Assessment tools for midterm assessment

Physics, Mathematics

Curriculum	31.05.01
Specialty	General Medicine
Form of education	Full-time
Designer Department	Experimental Physics
Graduate Department	Internal Diseases

Sample tests (Term 1)

Section1

Sample math test questions

TASK	ANSWERS
1. Given points A(0, –2, 3); B(2, 4, –1). Find the distance between them.	1) 7; 2) $2\sqrt{2}$; 3) 12; 4) $2\sqrt{14}$; 5) 8.
2. Find out at what value of α the vectors are orthogonal: $\vec{a} = (-2, 3, \alpha)$; $\vec{в} = (4, -6, -8)$.	1) $3\frac{1}{4}$; 2) –2; 3) 0; 4) –4; 5) 1.
3. Calculate the dot product of vectors $\vec{a} = (-1,\ 0,\ 3)$; $\vec{в} = (2,\ 1,\ -2)$.	1) 6; 2) $\sqrt{35}$; 3) $2\sqrt{14}$; 4) 3; 5) –8.
4. Calculate the length of the vector $\overrightarrow{AB}$, if $A(-1, 0, 2)$, $B(2, 3, 1)$.	1) $\sqrt{19}$; 2) 4; 3) $2\sqrt{10}$; 4) 11; 5) 8.
5. Calculate $\lim\limits_{n\to\infty} \dfrac{4n^2 + 5n - 1}{3n^3 - 5n}$.	1) 0; 2) $\dfrac{4}{3}$; 3) –1; 4) ∞; 5) $-\dfrac{1}{3}$.
6. Calculate $\lim\limits_{x\to 2} \dfrac{\sqrt{x^2 - 4}}{\sqrt{4x - 4} - 2}$.	1) ∞; 2) 1; 3) $-\dfrac{1}{2}$; 4) 2; 5) 0.
7. Calculate $\lim\limits_{x\to 1} \dfrac{\sin(x-1)}{x^2 - 1}$.	1) 0; 2) $\dfrac{1}{3}$; 3) 1; 4) ∞; 5) $\dfrac{1}{2}$.
8. Determine the abscissa of the point (for x> 0) at which the tangent to the graph of the function $y = x^3 - 12x$ is parallel to the Ox axis.	1) $2\sqrt{3}$; 2) 0; 3) 2; 4) 6; 5) 12.
9. Calculate $y'(0)$, if $y = \dfrac{x-2}{x+2}$.	1) $\dfrac{1}{4}$; 2) 1; 3) 0; 4) 4; 5) $-\dfrac{1}{4}$.
10. Determine the minimum point of the function $y = \dfrac{x^4}{4} - 2x^3 + \dfrac{11}{2}$.	1) 0; 2) $\dfrac{11}{2}$; 3) 1; 4) $-\dfrac{11}{2}$; 5) 6.

11. Calculate $y^{(3)}(2)$, if $y = \ln(4x - 4)$.	1) ln4; 2) 2; 3) $-\dfrac{1}{4}$; 4) –6; 5) 0.
12. Calculate $\dfrac{\partial^3 u(-1,\ 1)}{\partial x\, \partial y^2}$, if $u = y^3 + y^2 \ln(2x + 3)$.	1) 2; 2) $\dfrac{1}{4}$; 3) $\dfrac{9}{4}$; 4) 6; 5) 4.
13. Calculate $\displaystyle\int \dfrac{dx}{x^2 + 4x + 20}$.	1) $arctg(x+2) + C$; 2) $\ln(x^2 + 2)$; 3) $\dfrac{1}{4(x+2)^2} + C$; 4) $\dfrac{1}{4} arctg\left(\dfrac{x+2}{4}\right) + C$; 5) $\dfrac{1}{16} arctg\left(\dfrac{x+2}{16}\right) + C$.
14. Solve the Cauchy problem $y \ln y\, dx + x\, dy = 0$, if $y(1) = 1$.	1) $y = 1$; 2) $y = x$; 3) $y = e$; 4) $y = \dfrac{1}{x}$; 5) $y = e - 1$.
15. Solve the Cauchy problem $y^2 dx + (x+1) dy = 0$, if $y(0) = -1$.	1) $y^2 = \ln(x+1)$; 2) $y^{-1} = \ln\left\lvert\dfrac{x+1}{e}\right\rvert$; 3) $y = -\ln(x+1)$; 4) $y = \ln(x+1) + 1$; 5) $y^2 = \dfrac{x+1}{e}$.

