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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 6**

**МАТЕМАТИКА (СОВРЕМЕННЫЙ МЕНЕДЖЕР)**

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

1. (6 баллов) Найдите сумму корней уравнения

$$(4x^2 + 8x + 3)(x^2 + 3x + 2) = 6$$

2. (6 баллов) Сколько корней имеет уравнение  $\operatorname{tg}(\pi x) = 2^{-x}$  на промежутке  $(0; 10)$ ?

3. (6 баллов) Найдите наибольшее значение функции

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

4. (8 баллов) В выпуклом четырехугольнике последовательно соединены середины сторон. Образовавшийся «серединный» четырехугольник является ромбом, в котором стороны и одна из диагоналей равны 3. Найдите площадь искомого четырехугольника.
5. (8 баллов) В правильной треугольной пирамиде  $ABCDS$  через точки  $A$ ,  $B$  и середину ребра  $CS$  проведена плоскость. В каком отношении она делит высоту пирамиды?

Решения заданий:

~~N1,  $(4x^2 + 8x + 3)(x^2 + 3x + 2) = 6$   
 Найдём корни уравнения  
 1)  $4x^2 + 8x + 3 = 0$       2)  $x^2 + 3x + 2 = 0$   
 $x_{1,2} = \frac{-8 \pm \sqrt{64 - 48}}{8}$        $x_{2,3} = \frac{-3 \pm \sqrt{9 - 4}}{2}$   
 $x_1 = -1,5$      $x_2 = -\frac{1}{2}$        $x_1 = -2$      $x_2 = -1$~~

Математика (страница для решений - 2):

~~Уравнение:  $(4(x+1)(x+1.5))(x+2)(x+1) = 6$~~   
 ~~$(4x+2)(x+1.5)(x+2)(x+1) = 6$~~

~~$(4x^2 + 6x + 2x + 3)(x^2 + 2x + 2 + x) = 6$~~

~~$(4x^2 + 8x + 3)(x^2 + 3x + 2) = 6$  - выходим с условием~~

N1  $(4x^2 + 8x + 3)(x^2 + 3x + 2) = 6$

$4x^4 + 12x^3 + 8x^2 + 8x^3 + 24x^2 + 16x + 3x^2 + 9x + 6 - 6 = 0$

$4x^4 + 20x^3 + 35x^2 + 25x = 0$

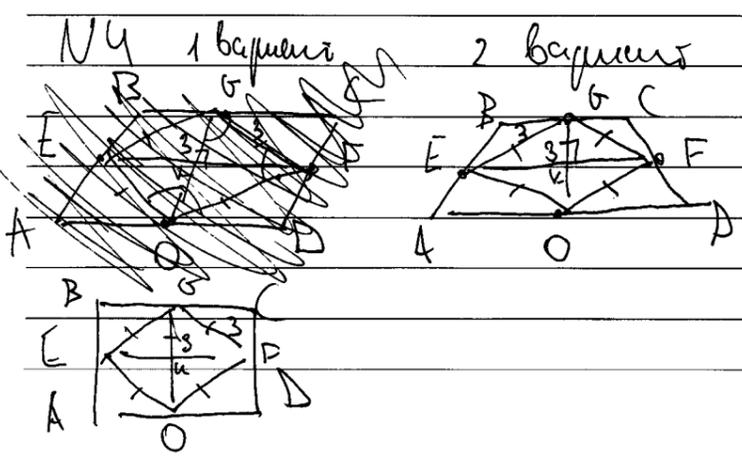
$4x^2(x^2 + 5x) + 5x(7x + 5) = 0$

$(4x^2 + 5x)(x^2 + 5x)(7x + 5) = 0$

1)  $4x^2 + 5x = 0$       2)  $x^2 + 5x = 0$       3)  $7x + 5 = 0$   
 $x(4x + 5) = 0$        $x(x + 5) = 0$        $7x = -5$   
 $x_1 = 0$  или  $4x + 5 = 0$        $x_2 = 0$        $x_3 = -5/7$   
 $x_4 = -5/4$

Сумма:  $0 + 0 - 5 - 5 - 5 = -15$   
 $\frac{-15}{7} = -\frac{15}{7}$

Ответ:  $-\frac{15}{7}$



Дано: ABCD - квадрат  
 AE = EB, BO = OC,  
 CF = FD, AO = OD  
 DEGF - ромб  
 EG = GF = FO = EO = 3 (см)  
 GO, EF - перпендикулярные  
 GO = 3 (см)  
 GO ∩ EF = O  
 SABCD? или SDEFO?

