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**ПИСЬМЕННАЯ РАБОТА УЧАСТНИКА
ОЛИМПИАДЫ ШКОЛЬНИКОВ СПбГУ
2018–2019**

заключительный этап

Предмет (комплекс предметов) Олимпиады

СОВРЕМЕННЫЙ МЕНЕДЖЕР

Город, в котором проводится Санкт-Петербург

Дата 16.03.2019

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ВАРИАНТ 5

МАТЕМАТИКА (СОВРЕМЕННЫЙ МЕНЕДЖЕР)

Для каждой из сформулированных задач приведите полное ее решение и запишите ответ.

1. (6 баллов) Найдите сумму корней уравнения

$$(x + 1)(x + 2)(x + 3)(x + 4) = 24$$

2. (6 баллов) Сколько корней имеет уравнение $\cos(\pi/(x + 2)) = \sin(\pi x)$ на промежутке $[0; 10]$?

3. (6 баллов) Найдите наибольшее значение функции

$$f(x, y) = \frac{x\sqrt{y-2} + y\sqrt{x-2}}{x^2 + y^2}$$

4. (8 баллов) В параллелограмме одна из диагоналей равна боковой стороне и равна 4, а другая диагональ является биссектрисой двух углов параллелограмма. Найдите его площадь.

5. (8 баллов) В кубе $ABCD A' B' C' D'$ точка P лежит на ребре $B' C'$ и при этом $B' P : P C' = 1 : 2$. Через точки B, D и P проведена плоскость. В каком отношении она делит объем куба?

Решения заданий:

$$\begin{aligned} 1. & (x+1)(x+2)(x+3)(x+4) = 24 \\ & (x^2 + 5x + 4)(x^2 + 5x + 6) = 24 \\ & x^2 + 5x = t \\ & (t+4)(t+6) = 24 \\ & t^2 + 10t + 24 = 24 \\ & t^2 + 10t = 0 \end{aligned}$$

Математика (страница для решений - 2):

$$t=0 \quad t=-10$$

$$x^2+5x=0 \quad x^2+5x=-10$$

$$x=0 \quad x=-5 \quad x^2+5x+10=0$$

$$D=25-40 < 0$$

нет корней

$$0-5 = -5$$

Ответ: -5

$$3. f(x, y) = \frac{x\sqrt{y-2} + y\sqrt{x-2}}{x^2 + y^2} \quad x \geq 2; y \geq 2$$

x, y -симметрично. Для максимального значения функции равен. Пусть $x = y = a$.

a	f
2	0
3	$\frac{1}{3}$
4	$\frac{\sqrt{2}}{4}$

Тогда $f(x, y) = \frac{\sqrt{a-2}}{a}$

Максимальное значение при a от 3 до 6

5	$\frac{\sqrt{3}}{5}$	$\frac{\sqrt{2}}{4}$	$\frac{1}{3}$	$\frac{\sqrt{3}}{5}$
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6	$\frac{1}{3}$	$\frac{1}{8} > \frac{1}{9} < \frac{3}{25}$
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11	$\frac{3}{11}$	$\frac{1}{8}$	$\frac{3}{25}$
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	$\frac{25}{8 \cdot 25}$	$>$	$\frac{24}{8 \cdot 25}$
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Если $\frac{\sqrt{2}}{4}$ - максимальное значение,

то $f(3,5,3,5)$ и $f(4,5,4,5)$ имеют равные значения

3,5	4,5	4
$\sqrt{1,5}$	$\sqrt{2,5}$	$\frac{\sqrt{2}}{4}$
3,5	4,5	4
1,5	2,5	$\frac{1}{8}$
$\frac{1,5}{8 \cdot 25}$	$\frac{2,5}{8 \cdot 25}$	

Task 3

For each question 1-2, mark one letter.

- In the text, the word in bold 'launched' is closest in meaning to:
 - started
 - agreed
 - completed
 - outlined
- According to paragraph 7, sustainable development measures taken in Sri Lanka and Philippines resulted in the following EXCEPT:
 - people are given better security
 - people earn more money than they used to
 - trading zones for groceries appeared
 - newly produced cars give off less fumes

АНГЛИЙСКИЙ ЯЗЫК И ОБЩЕСТВОЗНАНИЕ (СОВРЕМЕННЫЙ МЕНЕДЖЕР)

Task 1

In this integrated task, you should read the text on the topic of environmental issues and answer the essay question. You have about 30 minutes to read and analyse the text and 40 minutes to plan, write, and revise your essay. Write your essay in 200–250 words in an appropriate style. Use your own words as far as possible.