Questions:

1. What is the dot product of two vectors?
2. What is the cross product of two vectors?
3. What is the derivative of a function?
4. What is the integral of a function?
5. What is the height of the body falling at an angle to the horizon?
6. What is tangential acceleration?
7. Write down the Maxwell velocity distribution.
8. Formulate the Fourier's law.
9. Give the definition of electric potential.
10. How is the magnetic field distributed inside and outside the solenoid?
11. What is the source of electromagnetic waves?
12. What is Brewster's angle and how do I find it?
13. Formulate Einstein's Law for the Photo Effect.
14. Formulate the law of radioactive decay.

List of physics laboratory research

Laboratory research №1: Measurements and Error Analysis
1) How to measure with a caliper?
2) What are the direct and indirect measurements?
3) How to estimate the errors of the direct and indirect measurements?
4) What is confidence probability and confidence interval?

5) How to record final results?
6) Derive a formula for calculating the absolute and relative errors in the cylinder volume.

Laboratory research №2: Measurement of free fall acceleration using simple gravity pendulum
1) What is free fall acceleration?
2) What is simple gravity pendulum?
3) What is the amplitude and period of oscillations?
4) How does the period of oscillations of a pendulum depend on the free fall acceleration?
5) How free fall acceleration is measured in this experiment?
6) How to calculate the slope of the line of best fit for a data set of points on a graph?

Laboratory research №3: Measurement of fluid viscosity by ball drop
1) What is viscosity? What is the mechanism of viscosity of a liquid?
2) Write the equation of motion of the falling ball in a tube filled with viscous liquid.
3) What is the difference between laminar and turbulent flow?
4) How does the viscosity of a liquid depend on temperature?
5) What is the physical meaning of the dynamic viscosity coefficient?
6) What forces act on the ball falling in the liquid?
7) How can the friction forces between moving layers of liquids be calculated using Newton's law? What is the direction of this force? On what does this force depend?
8) Why is viscosity measurement using Stokes' law only valid for a low velocity of the ball?
9) How viscosity is measured in this lab?

Laboratory research №4: Ohm's Law
1) What does the Ohm's law states?
2) Write a mathematical equation describing the relationship between electric current, voltage, and resistance for a conductor.
3) What is electric current, voltage and electric resistance?
4) What determines the electrical resistance of a conductor?
5) What is conductance and conductivity?

Laboratory research №5: Polarization of light
1) What is the nature of light?
2) What is polarized light? What is unpolarized light?
3) What are the different types of polarization?
4) What are the ways of obtaining polarized light?
5) What is polarizer, analyzer?
6) Derive the Malus's law equation.
7) What is the Brewster's law?
8) What substances are called optically active?
9) What is the equation for the rotation of the optically active solutions and crystalline substances?
10) What is the physical meaning of specific rotation? Give a definition, write a dimension.

Section 2: Credit (Term 1)

Tasks for the credit include one theoretical question and a math problem.

Tasks for competence assessment «Knowledge»	Task type
List of topics: 1) Position and Displacement. Average Velocity and Instantaneous	theoretical

Velocity. Average Acceleration and Instantaneous Acceleration. Uniform Circular Motion.

2) Newton's First Law. Newton's Second Law. Newton's Third Law.

3) Kinetic Energy. Work. Conservative and Non-conservative Forces. Work and Potential Energy.

4) Conservation of Mechanical Energy.

5) Temperature. The Zeroth Law of Thermodynamics. Measuring Temperature.

6) Temperature and Heat. The Absorption of Heat by Solids and Liquids. Heats of Transformation.

7) Heat and Work. The First Law of Thermodynamics. Special Cases of the First Law of Thermodynamics

8) Heat Transfer Mechanisms. Conduction. Convection. Radiation.

9) The Electric Field. Electric Field Lines. The Electric Field Due to a Point Charge. A Point Charge in an Electric Field.

