2nd Round 2022./2023.

SCHOOL	
TEAM NUMBER	
YEAR	**8.**

NAME AND SURNAME OF STUDENT

NAME AND SURNAME OF MENTOR	
	M
	F
	K

ANSWERS:

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.		

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MATHEMATICS

CORRECT ANSWER: 10 points	ANSWER „E“: 0 points	ELSE: –2 points

M.1. The following is true for angle sizes in a triangle: $\alpha : \beta = 3 : 4$ and $\beta : \gamma = 2 : 3$. What is the size of angle β ?

A.	**B.**	**C.**	**D.**	**E.** we do not wish to answer
13°50'	55°23'	41°32'	55°32'	

M.2. Write the expression $\left(2^{2020}\right)^{2021} \cdot 4^{2022} : 8^{2023}$ as a power with the base 2. What is the sum of the first and last digit of the exponent in the power?

A.	**B.**	**C.**	**D.**	**E.** we do not wish to answer
9	13	7	it cannot be determined	

M.3. The number 3 517 153 is the same if read backwards. Write the greatest number with the same digits and the same property, but smaller than the given number. What is the sum of its tens and thousands digits?

A.	**B.**	**C.**	**D.**	**E.** we do not wish to answer
8	6	10	4	

CORRECT ANSWER: 20 points	ANSWER „E“ : 0 points	ELSE : –4 points

M 4. Monika cut two equal paper rectangles of width 3 cm and length 6 cm. She then placed them in different positions and noted their intersection. How many of the following figures are those that she cannot get as the intersection of the rectangles?

- Square
- Rectangle
- Parallelogram
- Rhombus
- Isosceles triangle
- Equilateral triangle
- Right angled triangle
- Pentagon
- Hexagon

A.	**B.**	**C.**	**D.**	**E.** we do not wish to answer
0	1	2	3	

M.5. What is the size of the angle formed by the big and small hand of the clock at 1:15?

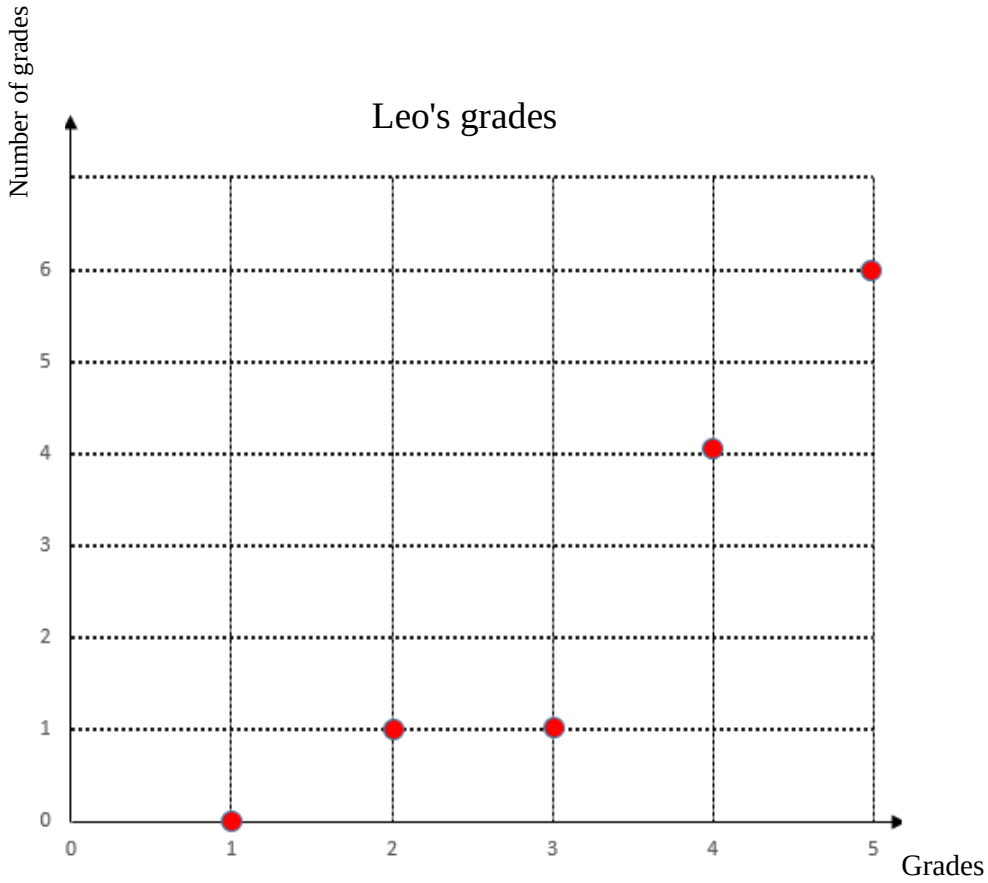
A.	**B.**	**C.**	**D.**	**E.** we do not wish to answer
60°	55,5°	52,5°	57,5°	