- Identify at least three key environmental challenges that Russia faces today and give your arguments for each of them.
- Using the information from the text, explain if the initiatives presented in the text could be used in Russia to protect and improve the environment.

From Afghanistan to Zimbabwe, 141 countries made significant progress in 2017 to tackle the most urgent environmental challenges facing humanity and our planet, inspiring us to seek out new and more innovative solutions.

The 2030 Agenda for Sustainable Development provides our vision for this work – connecting people and welfare with the planet; development with environment – and signals that our response to these complex and inter-connected challenges must do the same.

In this 10th annual performance report of the United Nations Development Programme (UNDP), we show how investments in the Sustainable Development Goals¹ (SDGs) – on affordable and clean energy, climate action, life below water, and life on land – accelerate the achievement of other goals aimed at ending poverty, achieving zero hunger, achieving gender equality, reducing inequalities, and building strong institutions.

The Asia and the Pacific region is home to more than half of the world's population and faces a range of development challenges. These are often worsened by natural disasters which strain efforts to sustain economic growth and work to improve environmental sustainability.

Since 1992, the Asia and Pacific region has received over 28% of all environmental grant financing mobilized by UNDP for 37 countries in the region. When combined with close to US\$7 billion in co-financing, this total investment of US\$9 billion over the past 25 years has made significant progress in addressing the root causes of environmental degradation, and has built capacity to recover and strengthened livelihoods across the region.

The Kokoda Trail, Papua New Guinea's most famous tourist site, is now protected by the government's Conservation and Environment Protection Agency. Preserving the unique biodiversity along the 100km corridor is vital, as the number of visitors to the country is rising. The trail brings the equivalent of over US\$1 million annually to the country. Tourism Development Area (TDA) management plans developed and launched in Samoa identify sensitive tourism locations, provide alternative destinations, and provide recommendations for climate change adaptation action on the ground. More than 75% of tourism operators in targeted TDAs have already invested in and implemented sustainable adaptation measures.

Over 1,300 home gardens using climate-adaptive agriculture and water management practices have been planted in the North Western province of Sri Lanka, supplying an average of 20,000 kg of fruits and vegetables monthly to eight newly established regional farmers markets. The annual income of participating families has increased by 34% and the distance between a farmer and a consumer has been reduced thereby lowering emissions from the transportation of produce. Over 5,400 small-scale farmers in Mindanao in the Philippines are getting compensation for climate risks through weather-indexed based

¹ Sustainable Development Goals – a plan of action to end poverty, protect the planet and guarantee the global well-being of people

insurance, which provides fast payouts to affected farmers after a climate shock; they then have the opportunity to replant and recover more quickly.

Detailed risk maps were developed for 15 mountainous provinces in Vietnam to assist local governments with making informed decisions on risk reduction measures, help in managing climate change impact, prioritizing investments for infrastructure upgrades, including the timing of such investments. In Timor Leste, climate sensitive rural infrastructure activities – including new and restored water supply systems (reservoirs, irrigation systems) – are bringing clean water to rural communities that experience frequent droughts. Farmers and residents have received training on soil bioengineering and management practices concerning rainwater collection.

In Tonga, the Fanga'uta Lagoon Environmental Management Plan was approved by the Cabinet. Efforts to improve long-term sustainability of the lagoon include development of a full monitoring system for the area of land from which water flows into the lagoon to improve water quality and mangrove (type of a tropical tree found near water) conservation work. China and the Republic of Korea border the Yellow Sea Large Marine Ecosystem (YSLME) are working together to foster long-term sustainable institutional, policy and financial arrangements for effective management of the area which covers 400,000 km². A special YSLME Commission was set up to coordinate and strengthen legal mechanisms for governing the YSLME which tens of millions of residents rely on.

The East Godavari River Estuarine Ecosystem holds the second largest area of mangroves along the east coast of India and is rich in floral and faunal diversity. It generates significant ecological and economic benefits such as shoreline protection, livelihood provision and services to reduce the effect of global warming by protecting forests that absorb large amounts of carbon dioxide. This area is being protected via significant reforms including sustainable fishing and aquaculture regulations integrated into the Andhra Pradesh Marine Fisheries Act and specific protections for marine and coastal biodiversity in the Wildlife Act. These protect water and land ecosystems including manmade landscapes and native biodiversity from risks associated with non-native species.

Essay:

Nowadays Russia faces a great number of environmental challenges ~~problems~~. First of all, the problem is air, water and soil pollution. The worst ecological situation is at big cities like Saint-Petersburg and Moscow.

