



## Winter round 2021./2022.

SCHOOL	
TEAM NUMBER	
YEAR	<b>8.</b>

NAME AND SURNAME OF STUDENT

NAME AND SURNAME OF MENTOR	
	<b>M</b>
	<b>F</b>
	<b>K</b>

### ODGOVORI:

Mathematics (M)		Physics (F)		Chemistry (K)		M-F-K
M.1.		F.1.		K.1.		
M.2.		F.2.		K.2.		
M.3.		F.3.		K.3.		
M.4.		F.4.		K.4.		
M.5.		F.5.		K.5.		
M.6.		F.6.		K.6.		
M.7.		F.7.		K.7.		
M.8.		F.8.		K.8.		
M.9.		F.9.		K.9.		

#### Authors:

Maja Zelčić, mathematics professor  
 Stjepan Sabolek, mathematics and physics professor  
 Marijana Bastić, biology and chemistry professor

#### Revision:

Luka Milačić, student at PMF Mathematics  
 Jakov Budić, student at PMF Physics  
 Lea Komočar, student at PMF Chemistry

# MATHEMATICS

<b>CORRECT ANSWER: 10 points</b>	<b>ANSWER „E“: 0 points</b>	<b>ELSE: -2 points</b>
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M.1. Which of the following numbers will we get when we write 0.000000000003745 in scientific notation?

<b>A.</b> $0,3745 \cdot 10^{-11}$	<b>B.</b> $3,745 \cdot 10^{-11}$	<b>C.</b> $3,745 \cdot 10^{-12}$	<b>D.</b> $3,745 \cdot 10^{-13}$	<b>E.</b> we do not wish to answer
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M.2. What is the remainder when we divide 123 456 789 101 112 131 415 by 3?

<b>A.</b> 0	<b>B.</b> 1	<b>C.</b> 2	<b>D.</b> it cannot be determined	<b>E.</b> we do not wish to answer
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M.3. What is the measure of the angle formed by the longest and shortest diagonal from one vertex of a regular octagon?

<b>A.</b> 30°	<b>B.</b> 45°	<b>C.</b> 60°	<b>D.</b> it cannot be determined	<b>E.</b> we do not wish to answer
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<b>CORRECT ANSWER: 20 points</b>	<b>THE ANSWER “E” : 0 points</b>	<b>ELSE : -4 points</b>
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M.4. What is the sum of the first 1 000 digits after the decimal point of the number  $\frac{24}{13}$ ?

<b>A.</b> 4 819	<b>B.</b> 4 500	<b>C.</b> 4 482	<b>D.</b> 4 501	<b>E.</b> we do not wish to answer
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M.5. The profit of the „Tata Mata“ company in the first trimester of this year was 145 250 kn, and in the second trimester it was 167 231 kn. By how much does the profit in the last trimester have to exceed the profit in the first trimester so that the profit growth is linear?

<b>A.</b> less than 50 000 kn	<b>B.</b> between 50 000 kn and 60 000 kn	<b>C.</b> between 60 000 kn and 65 000 kn	<b>D.</b> more than 65 000 kn	<b>E.</b> we do not wish to answer
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M.6. The prices of new cars in the “Auti” car shop are given. If we know that, after purchase, the cars depreciate by a certain percent each year, which of the cars below will have the highest value?

Car	the price of the new car in kn	the percent by which the car depreciates in a year
Munjeviti Jurić	105 210	19 %
Klara Ramirez	123 400	22 %
Jura Grom	98 900	20 %
Jasna Pouzdanić	97 580	18 %

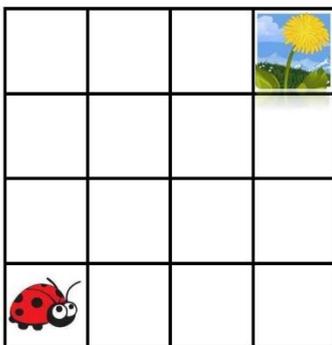
<b>A.</b> Munjeviti Jurić	<b>B.</b> Klara Ramirez	<b>C.</b> Jura Grom	<b>D.</b> Jasna Pouzdanić	<b>E.</b> we do not wish to answer
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<b>CORRECT ANSWER: 30 points</b>	<b>THE ANSWER "E" : 0 points</b>	<b>ELSE : -6 points</b>
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M.7. How many four-digit numbers are there such that they are divisible by 15 and that all their digits are different and either all odd or all even?