## 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 Goals<sup>1</sup> (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.

In Nepal, a lift irrigation system for the Chepang and Magar communities uses electricity from micro hydro pumps to transfer clean water 100m uphill, saving residents the 90 minute trip needed to fetch the water by foot. The water is used for drinking and irrigation on land that had previously only been rain fed. Because of the support from the micro hydro pump, income has gone up tenfold in the community. At the national level, the Government of Nepal approved the Renewable Energy Subsidy Policy and the Renewable Subsidy Delivery Mechanism. Malaysia has reduced GHG emissions from the building sector almost twice the targeted amount. The biggest contributor of the reduced greenhouse gas (GHG) emissions from the building sector is from the Energy Performance Contract Financing Scheme which provides financing support to energy service companies. This enables the uptake of energy efficient technologies and the growth of the building renovation market.

Lessons from autonomous power supply systems and rural electrification models in Nepal were shared with the State Council of Science, Technology and Environment in India for an autonomous power supply initiative in Meghalaya. Tonga and Fiji organized a study tour to compare and contrast the challenges and benefits of establishing locally managed marine areas (LMMAs) and to develop a

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

structure for LMMA's in Nauru. A delegation from Timor Leste traveled to Bangladesh, which supports the world's largest single tract of *mangrove* (type of a tropical tree found near water) forest, to learn about and share experiences on community based management of *mangrove* ecosystems. Vietnam and Timor Leste have exchanged knowledge and experience on promoting climate-adaptive infrastructure, which includes, among others: sensitivity assessments, mapping of essential rural infrastructure, integration of climate change adaptation into policies and designs of rural roads, irrigation and river embankments, and low-cost bio-engineering using locally-available resources. Sri Lanka and China have discussed the applicability of technology transfer from China for facilities to produce fertilizer out of ash waste, biomass heaters for the tea industry, and activated carbon based product manufacturing in Sri Lanka.

Native groups in Myanmar are involved in strengthening the sustainability of protected areas by identifying their **customary** land use practices and being involved in zoning processes. In addition, community guardians have been identified and trained to participate in protected area management. Selected native youth have been employed as community guards in protected areas. In Laos, native communities in targeted areas have been involved in prioritizing development interventions for increasing climate change adaptation and in land use planning at the village level, e.g. through their local knowledge, and in developing management plans for ecosystem areas.

## Essay:

Nowadays every country in the world faces different environmental problems. And Russia is not an exception.

I think one of the main environmental problems in Russia is deforestation. Huge areas of forests are cut in Siberia, this destroys animals' natural habitats and makes them extinct. The second big problem is the pollution of Baikal. This lake is our national treasure and some factories dare to pollute it. We should stop this, or we'll lose this wonderful water body. The third problem is air pollution and the greenhouse effect as there are too many cars and factories producing carbon dioxide and destroying the ozone layer.

I believe Russia should start using renewable energy or find some alternative energy sources to reduce the greenhouse gases and usage of oil. As well we should learn more about autonomous power supply system and rural electrification models as probably it'll help us to clean the atmosphere and use less ~~natural~~ resources. We should learn more about climate-adaptive infrastructure as it'll help us to live in harmony with our environment, we will destroy less and save more. We should identify our customary land use practices, we have to find people

Essay (продолжение)

Who will protect their areas and fight for their safety. Anyway, everyone should take steps in saving the planet. Why don't we just start recycling using electrocars or just turning the lights off leaving the room. Everyone should make their contribution.