Russia is an industrial country with many plants, fabrics and cars. Plants burn fossil fuels, cars pump out toxic emissions. People and animals have to breathe this emissions in. Ecological situation with air is quite bad nowadays. Other problem is soil and water pollution. We usually don't reuse and recycle rubbish. We throw it out and as a result, Russia faces environmental degradation and pollution. Besides, the problem is in chemicals that are used for plants ~~to~~ because they pollute soil. Fabrics put chemical dirty water into

rivers and lakes. The third problem is an animal hunt. Many animals in Russia are now at the Red book. People hunt animals and then sell their fur for example, to clothes fabrics. This ecological problem should be solved because in twenty years Russia will face problems because of lack of important resources. Some of this environmental initiatives could be used in Russia. Monitoring systems and risk maps could be use in order to prevent climate changes and to improve quality of water into lakes and rivers. Besides, we can plant trees to struggle against a soil erosion and air pollution. However, in Russia it is often useless to try to increase number of farmer's families because at ~~the~~ large territories in Russia it's very difficult to plant fruits or vegetables.



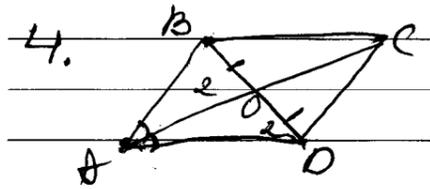
Task 2

Explain the meaning of the term "gender equality" from the text in about 50-100 words.

Gender equality is when both men and women have equal opportunities to work or to be with their families, when ~~there~~ is no difference between man and woman for employees. Besides, all people should be paid ^{equally} money * either they are men and/or women. Nowadays many countries ~~to~~ try to ~~to~~ achieve gender equality but it is quite difficult because of tradition of men domination.

* ^{with} at the same work

$$\frac{1}{8} > \frac{1,5}{12,25} \quad \frac{1}{8} > \frac{2,5}{20,25} \quad \text{Ответ: } \frac{\sqrt{2}}{4}$$

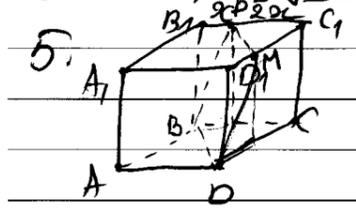


4. Дано: $BD = AB = 4$; $ABCD$ - параллелограмм,
 AC - биссектриса углов BAD, BCD
 Найти S_{ABCD}
 Решение: Диагональ параллелограмма
 TH делит пополам
 $BO = OD = 2$

Тогда в $\triangle ABD$ AO - медиана и биссектриса
 $\triangle ABD$ равнобедренный, $AB = AD$. По теореме $BO = AB$
 Тогда $\triangle ABD$ равносторонний, $AB = BD = AD = 4$
 Тогда $BC = CD = 4$; $ABCD$ - ~~квадрат~~ ромб.
 $\angle BAD = 60^\circ$; $S_{ABCD} = \frac{1}{2} AB \cdot AD \cdot \sin 60^\circ$

$$S_{ABCD} = \frac{16 \cdot \sqrt{3}}{2} = 8\sqrt{3}$$

Ответ: $8\sqrt{3}$



5. Дано: $ABCD, B_1, C_1, D_1$ - куб; $B_1P:PC_1 = 1:2$
 Найти: в каком отношении (BPP) делит отрезок
 Решение: Проведем $DM \parallel B_1B$
 $MC_1 = 2x$; $P_1M = x$ B_1PMD - искомая плоскость
 Проведем $PB_2, MD_2 \parallel B_1B; D_1D$. Пусть сторона куба = $3x$

$$S_{A_1B_1D_1ABD} = \frac{1}{2} S_{куба} = \frac{27x^3}{2} \quad BD = \sqrt{9x^2 + 9x^2} = 3\sqrt{2} \cdot x$$

$$S_{B_1PMD B_2D_2D} = 300 \cdot x \cdot 3\sqrt{2} \cdot x = 9\sqrt{2} \cdot x^3$$

$$S_{B_1PMD, B_1B, P, D_1, MD} = \frac{1}{2} \cdot 9\sqrt{2} \cdot x^3$$

$$\frac{S_{A_1B_1D_1ABD}}{S_{P, C_1, M, B, C, D}} = \frac{\frac{27x^3}{2} + \frac{9\sqrt{2}x^3}{2}}{\frac{27x^3}{2} - \frac{9\sqrt{2}x^3}{2}} = \frac{27 + 9\sqrt{2}}{27 - 9\sqrt{2}} = \frac{3 + \sqrt{2}}{3 - \sqrt{2}}$$

Ответ: $\frac{3 + \sqrt{2}}{3 - \sqrt{2}}$