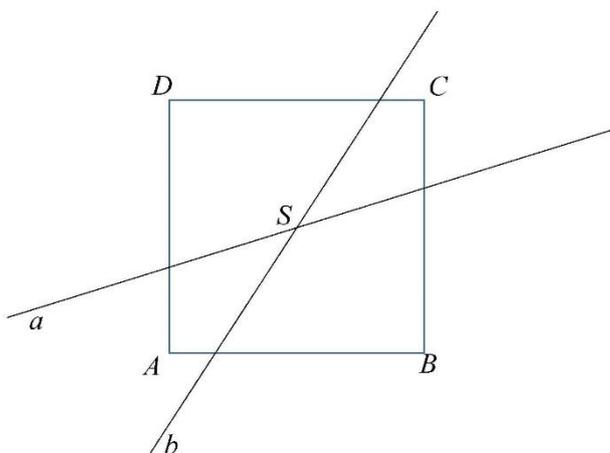
<b>A.</b> less than 10	<b>B.</b> 12	<b>C.</b> 18	<b>D.</b> more than 20	<b>E.</b> we do not wish to answer
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M.8. Mara the ladybug wants to reach the dandelion square by walking vertically and horizontally through the squares. How many shortest paths to do this are there?



<b>A.</b> less than 15	<b>B.</b> more than 14 and less than 20	<b>C.</b> more than 19 and less than 25	<b>D.</b> more than 24	<b>E.</b> we do not wish to answer
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M.9. The point  $S$  is the centre of the square  $ABCD$ . Line  $a$  intersects the segment  $\overline{AD}$  in point  $M$ , and line  $b$  intersects the segment  $\overline{CD}$  in point  $N$ . In the area of the quadrilateral  $MSND$  is three times smaller than the area of the square  $ABCD$ , what is the ratio of the side length of  $ABCD$  and  $|MD|+|DN|$  ?.



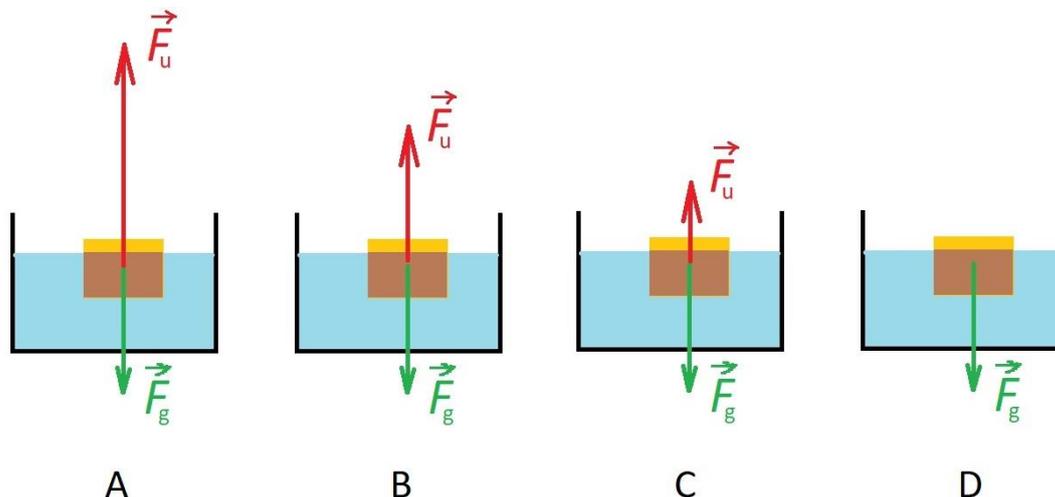
<b>A.</b> 2 : 3	<b>B.</b> 3 : 4	<b>C.</b> 4 : 5	<b>D.</b> it cannot be determined	<b>E.</b> we do not wish to answer
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# PHYSICS

Use the approximate value  $g = 10 \text{ m/s}^2$  for gravitational acceleration.

<b>CORRECT ANSWER : 10 points</b>	<b>THE ANSWER "E" : 0 points</b>	<b>ELSE : -2 points</b>
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F.1. A piece of wood floats on the surface of water so that a part of it is above, and the rest below the surface of water, as shown on the images. In which of the images are the vectors of forces acting on the piece of wood shown correctly?  $\vec{F}_g$  is the gravitational force, a  $\vec{F}_u$  is buoyancy.



