

УДК 378

THE ONLINE MATHEMATICS COMPETITION FOR STUDENTS
OF EUROPEAN UNIVERSITIES OCTOBERTEST 2015

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The Online Mathematics Competition for Students of European Universities Octobertest 2015 was initiated and organized by the Department of Higher Mathematics of the Belarusian-Russian University.

Undergraduate and postgraduate students of any specialty and any year of study were invited to take part in the competition. Working language of Octobertest 2015 was English. The participation in the competition was free of charge. To register for Octobertest 2015, the participants were asked to fill out and submit the online registration form. We used Google Forms, which is part of a free, web-based software office suite offered by Google within its Google Drive service, for this purpose.

Octobertest 2015 was held as a competition with individual classification in one round in the form of online computer testing. The University's server and a free and open-source software learning management system, Moodle, were used to hold the testing. The competition was scheduled to be held on October 23, 2015. Access to the test was opened from October 22, 12:00 GMT to October 24, 12:00 GMT. Each participant could select the place for testing and the time to begin.

The test consisted of 16 problems, and students had 2 hours in succession to solve the tasks. The tasks contained problems from algebra, theory of numbers, real and complex analysis, analytical geometry, combinatorial analysis and ordinary differential equations. The problems were taken from different sources. Only one test attempt was allowed. The jury did not check the solutions of the problems, only the answers. Each answer was an integer number.

Four-function calculators, i.e. calculators which can perform only the four basic arithmetic operations, were permitted on Octobertest 2015. Any other computational aids, including scientific calculators, graphing calculators, or computer programs were prohibited. All problems on the Octobertest 2015 were solvable without a calculator, four-function calculators were permitted only to help participants reduce computation errors. Drawing aids such as graph paper, ruler and compass were permitted. However, electronic drawing aids, such as Geogebra and graphing calculators, were not allowed. Print and electronic publications were also not allowed.

Participants of Octobertest 2015 were asked not to communicate with each other about the contest while the contest was running. We asked them not to discuss the test problems in public or with other participants until October 24, 12:00 GMT.

The score of the participant was the number of questions answered correctly; that is, every problem was worth one point. The answers to the problems were released on the official site of MathOpen Belarus after November 2, 2015. If a participant had a protest about an answer, he or she might send an email to the organizers, including "Protest" in the subject. Results were released after November 6, 2015.

One hundred and thirteen undergraduate and postgraduate students of 28 universities from Armenia, Belarus, Ecuador, Germany, Ireland, Israel, Italy, Mongolia, Poland, Russia, Sweden, Turkmenistan, and United Kingdom took part in the competition. There were citizens of Canada, China, Germany, Hong Kong, Portugal, and Romania among the participants from the UK, one citizen of the USA represented Israel, and one citizen of Belarus represented Germany.

Table 1. Dependence of the degree of diploma from the number of correct answers

Number of correct answers	Degree of the diploma
13–16	diploma of the first degree
10–12	diploma of the second degree
7–9	diploma of the third degree
4–6	encouraging diploma
0–5	certificate of participation

The winners of the competition were determined according to the results of testing. Table 1 presents the dependence of the degree of diploma from the number of correct answers. Diplomas of the first, second and third degree were awarded to 24 competition winners, 34 participants received encouraging diplomas, 55 participants received certificates of participation. Table 2 contains top 10 results by country, Table 3 contains top 10 results by university.

Table 2. Top 10 results by country

	Number of participants		Number of diplomas			
	Students	Universities	First degree	Second degree	Third degree	Encouraging
Russia	54	10	2	4	6	12
Poland	13	3	0	3	2	4
UK	8	1	0	0	3	2
Belarus	10	2	0	0	1	5
Armenia	7	2	0	0	1	3
Italy	5	1	0	0	1	3
Mongolia	2	1	0	0	1	1
Sweden	3	2	0	0	0	2
Israel	4	1	0	0	0	1
Turkmenistan	1	1	0	0	0	1
Total	107	24	2	7	15	34

Table 3. Top 10 results by university

University	Country	Number of participants	Number of diplomas			
			First degree	Second degree	Third degree	Encouraging

Lomonosov Moscow State University	Russia	5	2	2	1	0
North-Eastern Federal University	Russia	9	0	2	1	2
Nicolaus Copernicus University in Toruń	Poland	8	0	1	2	2
Jagiellonian University	Poland	4	0	1	0	2
AGH University of Science and Technology	Poland	1	0	1	0	0
University of Oxford	UK	8	0	0	3	2
Ryazan State Radio Engineering University	Russia	8	0	0	2	1
Belarusian State University of Informatics and Radioelectronics	Belarus	4	0	0	1	3
University of Udine	Italy	5	0	0	1	3
Moscow State Institute of Radio Engineering, Electronics and Automation	Russia	7	0	0	1	2
Total		59	2	7	12	17

The next Problem 1 turned out to be the most difficult for the competitors, only 2 students gave the correct answer, and the next Problems 2 and 3 were the easiest, the number of correct answers was 60 (53,10 %) and 57 (50,44 %), respectively.

Problem 1. How many polynomials $p(x)$ of the degree $n \leq 2014$, satisfying the equation $p(x) \cdot p(x+1) = p(x^2 + x + 1)$ does there exist?

Problem 2. Find
$$\frac{1 \cdot 2}{2} + \frac{2 \cdot 3}{4} + \frac{3 \cdot 4}{8} + \frac{4 \cdot 5}{16} + \dots$$

Problem 3. Find
$$\lim_{x \rightarrow +\infty} 6 \left(\sqrt[6]{x^6 + x^5} - \sqrt[6]{x^6 - x^5} \right).$$

The average value of correct answers was about 3,9.

Six students of the Belarusian-Russian University took part in the competition, two of them were awarded encouraging diplomas.

The only participant, who gave 16 correct answers, was the winner of MathOpen 2015 Belarus, undergraduate student of the faculty of Mechanics and Mathematics of the Lomonosov Moscow State University Roman Pocherevin.