M.6. Let *a*, *b* and *c* be elements of the set $\{1,2,4,5,7,8\}$. How many ordered triples (*a*, *b*, *c*) exist for which the number $4ab+5bc+6ca$ is even?

A.	**B.**	**C.**	**D.**	**E.** we do not wish to answer
207	496	162	54	

CORRECT ANSWER: 30 points	**ANSWER „E“ : 0 points**	**ELSE : –6 points**

M.7. A dot graph shows Leo's grades in Maths. At least how many fives must Leo get in Maths so that the average of his grades is at least 4,5?



A.	**B.**	**C.**	**D.**	**E.** we do not wish to answer
4	5	6	More than 6	

M.8. The ratio of the length of the base and the length of the leg of an isosceles triangle is $\sqrt{3}:1$. What is the ratio of the height (altitude) dropped onto the leg and the length of the base of the triangle?

A.	**B**.	**C**.	**D**.	**E**. we do not wish to answer
$1:\sqrt{2}$	$1:\sqrt{3}$	$\sqrt{3}:2$	1 : 2	

M.9. In how many different ways can we move the letters **MAT**E**MAT**IKA so that in the word we get we have **MAT** written twice?

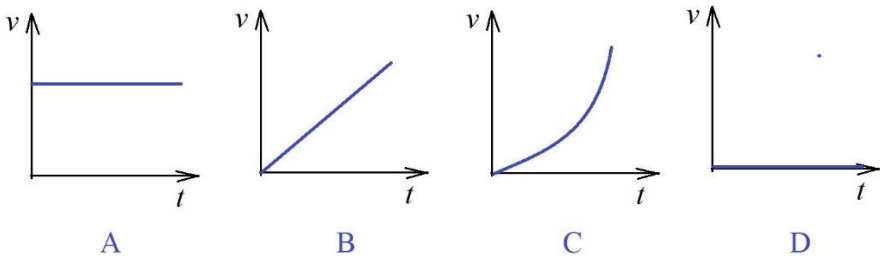
A.	**B**.	**C**.	**D**.	**E**. we do not wish to answer
1 440	360	720	None of the above	

PHYSICS

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

CORRECT ANSWER : 10 points	ANSWER „E“ : 0 points	ELSE : –2 points

F.1. Katarina pulls a wooden cube on a smooth surface (friction is neglectable) with a force with constant magnitude and direction. Which graph correctly shows how the velocity of the cube depends on time?

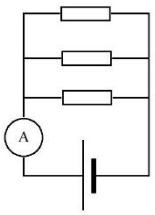


A.	**B**.	**C**.	**D**.	**E**. we do not wish to answer
A	B	C	D	

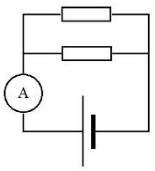
F.2. Iva took a neutral plastic rod and charged it so that it became negatively charged. What happened with the mass of the rod during the charging?

A.	**B**.	**C**.	**D**.	**E**. we do not wish to answer
It increased.	It remained the same.	It decreased.	There isn't enough data to determine this.	