A.	B.	C.	D.	E. we do not wish to answer
A	B	C	D	

F.2. Marko had two identical glasses. He poured a certain mass of water into the first one, and he poured oil of the same mass into the second one. At the beginning, the temperature of oil and water was the same. Then he heated the oil and water, making sure that the oil and the water received the same amount of heat. Immediately after heating, he recorded the final temperatures of the water  $t_v$  and oil  $t_u$ . Which statement is correct for the temperatures  $t_u$  and  $t_v$ ? The specific heat capacity of oil is  $2180 \text{ J/(kgK)}$ , and the specific heat capacity of water is  $4190 \text{ J/(kgK)}$ .

A.	B.	C.	D.	E. we do not wish to answer
$t_u > t_v$	$t_u = t_v$	$t_u < t_v$	$t_u$ and $t_v$ are less than the initial temperature	

F.3. When we celebrate a birthday, we rub balloons with a cloth, so they get charged and they stick to walls because of the electrostatic force between the balloon and the wall. It is determined that the balloon gets negatively charged while being rubbed by a cloth. So, the balloon:

A.	B.	C.	D.	E. we do not wish to answer
received protons	received electrons	released protons	released electrons	

<b>CORRECT ANSWER: 20 points</b>	<b>THE ANSWER "E" : 0 points</b>	<b>ELSE : -4 points</b>
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F.4. The Physicson family used 324 grams of aluminium wrap (foil) in their household. The thickness of the foil is 20µm, and its width is 30 cm. Which length of the foil did the Physicsons use? The density of aluminium is 2700 kg/m<sup>3</sup>.

<b>A.</b> 2000 m	<b>B.</b> 200 m	<b>C.</b> 20 m	<b>D.</b> 2 m	<b>E.</b> we do not wish to answer
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F.5. When a round wooden pole is put up upright, it exerts a pressure of 24000 Pa on the surface. What is the height of the pole? The density of the wood that the pole is made of is 800 kg/m<sup>3</sup>.

<b>A.</b> 0,3 m	<b>B.</b> 3 m	<b>C.</b> 30 m	<b>D.</b> 300 m	<b>E.</b> we do not wish to answer
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F.6. Three ants are pushing a leaf that fell on the ground from a tree. Two of them are pushing from left to right with forces  $F_1 = 0,07\text{ N}$  and  $F_2 = 0,04\text{ N}$ , and the third ant is pushing from the other side with force 0,09 N to the left. What is the amount of the friction force between the leaf and the surface if the leaf is moving at constant speed?

<b>A.</b> 0,2 N	<b>B.</b> 0,11 N	<b>C.</b> 0,09 N	<b>D.</b> 0,02 N	<b>E.</b> we do not wish to answer
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<b>CORRECT ANSWER: 30 points</b>	<b>THE ANSWER "E" : 0 points</b>	<b>ELSE : -6 points</b>
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F.7. The average density of a human is 950 kg/m<sup>3</sup> (this amount is calculated including the air in the lungs). Life vests are made from plastic foam that has a density 580 kg/m<sup>3</sup>. What is the minimum volume of the foam that must be used to produce a life vest so that at least 20 % of the volume of the human weighing 80 kg is above the surface of the water? The density of sea water is 1020 kg/m<sup>3</sup>.



<b>A.</b> 0,0156 m <sup>3</sup>	<b>B.</b> 0,0265 m <sup>3</sup>	<b>C.</b> 0,0256 m <sup>3</sup>	<b>D.</b> 0,0305 m <sup>3</sup>	<b>E.</b> we do not wish to answer
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F.8. Fran dragged a sled of mass 20 kg through the snow. Denis sat on the sled, and his mass is 50 kg. Fran had to pull with a force of 140 N to achieve a constant speed. Later, Mirta also sat on the sled with Denis, and her mass is 40 kg. What is the force Fran should use to pull the sled to continue going at constant speed?

<b>A.</b> 160 N	<b>B.</b> 180 N	<b>C.</b> 200 N	<b>D.</b> 220 N	<b>E.</b> we do not wish to answer
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F.9. Mia prepared the water for a bath. She mixed hot water of temperature 70 °C and cold water of temperature 15 °C to get 120 liters of water of temperature 42 °C. During the process, the hot water releases heat, but all the heat does not transfer to the cold water, but 20 % is released into the environment. How much cold and how much hot water did Mia use?

