an aqueous solution of alkali, absorption with water, interaction with an aqueous solution of monoethanolamine, adsorption with solid absorbers

- C. absorption by aqueous hydrochloric acid solution, interaction with an aqueous solution of monoethanolamine, adsorption by solid absorbents
- D. absorption by an aqueous solution of alkali, absorption by water, interaction with an aqueous solution of alcohol, adsorption by solid absorbers

2.7 State the disadvantage of organizing the process in thermophilic digesters:

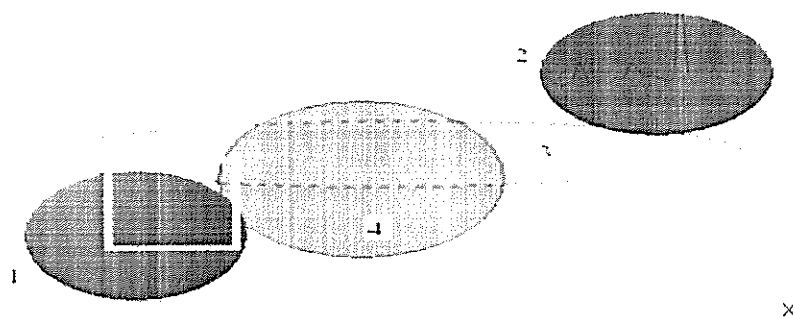
- A. low methane yield
- B. increased costs for aeration
- C. low stability of work in this mode
- D. the process is very slow

2.8 The figure shows the results of:



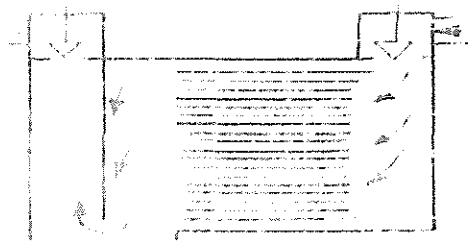
- A. chromatography
- B. colorimetry
- C. spectrophotometry
- D. chemical analytical determination

2.9 In the coordinate space of two axes (X-axis - temperature in the range from 0 to 40°C, Y-axis - humidity in the range from 20 to 100%), round or oval shapes are constructed, which are graphical models of ecological niches of four species (1, 2, 3, and 4). Analyze the figure and select the correct statement from the answers.



- A. species 1 can withstand the greatest range of humidity, so it is a eurythermal species
- B. species 3 can withstand the greatest range of temperature changes, so it is a eurythermal species
- C. species 3 and 4 can withstand a small variation in temperature but have a wide range of humidity, so they are both eurythermal species
- D. none of the species in the figure are eurythermal

2.10 The figure shows the device...



- A. wet gas purification
- B. for gas purification by filtration
- C. electric gas purification
- D. dry gas purification

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Committee

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