F.3. A circuit with three identical resistors is shown on image 1 (slika 1). The ammeter shows a current of 3 A. Which current will the ammeter show if we disconnect one of the resistors to get a circuit as shown on image 2 (slika 2)? The internal resistance of the source is neglectable.



slika 1



slika 2

A.	**B**.	**C**.	**D**.	**E**. we do not wish to answer
1 A	2 A	3 A	4 A	

CORRECT ANSWER: 20 points	ANSWER „E“ : 0 points	ELSE : –4 points

F.4. Petra suspended an aluminium cube on a spring with the elasticity constant of 20 N/m and the spring extended by 30 cm. She then submerged the cube (still suspended on the spring) into a bowl that has a base of area 70 cm^2 and is half filled with water. By how many centimetres will the level of the water in the bowl rise if the cube is fully submerged? The density of aluminium is 2700 kg/m^3.

A.	**B**.	**C**.	**D**.	**E**. we do not wish to answer
3,17 cm	3,37 cm	3,57 cm	3,77 cm	

F.5. A big balloon, whose mass including the gas it's filled with is 20 kg, rises vertically upwards through the air with constant speed. The air resistance force is 60 N. What is the volume of the balloon? The density of air is 1,29 kg/m^3.

A.	**B**.	**C**.	**D**.	**E**. we do not wish to answer
20,16 m^3	15,13 m^3	10,92 m^3	8,16 m^3	

F.6. A four-member crew and their bobsleigh have a mass of 550 kg. The finish of the ice track is 200 m lower in altitude than the start. During the ride from start to finish, due to force of friction, 722700 J of heat is produced. What is the speed of the sleigh with the crew in the moment of passing through the finish line?

A.	**B**.	**C**.	**D**.	**E**. we do not wish to answer
37 km/h	37 m/s	81 km/h	81 m/s	

CORRECT ANSWER: 30 points	**ANSWER „E" : 0 points**	**ELSE : –6 points**

F.7. The mass of a tram including the passengers is 40 tons. Climbing uphill, the tram covered a difference in altitude of 20 m in 5 minutes. The electrical voltage in the tram network is 500 V. What is the resistance of the electromotor of the tram? Neglect all losses of energy.

A.	**B**.	**C**.	**D**.	**E**. we do not wish to answer
13,4 Ω	11,4 Ω	9,4 Ω	7,4 Ω	

F.8. Mirko wanted to determine the temperature of the fire in the fireplace. He did not have a thermometer for high temperatures so he used the following method. He placed a piece of iron of 300 g into the fire and left it for some time. After that he used tongs to quickly transfer this piece of iron into an aluminium bowl containing 3 litres of water at a temperature of 20 °C. The mass of the bowl was 200 g. When they reached a balance, the temperature of the bowl with water was 30 °C. What was the temperature of the fire? The specific heat capacities of iron, aluminium and water are 460 J/(kg·°C), 920 J/(kg·°C) and 4200 J/(kg·°C), respectively.

A.	**B**.	**C**.	**D**.	**E**. we do not wish to answer
917 °C	930 °C	943 °C	956 °C	

F.9. A car has a mass 1200 kg. Each one of its four disc brakes has a mass of 5 kg and the specific heat capacity of 240 J/(kgK). While driving on a straight toad, the driver noticed a large object on the road and started to brake till stopping. During the braking 55 % of the mechanical energy transformed into internal energy of the discs. The temperature of the discs before braking was 22 °C, and in the moment it stopped the temperature was 90 °C. What was the speed of the car in the moment it started braking?

A.	**B**.	**C**.	**D**.	**E**. we do not wish to answer
56,6 km/h	72,4 km/h	96,6 km/h	113,2 km/h	

CHEMISTRY

Note: In all tasks, adhere to the data from the obtained table of the periodic table of elements.

CORRECT ANSWER : 10 points	ANSWER „E“ : 0 points	ELSE : –2 points

C1. Which statement accurately describes the change in the physical properties of water that occurs as a result of heating ice cubes in a laboratory beaker?