<b>A.</b> 65,6 L of hot and 54,4 L cold	<b>B.</b> 54,4 L of hot and 65,6 L cold	<b>C.</b> 61,1 L of hot and 58,9 L cold	<b>D.</b> 58,9 L of hot and 61,1 L cold	<b>E.</b> we do not wish to answer
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# CHEMISTRY

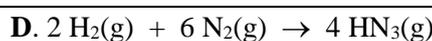
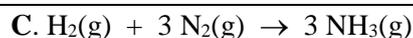
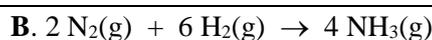
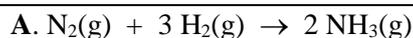
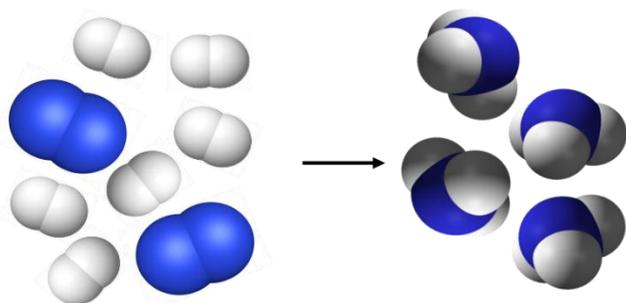
Note: In all tasks, follow the data from the obtained Periodic table of elements.

**CORRECT ANSWER: 10 points**

**ANSWER „E“ : 0 points**

**OTHER : -2 points**

K.1. Which chemical equation represents chemical reaction of the particle model?



E. we do not want to answer the question

K.2. Which of the following changes will produce a gaseous substance that turns limewater milky?

A. Electrolysis of water	B. pyrolysis of blue vitriol	C. heating of potassium permanganate	D. vinegar and baking soda reaction	E. we do not want to answer the question
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K.3. Which of the following compounds contains a non-metal that is not diatomic molecule in its elemental state?

A. ammonia	B. calcium carbonate	C. magnesium chloride	D. hydrogen peroxide	E. we do not want to answer the question
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**CORRECT ANSWER: 20 points**

**ANSWER „E“ : 0 points**

**OTHER : -4 points**

K.4. The mass of the empty beaker is 165 g. With 125 mL of unknown liquid X poured in, the total mass is 309 g. What is the density of the unknown liquid in relation to the density of water at 4 ° C?

A. $\rho(X) \leq \rho(\text{water})$
B. $\rho(X) \geq \rho(\text{water})$
C. $\rho(X) < \rho(\text{water})$
D. $\rho(X) > \rho(\text{water})$
E. we do not want to answer the question

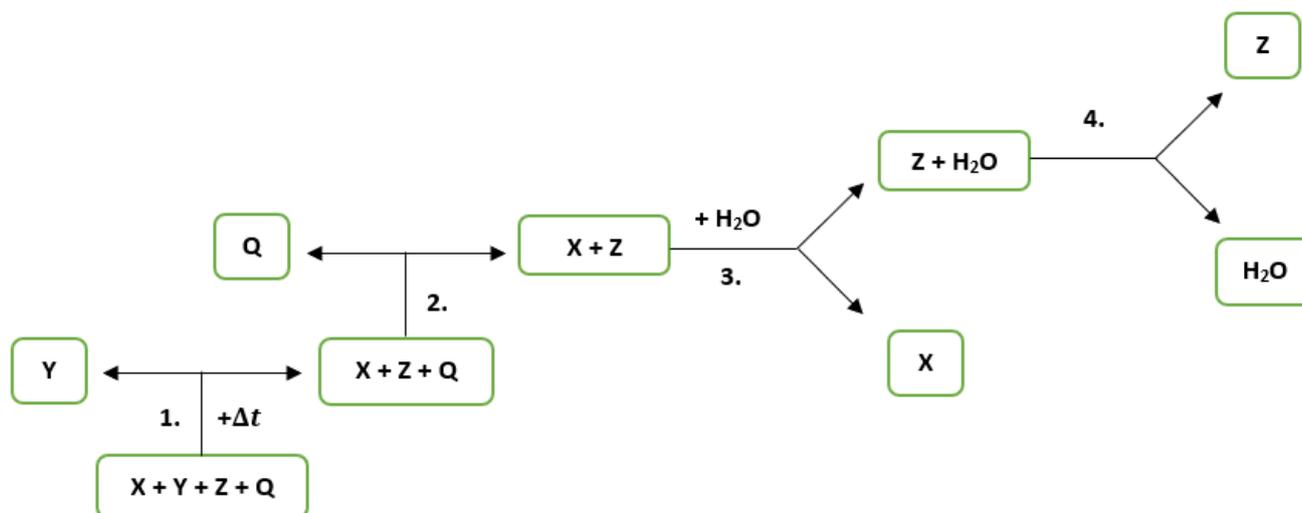
K.5. What is the total number of charged subatomic particles in one molecule of phosphine,  $PH_3$ , if the isotopes  $^1H$  and  $^{31}P$  are present in that molecule?