10) Electric Potential Energy. Electric Potential. Calculating the Potential from the Field. Potential Due to a Point Charge. Calculating the Field from the Potential.

11) Capacitance. Calculating the Capacitance. A Parallel-Plate Capacitor. A Cylindrical Capacitor. A Spherical Capacitor. Capacitors in Parallel and in Series.

12) Magnetic Field. The Definition of $\boldsymbol{B}$. Finding the Magnetic Force on a Particle. Magnetic Force on a Current-Carrying Wire.

13) Calculating the Magnetic Field Due to a Current. Magnetic Field Due to a Current in a Long Straight Wire.

14) Faraday's Law of Induction. Lenz's Law. Self-Induction.

15) Light as a Wave. The Law of Refraction. Wavelength and Index of Refraction.

16) Coherence. Intensity in Double-Slit Interference. Interference from Thin Films.

17) Diffraction and the Wave Theory of Light. Diffraction by a Single Slit. Diffraction by a Circular Aperture. Resolvability.

18) Polarized Light. Intensity of Transmitted Polarized Light.

19) Nucleus. Nuclear Terminology. Organizing the Nuclides. Atomic

Masses. Nuclear Binding Energies. Nuclear Energy Levels. The Nuclear Force.	
20) Radioactive Decay. Alpha Decay. Beta Decay.	
21) Measuring Radiation Dosage	

Tasks for competence assessment «Abilities»	Task type - practical

List of math problems:

Variant №	Calculate Limit	Calculate Partial Derivatives respect to x and y	Calculate Integral	Calculate Integral by Parts	Solve Differential Equation
1	$\lim\limits_{x\to\infty} \dfrac{x^2+3x-3}{x-1}$	$z = arccos\sqrt{\dfrac{x}{y}}$	$\int (5-2x)^6 dx$	$\int xe^x dx$	$3(x^2y+y)dy + \sqrt{2+y^2}dx = 0$
2	$\lim\limits_{x\to\infty} \dfrac{2x}{3x^2-x-1}$	$z = cos\dfrac{2x}{y^2}$	$\int x^3(1-2x^4)^2 dx$	$\int x^2 e^x dx$	$\sqrt{3+y^2} + \sqrt{1-x^2}yy' = 0$
3	$\lim\limits_{x\to0} \dfrac{x^2+3x}{2x^2-x}$	$z = \dfrac{sin2x}{cosy^2}$	$\int \dfrac{dx}{3-5x}$	$\int xe^{2x} dx$	$y(1+lny) + xy' = 0$
4	$\lim\limits_{x\to1} \dfrac{x^2-2x+1}{2x^2-x-1}$	$z = ln(x^2+y^2+2x+1)$	$\int \dfrac{x}{5-3x^2}dx$	$\int x^3 e^{2x-1} dx$	$\sqrt{1-x^2}y' + xy^2 + x = 0$
5	$\lim\limits_{x\to2} \dfrac{x^2-3x+2}{2x^2-x+6}$	$z = xe^{xy}$	$\int \dfrac{x}{(x^2-1)^3}dx$	$\int x\cdot sin(x+2)dx$	$ylny + xy' = 0$
6	$\lim\limits_{x\to3} \dfrac{x^2+3x-18}{2x^2-x+15}$	$z = xsiny + ycosx$	$\int \dfrac{3x-1}{x^2+96}dx$	$\int x\cdot sin(2x)dx$	$\sqrt{5+y^2} + y'y\sqrt{1-x^2} = 0$
7	$\lim\limits_{x\to0} \dfrac{sin5x}{x}$	$z = ln(e^x+e^y)$	$\int \dfrac{dx}{x^2+x+1}$	$\int x^2\cdot sin(2x-1)dx$	$\sqrt{4-x^2}y' + xy^2 + x = 0$
8	$\lim\limits_{x\to0} \dfrac{sin3x}{sin2x}$	$z = sin(x+7y)$	$\int \dfrac{2x+3}{x^2+3x+5}dx$	$\int x\cdot cos(x)dx$	$y'y\sqrt{(1-x^2)/(1-y^2)} + 1 = 0$
9	$\lim\limits_{x\to0} \dfrac{cos2x}{sin2x}$	$z = tg\dfrac{x}{y}$	$\int \dfrac{6x^2-6x+1}{2x^3+3x^2+x-2}dx$	$\int x^2\cdot cos(2x-1)dx$	$\sqrt{3+y^2}dx - ydy = x^2ydy$