Task 2

Explain the meaning of the term "energy efficient technologies" from the text in about 50-100 words.

Energy efficient technologies are technologies used in our everyday life which help us use less energy or use renewable/alternative energy. Technologies that just don't waste our natural sources but, on contrary, help us if not protect them, save them. Help us save them and waste less. Such technologies don't destroy environments, atmosphere, water and air that we need. This term includes recycling and producing something else out of already used materials. So, all in all, energy efficient technologies help us to save the planet and to use less.

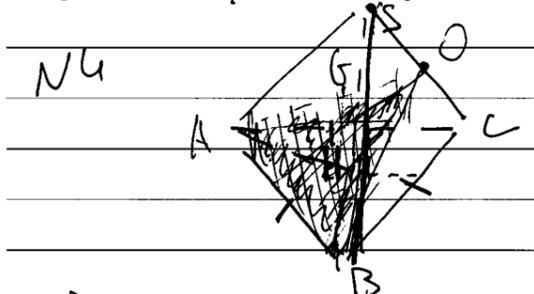
Математика (страница для решений - 3):

Решено:  
1 вариант) 1)  $\Delta OEF$  - к/т, так  $GO \perp FE$  - по свойству ромба  
~~по свойству ромба~~  $OK = 1,5$  и  $OK = KO$  - по свойству ромба  
по теореме Пифагора:  $OF = \sqrt{GF^2 - GK^2} = \sqrt{9 - 2,25} = \sqrt{6,75} \text{ (см)}$   
 $EF = 2KF = 2\sqrt{6,75} \text{ (см)}$

2)  $S_{ABCD} = CD \cdot BC$   
 $BC = ED = 2\sqrt{6,75} \text{ (см)}$   
 $CD = GO = 3 \text{ (см)}$   
 $S_{ABCD} = 2\sqrt{6,75} \cdot 3 = 6\sqrt{6,75} \text{ (см}^2\text{)}$

2 вариант) 1) П.1 аксиомы  
2)  $S = \frac{BC + AD}{2} \cdot GO$   
 $EF$  - ср. линия - по определению  
 $EF = \frac{BC + AD}{2}$  - по свойству ср. линии  
 $S = EF \cdot GO = 2\sqrt{6,75} \cdot 3 = 6\sqrt{6,75} \text{ (см}^2\text{)}$   
Объём:  ~~$6\sqrt{6,75} \text{ (см}^2\text{)}$~~   $S_{ABCD} = 6\sqrt{6,75} \text{ (см}^2\text{)}$

или из  $S_{GEFO}$ ,  
по свойству ромба или по формуле  
 $S_{GEFO} = \frac{1}{2} GO \cdot EF =$   
 $= \frac{1}{2} \cdot 3 \cdot 2\sqrt{6,75} = 3\sqrt{6,75} \text{ (см}^2\text{)}$   
Объём:  $S_{GEFO} = 3\sqrt{6,75} \text{ (см}^2\text{)}$



Дано:  $ABCD$  - параллелограмм  
 $(ABO)$  - ромб  
 $SO = O$   
 $SH = GO$   
 $\frac{GS}{SH} = ?$

Решено:  
1)  $\Delta SBC = \Delta SAC$  - по 3 сторонам.  
 $SC$  - ось симметрии,  $AC = CB$  - по условию;  $SA = SB$  - по условию;  $\angle SAC = \angle SBC$  - по условию  
по теореме  $AO$  и  $BO$  - медианы,  $AO = BO$ , тем самым  $SO$  - медиана  
2)  $\Delta AOB$  -  $\rho$  - по определению  
 $\Delta SHK = \Delta SHB$  - по 2 сторонам  
 $AK = KB = \frac{1}{2} AB$ ,  $AS = SB$  - по условию  
3)  $SH$  - медиана в  $\Delta AOB$   
 $\frac{GS}{SH} = \frac{1}{2}$ , где  $SH$  - медиана

Объём:  $\frac{GS}{SH} = \frac{1}{2}$