A. 18	B. 19	C. 36	D. 38	E. we do not want to answer the question
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K.6. A mixture was made of 1 teaspoon of zinc powder, silicate stones, crushed sodium chloride salt and naphthalene leaves.

a) Select the exact sequence of procedures for separating the ingredients from the prepared mixture according to the given scheme.

b) Determine the names of substances X, Y, Z and Q.



<p><b>A.</b></p> <p><b>a)</b></p> <p>1. – sieving</p> <p>2. – sublimation</p> <p>3. – filtration</p> <p>4. – evaporation</p> <p><b>b)</b></p> <p>X – naphthalene</p> <p>Y – zinc</p> <p>Q – sodium chloride</p> <p>Z – silicate stones</p>	<p><b>B.</b></p> <p><b>a)</b></p> <p>1. – filtration</p> <p>2. – sieving</p> <p>3. – sublimation</p> <p>4. – evaporation</p> <p><b>b)</b></p> <p>X – silicate stones</p> <p>Y – naphthalene</p> <p>Q – sodium chloride</p> <p>Z – zinc</p>	<p><b>C.</b></p> <p><b>a)</b></p> <p>1. – evaporation</p> <p>2. – sieving</p> <p>3. – filtration</p> <p>4. – sublimation</p> <p><b>b)</b></p> <p>X – zinc</p> <p>Y – sodium chloride</p> <p>Q – silicate stones</p> <p>Z – naphthalene</p>	<p><b>D.</b></p> <p><b>a)</b></p> <p>1. – sublimation</p> <p>2. – sieving</p> <p>3. – filtration</p> <p>4. – evaporation</p> <p><b>b)</b></p> <p>X – zinc</p> <p>Y – naphthalene</p> <p>Q – silicate stones</p> <p>Z – sodium chloride</p>	<p><b>E.</b> we do not want to answer the question</p>
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**CORRECT ANSWER: 30 points**

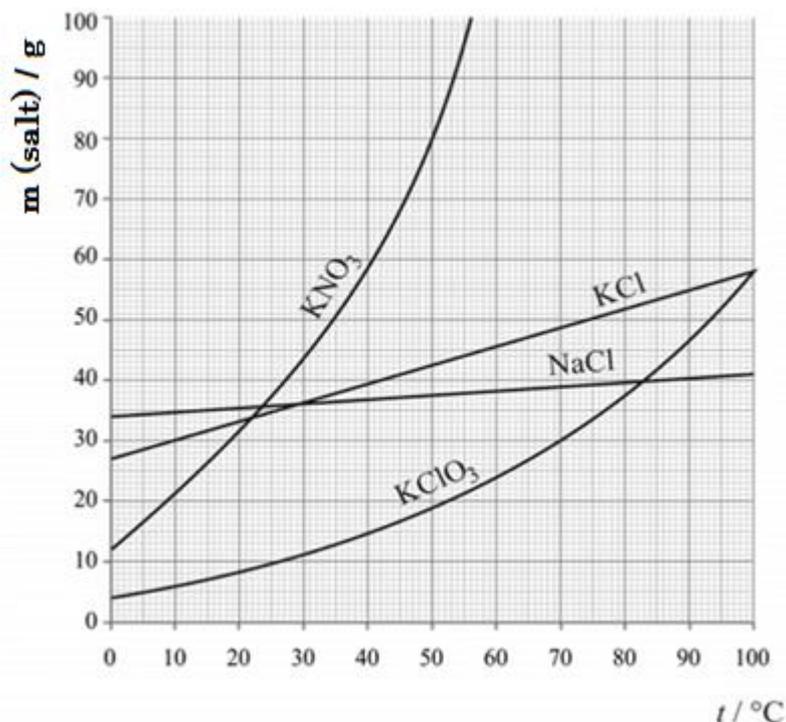
**ANSWER „E“ : 0 points**

**OTHER : -6 points**

K.7. The directions for use pesticide powder for the orchards protection against pests state: “For manual spraying of orchards with an area of 1 ha, it is necessary to dissolve 0,6 kg of pesticides in 1000 L of water. Spray machine uses 30 % less water and 30 % less pesticides.” How many kilograms of pesticides and how many liters of water should be mixed for machine spray to protect 1.5 hectares of orchards?