A. the mass increased, the volume decreased and the density of water increased
B. mass decreased, volume increased and water density decreased
C. the mass did not change, the volume decreased and the density of water increased
D. the mass did not change, the volume increased and the density of water decreased
E. we do not wish to answer

C2. The table contains data on the melting point and boiling point of substances X and Y.

	X	**Y**
Melting point / °C	–259	–218
Boiling point / °C	–253	–183

In which state of aggregation are substances X and Y at a temperature of –225 °C?

A.	**B**.	**C**.	**D.**	**E.** we do not wish to answer
matter X: gas **matter Y**: liquid	**matter X**: liquid **matter Y**: solid	**matter X**: solid **matter Y**: gas	**matter X**: gas **matter Y**: solid	

C3. The table lists some toxic compounds that have been found on the mucous membranes of frogs or are used as pesticides. Also listed are their lethal doses (LD50) for mice per kilogram of body weight.

(The lethal dose (LD50) is the amount of a toxic compound sufficient to cause the death of 50% of the individuals that absorbed it per kilogram of mass.)

Name of poison	**LD_{50} / per kg of mouse weight**
batrachotoxin	0,00000199 g
strychnine	0,002 g
piperonyl butoxide	0,0046 g
parathion	0,006 g
arsenic(III) oxide	0,013 g
nicotine	0,050 g
zinc phosphide	0,072 g

Which of the listed substances is the most toxic to mice?

A.	**B**.	**C**.	**D**.	**E.** we do not wish to answer
batrachotoxin	zinc phosphide	parathion	arsenic(III) oxide	

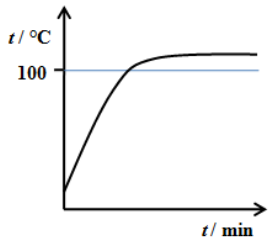
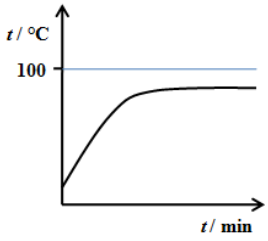
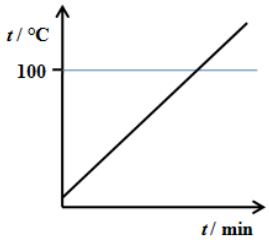
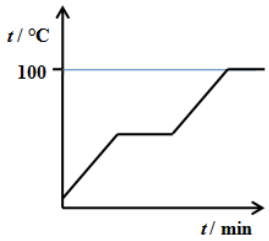
CORRECT ANSWER: 20 points	ANSWER „E“ : 0 points	ELSE : –4 points

C4. Solutions **O** and **T** are in separate beakers. Solution **O** has a pH value of 3 and the pH value of solution **T** is unknown. After mixing the contents of the two glasses, the pH-value of the mixture was determined using universal indicator paper, which is 5.

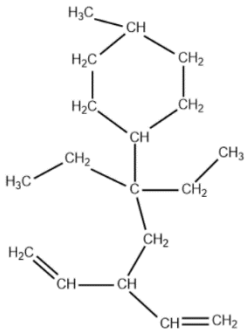
Which statement is correct for solutions **O** and **T**?

A. solution **T** has more oxonium ions than solution **O**
B. solution **O** has more hydroxide ions than solution **T**
C. solution **T** has more hydroxide ions than solution **O**
D. solution **O** has fewer oxonium ions than solution **T**
E. we do not wish to answer

C5. A saturated solution of sodium chloride was heated with an electric heater in a glass, and during heating the solution temperature values were recorded. Which diagram correctly shows the change in temperature of a solution during heating at normal atmospheric pressure?

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

C6. How many molecules of oxygen are needed for the complete combustion of an unusual hypothetical "human-sized" molecule?