10	$\lim\limits_{x\to 0}\dfrac{tg5x}{sin2x}$	$z = arccos\sqrt{2\dfrac{x}{y}}$	$\displaystyle\int \dfrac{x^2}{5+x^6}dx$	$\displaystyle\int x^2 \cdot ln(x)dx$	$x\sqrt{1+y^2} + yy'\sqrt{1+x^2} = 0$
11	$\lim\limits_{x\to\infty}\dfrac{x^2+3x-3}{2x^2-x-1}$	$z = tgxy$	$\displaystyle\int \dfrac{x}{2x^4+5}dx$	$\displaystyle\int (x^4+3x^3)\cdot ln(x)dx$	$20xdx - 3ydy = 3x^{2ydy} - 5xy^2dx$
12	$\lim\limits_{x\to\infty}\dfrac{x^2+x-1}{2x^2+5x+3}$	$z = xy - 2x^y$	$\displaystyle\int \dfrac{x}{2x^4+5}dx$	$\displaystyle\int sin(2x)\cdot e^x dx$	$2x + 2xy^2 + \sqrt{2-x^2}y' = 0$
13	$\lim\limits_{x\to\infty}\dfrac{x^4+3x^3-3}{2x^2-x-1}$	$z = y^2 tgx$	$\displaystyle\int \dfrac{dx}{(2x-1)^{3/2}}dx$	$\displaystyle\int sin(x)\cdot e^{2x} dx$	$2xdx - ydy = yx^2dy - xy^2dx$
14	$\lim\limits_{x\to 1}\dfrac{x-1}{1-\sqrt{x}}$	$z = x^2(2y+1)^3 + \dfrac{x^3}{y}$	$\displaystyle\int \dfrac{x}{\sqrt{2-7x}}dx$	$\displaystyle\int cos(2x)\cdot e^x dx$	$(1+e^x)yy' = e^x$
15	$\lim\limits_{x\to 0}\dfrac{2\sqrt{x}-3x}{3\sqrt{x}-2x}$	$z = e^{(y+2x)}cosx$	$\displaystyle\int \sqrt{3x+1}dx$	$\displaystyle\int cos(2x)\cdot e^{3x-1} dx$	$\sqrt{5+y^2}dx + 4(x^2y+y)dy = 0$
16	$\lim\limits_{x\to 1}\dfrac{\sqrt{x+3}-2}{x-1}$	$z = \dfrac{x}{y} + \dfrac{(x^2+1)^2}{y^2}$	$\displaystyle\int x\sqrt{x^2-1}dx$	$\displaystyle\int cos(x)\cdot ln(sin(x))dx$	$yy' = \dfrac{e^x}{1+e^x}$
17	$\lim\limits_{x\to 0}\dfrac{x}{\sqrt[3]{x+1}-1}$	$z = e^{x^2-2y+3}$	$\displaystyle\int \sqrt[3]{x^3-3x^2}dx$	$\displaystyle\int sin(x)\cdot ln(cos(x))dx$	$xdx - ydy = yx^2dy - xy^2dx$

Methodological guidelines for assessment

Section 1

Formative assessment is a regular checking of student academic progress during the academic term. It is performed in various oral and written forms (quizzes, essays, checking of home assignments, compilation of cases, self-study, colloquiums, and testing). During formative assessment, the teacher monitors the level of student's academic progress according to the curriculum identifying lack of knowledge, or misunderstanding.

The tasks of formative assessment are aligned with the Curriculum and Syllabus.

1. Guidelines for math problems assessment

Math test consists of fifteen test tasks on topics: vectors, limits, derivatives, integrals, differential equations. One point is given for each correct answer. Each of the lab reports are assessed in a scale: "excellent", "good", "satisfactory", "unsatisfactory".

Task type	Competence	Assessment criteria	Grade
Test	GPC-1: ability to abstract thinking, analysis, synthesis	14-15 points	Excellent
		10-13 points	Good
		5-9 points	Satisfactory
		L	Unsatisfactory

2. Guidelines for lab reports assessment

By the end of the course the learner should have done 5 lab reports. Each of the lab reports are assessed in a scale: "excellent", "good", "satisfactory", "unsatisfactory".