<p><b>A.</b></p> <p><math>m(\text{pesticide}) = 0,42 \text{ kg}</math></p> <p><math>V(\text{water}) = 700 \text{ L}</math></p>	<p><b>B.</b></p> <p><math>m(\text{pesticide}) = 0,27 \text{ kg}</math></p> <p><math>V(\text{water}) = 450 \text{ L}</math></p>	<p><b>C.</b></p> <p><math>m(\text{pesticide}) = 0,63 \text{ kg}</math></p> <p><math>V(\text{water}) = 1050 \text{ L}</math></p>	<p><b>D.</b></p> <p><math>m(\text{pesticide}) = 0,90 \text{ kg}</math></p> <p><math>V(\text{water}) = 1500 \text{ L}</math></p>	<p><b>E.</b> we do not want to answer the question</p>
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K.8. The diagram shows the largest masses of four types of salt that can be dissolved in 100 g of water at a given temperature.



a) Which of the following salts can be dissolved twice as much at 50 °C as the 19 g of salt dissolved at that temperature?

b) Which of the following statements is correct?

1. To prepare 500 g of saturated solution at 40 °C, 45 g of KClO<sub>3</sub> must be dissolved.

2. To prepare 500 g of saturated solution at 40 °C, 195 g of KNO<sub>3</sub> must be dissolved.

3. To prepare 500 g of saturated solution at 40 °C, 110 g of NaCl must be dissolved.

4. To prepare 500 g of saturated solution at 40 °C, 140 g of KCl must be dissolved.

A.	B.	C.	D.	E.
a) KCl b) 1.	a) NaCl b) 2.	a) KCl b) 3.	a) NaCl b) 4.	we do not want to answer the question

K.9. The chemical element X is located in the 2nd group and the 3rd period of the periodic table of elements, and in the presence of oxygen and heat it burns, creating a new substance. The properties of the substances that may participate in the described change are listed in the attached table.

Substance 1	Substance 2	Substance 3	Substance 4
colorless	white	silvery gray	silvery gray
(g)	(s)	(s)	(s)
$\rho = 1,429 \text{ g/dm}^3$	$\rho = 3,58 \text{ g/cm}^3$	$\rho = 7,874 \text{ g/cm}^3$	$\rho = 1,738 \text{ g/cm}^3$
$t_f = -218,79 \text{ }^\circ\text{C}$	$t_f = 2852 \text{ }^\circ\text{C}$	$t_f = 1538 \text{ }^\circ\text{C}$	$t_f = 650 \text{ }^\circ\text{C}$
does not conduct electricity	does not conduct electricity	conduct electricity	conduct electricity
does not burn	does not burn	does not burn	burn
does not attract a magnet	does not attract a magnet	magnetic	does not attract a magnet

Based on the properties, determine which of the substances (1 - 4) corresponds to each participant of the described chemical change. One of the substances in the table is redundant.

A.	B.	C.	D.	E.
The reactants are: Substance 1 and 2 Product is: Substance 3	The reactants are: Substance 1 and 3 Product is: Substance 2	The reactants are: Substance 2 and 3 Product is: Substance 4	The reactants are: Substance 1 and 4 Product is: Substance 2	we do not want to answer the question

**M - F - K**

<b>TOČAN ODGOVOR : 30 bodova</b>	<b>ODGOVOR „E“ : 0 bodova</b>	<b>OSTALO : -6 boda</b>
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M-F-K. Mountaineer Maja decides to climb Triglav. Maja is also a scientist, so at a cabin at the base of Triglav, at the height of 2515 m, Maja made a water electrolysis system. In the bowl containing the electrodes, she poured 2 L of distilled water and started the process. After the experiment, 1099 mL of water was left in the bowl, and Maja had two closed containers containing the products. Generally, Maja knows that when all the oxygen and hydrogen produced in electrolysis are mixed, we get a mixture that has a mass fraction of oxygen of 88,79 %.

The next morning, Maja climbed to the top of Triglav, which is at height 2864 m, carrying the container with the hydrogen to experiment further. By how much did the gravitational potential energy of Maja's hydrogen change on the way from the cabin to the top of Triglav?

*Remark:* Maja is a careful and precise scientist, so she collected all the products of electrolysis, with no losses.

*(Author of the task: Jakov Budić)*

<b>A.</b> 345,8 J	<b>B.</b> 767,59 J	<b>C.</b> 2738,94 J	<b>D.</b> 2837,74 J	<b>E.</b> we do not wish to answer
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