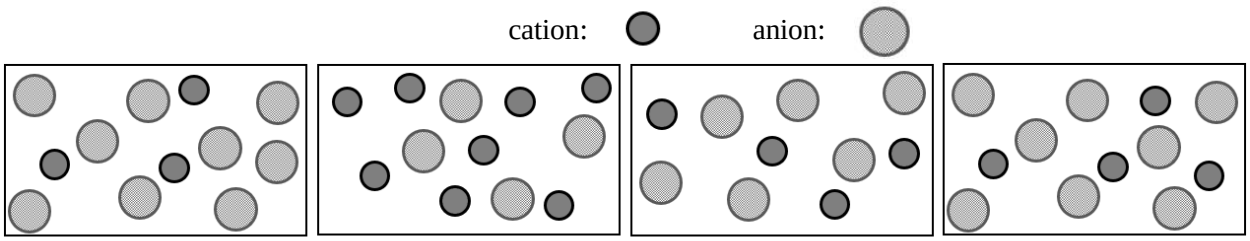
A.	**B.**	**C.**	**D.**	**E.** we do not wish to answer
16	18	26	52	

CORRECT ANSWER: 30 points	ANSWER „E“ : 0 points	ELSE : –6 points

C7. Atoms of a chemical element X with fluorine atoms form a compound of the molecular formula XF_5. The ratio of the mass of the X atom to the mass of all fluorine atoms in the molecule is 0,3732. What is the correct chemical formula of the compound?

A.	**B**.	**C**.	**D.**	**E**. we do not wish to answer
ClF_5	SF_5	PF_5	NF_5	

C8. Figures 1-4 show the particle composition of aqueous solutions of different salts.



Sl. 1 **Sl. 2** **Sl. 3** **Sl. 4**

In which series are the pictures of the particle composition of aqueous solutions correctly associated with examples of salt.

A.	**B**.	**C**.	**D.**	**E**. we do not wish to answer
Sl. 1 iron(III) sulfate **Sl. 2** magnesium nitrate **Sl. 3** aluminum chloride **Sl. 4** sodium carbonate	**Sl. 1** aluminum chloride **Sl. 2** sodium carbonate **Sl. 3** iron(III) sulfate **Sl. 4** magnesium nitrate	**Sl. 1** magnesium nitrate **Sl. 2** aluminum chloride **Sl. 3** sodium carbonate **Sl. 4** iron(III) sulfate	**Sl. 1** sodium carbonate **Sl. 2** iron(III) sulfate **Sl. 3** magnesium nitrate **Sl. 4** aluminum chloride	

C9. Students found instructions for preparing several experiments with cobalt(II) chloride. The color of the aqueous solution of cobalt(II) chloride depends on the temperature, and changes from blue to pink. This solution can also be used as "invisible ink".

For the experiments, they should prepare 500 g of a solution in which the mass fraction of cobalt(II) chloride ($CoCl_2$) is 5%. In the cabinet, they found a bottle of hydrated salt of cobalt(II) chloride hexahydrate ($CoCl_2 \times 6\ H_2O$). What mass of these hydrate salts should be weighed in order to prepare the desired solution?

A.	**B**.	**C**.	**D**.	**E**. we do not wish to answer
5,00 g	9,16 g	25,0 g	45, 8 g	

M– F - K

CORRECT ANSWER : 30 points	ANSWER „E“ : 0 points	ELSE : –6 points

M-F-K. Lara s tidying the chemistry room. She wants to put 13 bottles with chemicals into a cabinet with 5 shelves. She wants the acids on the lowest shelf, and the organic compounds on the topmost shelf. Also, she wants all the bases to be on the same shelf, but it doesn't matter which one. She wants to place the remaining bottles onto the remaining two shelves without any special rules. Lara knows that every shelf lies on two supports and that each support would break if the force exerted on it is larger than 6 N. In how many ways can Lara organise her cabinet according to her wishes?

The bottles have the following labels: H_2O, NaOH, $CaCO_3$, H_2SO_4, C (graphite), C_2H_5OH, HNO_3, HCl, $CH_3CH_2CH_2CH_2CH_3$, KCl, KOH, $Ca(OH)_2$, $KMnO_4$.

The mass of each bottle including the chemical is 300 g.

Note: Each shelf can hold only one row of bottles, they cannot be placed behind each other, only next to each other.

A.	**B**.	**C**.	**D**.	**E**. We do not wish to answer
7 776	8 640	25 920	103 680	

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