Task type	Competence	Assessment criteria	Grade
Physics Lab reports	GPC-7: readiness to use basic physicochemical, mathematical and other natural science concepts and methods in solving professional problems	• Summary allows the reader to understand the basics of the laboratory by reading a few sentences. • Report has clear verbal explanations accompanying all appropriate graphs, equations, and/or quantities. • The report's conclusions section clearly communicated the main physics principles and ideas that were used and discovered in the laboratory. • The report should make use of appropriately constructed graphs whenever needed in order to explain results. The student demonstrates a consistent and thorough understanding of the required knowledge, concepts, skills of the material learned, and their significance for future profession.	Excellent
		• Report is missing one of the requirements. a) Does not contain a	Good

		brief statement about the experimental procedure. b) Does not contain a brief statement about the results. c) Does not contain a brief statement about the conclusions. • The procedure used in the experiment is described but incomplete. • Report contains appropriate graphs, equations, and/or quantities with confusing or incomplete explanations. • Report does contain conclusions section, but the main physics principles are not clearly stated or they are poorly developed.	
		• Report does not contain a summary. • The procedure used in the experiment is described but is difficult to understand and would be hard to reproduce. • Report does not contain appropriate graphs, equations, and/or quantities. • Report does not contain a conclusions section. • Some important data that should have been represented in graphical form have not been included.	Satisfactory
		• No lab report submitted.	Unsatisfactory

Section 2: midterm assessment (exam)

Methodological guidelines for exam

Midterm assessment is carried out in the form of exam. Examination is in written form and includes two parts:

- theoretical physics questions

- practical task (one of the math problems)

Students must:

1. attend classes regularly (the absence is not allowed without good reason);

2. complete assignments from passed classes in case of absence;

3. hand over written papers on time;

4. successfully complete all tasks provided by the plan;

5. redo the tasks in case the student has been negatively assessed.

The students are allowed to take examinations in case of all the tasks passed (on the basis of the academic records).

The students are not allowed to take examination if they:

- fail results on tests;

- miss classes, had debts;

- have 5 (five) and more debts for the previous term;

- have one debt for previous terms for more than a year.

Recommendations for the examination assessment:

Task type	Competence	Assessment criteria	Grade
Questions	GPC-7: readiness to use basic physicochemical, mathematical and other natural science concepts and methods in solving professional problems	92 – 100%	Excellent
		64 – 91%	Good
		36 – 63%	Satisfactory
		less than 36%	Unsatisfactory
Practical task (solving the math problem)	GPC-1: ability to abstract thinking, analysis, synthesis	The student correctly and fully solves the the math problem, demonstrating deep knowledge. There are no errors in logical reasoning and solution, the problem is solved in a rational way. The right answer is obtained, ways are clearly described.	Excellent
		The student correctly solves the math problem, demonstrating deep knowledge. There are minor errors in logical reasoning and solution, the problem is solved in a rational way. The right answer is obtained, ways are clearly described.	Good
		The student correctly solves the math problem, demonstrating basic knowledge. There are significant errors in logical reasoning and	Satisfactory

| | | solution. The student demonstrates difficulties, but still is able to solve a case-study task. | |
| | | The student incorrectly solves the math problem, makes significant mistakes answering most of the questions of the case-study. The student is not able to solve a case-study. | Unsatisfactory |

Examination grade assessment:

Tasks	Competence	Grade	Score
Questions	GPC-7: readiness to use basic physicochemical, mathematical and other natural science concepts and methods in solving professional problems	Excellent	5
		Good	4
		Satisfactory	3
		Unsatisfactory	2
Practical task (solving the math problem)	GPC-1: ability to abstract thinking, analysis, synthesis	Excellent	5
		Good	4
		Satisfactory	3
		Unsatisfactory	2
Total	GPC-7: readiness to use basic physicochemical, mathematical and other natural science concepts and methods in solving professional problems GCC-1: ability to abstract thinking, analysis, synthesis	Excellent	9-10
		Good	7-8
		Satisfactory	5-6
		Unsatisfactory	4