САНКТ-ПЕТЕРБУРГСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ

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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 $tg(\pi x) = 2^{-x}$ на промежутке *(0;10)*?

3. **(6 баллов)** Найдите наибольшее значение функции

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

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:

№ 1

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

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

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

$x \cdot (4x^3 + 20x^2 + 35x + 25) = 0$

Для того чтобы решить уравнение 3-ей степени, необходимо

Математика (страница для решений – 2):

подобрать один его корень, для $4x^3 + 20x^2 + 35x + 25 = 0$

это корень $-2,5$; $4 \cdot (-15,625) + 20 \cdot 6,25 + 35 \cdot (-2,5) + 25 = 0$;

$$-62,5 + 125 - 87,5 + 25 = 0$$

$$150 = 150 \Rightarrow x = -2,5 \text{ подходит}$$

Разложим уравнение 3-ей степени:

$$
\begin{array}{r|l}
4x^3 + 20x^2 + 35x + 25 & \underline{x + 2,5} \\
\underline{4x^3 + 10x^2} & 4x^2 + 10x + 10 \\
\quad 10x^2 + 35x + 25 & \\
\quad \underline{10x^2 + 25x} & \\
\qquad 10x + 25 & \\
\qquad \underline{10x + 25} & \\
\qquad\qquad 0 &
\end{array}
$$

Таким образом, исходное уравнение можно представить в виде:

$$x \cdot (x + 2,5) \cdot (4x^2 + 10x + 10) = 0$$

У уравнения $4x^2 + 10x + 10$ нет корней, так как $a = 4 > 0$ и

$D = 100 - 160 = -60 < 0$; если у уравнения $ax^2 + bx + c = 0$ старший

член > 0 и $D < 0$, то у него нет корней и оно всегда положительно.

Корни уравнения: 0; $-2,5$ (исходного уравнения)

Сумма корней: $0 + (-2,5) = -2,5$

Ответ: $-2,5$.

(N 2.)

$\text{tg}(\pi x) = 2^{-x}$;

$\text{tg}(\pi x) = \dfrac{1}{2^x}$; $\quad x = 0$; $\text{tg}(0) = 1$ ложь

$\qquad\qquad\qquad x = \dfrac{1}{2}$; $\text{tg}\left(\dfrac{\pi}{2}\right) = \dfrac{\sqrt{2}}{2}$ ложь

$\qquad\qquad\qquad x = 1$; $\text{tg}(\pi) = \dfrac{1}{2}$ ложь

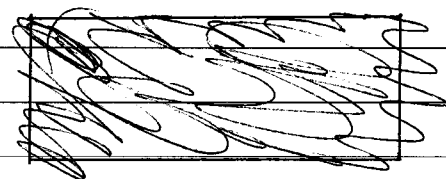$\qquad\qquad\qquad x = 2$; $\text{tg}(2\pi) = \dfrac{1}{4}$ ложь

Ответ: 0 (ни одного).

(N 4.)

У ромба все стороны равны и противоположные углы равны.

По условию задачи, его вписывают в четырёхугольник, но так

как его $\angle \ne$ одной из d, он может быть вписан только в

прямоугольник.

Task 3

For each question 1-2, mark one letter.

1. In the text, the word in bold **'customary'** is closest in meaning to:

   (A) experimental
   (B) client-oriented
   (C) trial
   (D) traditional

2. According to paragraph 7, Vietnam and Timor Leste have shared the information about all of the following EXCEPT:

   (A) adopting climate adjusting solutions in economic sphere
   (B) examining areas needing special care in changing climate conditions
   (C) planning basic systems and services in the countryside
   (D) adopting climate adjusting solutions in agricultural sphere

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[1] (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

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[1] 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, the problem of environmental protection is on agenda. Almost every country suffer from air pollution and climate's changes today. The influence of a human on the environment causes a lot of global problems.

Russia is the biggest country in the world, that is why the sollution of ecological problems is really wanted here. To begin with, the main ecological problem of Russia is air pollution. Factories do not use „green" technologies and throw out lodds of fumes daily. Moreover, last studies show that every Russian family has 2 cars in average and only 0,5% of them use electricity. In addition, Russia exports tons of wood regularly. The less trees we have, the worce air we breath.

The next problem is water pollution. Establishment recklessly store nuclear wastes of other countries ~~[crossed out]~~ not far from lakes and rivers. As a result, the water is ~~[crossed out]~~ toxicated and even animals cannot drink it.

The last challenge that Russia faces today is forests' fires. It is a really important problem with a negative impact on Russia's economy. We cannot do anything with it but to obey some simple rules in the forest.

In my opinion, only a few initiatives may be used in Russia to protect the environment. Russian climate does not allow using of energy efficient technologies, such as using of solar energy. Using locally-available resources is fully depended on the CEO's decisions. Only integration

Essay (продолжение)

of climate change adaptation into policies and laws may give a result.

protection

To sum up, the problem of environmental is burning. ~~All of us~~ Everyone has to search the solution of it, and care about the nature.

Task 2

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

Energy efficient technologies — modern innovative technologies that require less energy than older ~~ones~~ types. Some of ~~these~~ machines, which work with the help of these technologies, may work by the sun or wild energy. For example solar panels. Energy efficient technologies decrease ~~its~~ the negative impact on the environment and save the money of organization.

Математика (страница для решений – 3):

Тогда $BD = AC = SM = 3$; $OD = \frac{BD}{2} = 1,5$

$MD = \sqrt{MO^2 - OD^2} = \sqrt{9 - 2,125} = \sqrt{6,75} =$
$= \sqrt{\frac{675}{100}} = \frac{\sqrt{675}}{\sqrt{100}} = \frac{25}{10} = 2,5$

$CD = 2MD = 2 \cdot 2,5 = 5$

$S_{ABCD} = CD \cdot BD = 5 \cdot 3 = 15$

Ответ: 15.