

WYPEŁNIA ZDAJĄCY

KOD

--	--	--

PESEL

--	--	--	--	--	--	--	--	--	--	--

Miejsce na naklejkę.

Sprawdź, czy kod na naklejce to
M-100.

Jeżeli tak – przyklej naklejkę.
Jeżeli nie – zgłoś to nauczycielowi.

Egzamin maturalny

Formuła 2023

CHEMIA

Poziom rozszerzony

Dodatkowe zadania w języku angielskim

Symbol arkusza

MCHA-Z0-100-2505

DATA: **22 maja 2025 r.**

GODZINA ROZPOCZĘCIA: **9:00**

CZAS TRWANIA: **80 minut**

LICZBA PUNKTÓW DO UZYSKANIA: **25**

Przed rozpoczęciem pracy z arkuszem egzaminacyjnym

1. Sprawdź, czy nauczyciel przekazał Ci **właściwy arkusz egzaminacyjny**, tj. arkusz we **właściwej formule**, z **właściwego przedmiotu** na **właściwym poziomie**.
2. Jeżeli przekazano Ci **niewłaściwy** arkusz – natychmiast zgłoś to nauczycielowi. Nie rozrywaj banderol.
3. Jeżeli przekazano Ci **właściwy** arkusz – rozerwij banderole po otrzymaniu takiego polecenia od nauczyciela. Zapoznaj się z instrukcją na stronie 2.





Instrukcja dla zdającego

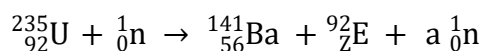
1. Sprawdź, czy arkusz egzaminacyjny zawiera 13 stron (zadania 1–12). Ewentualny brak zgłoś przewodniczącemu zespołu nadzorującego egzamin.
2. Na pierwszej stronie oraz na karcie odpowiedzi wpisz swój numer PESEL i przyklej naklejkę z kodem.
3. Odpowiedzi i rozwiązania zapisz w miejscu na to przeznaczonym przy każdym zadaniu.
4. W rozwiązaniach zadań rachunkowych przedstaw tok rozumowania prowadzący do ostatecznego wyniku oraz pamiętaj o jednostkach.
5. Pisz czytelnie. Używaj długopisu/pióra tylko z czarnym tuszem/atramentem.
6. Nie używaj korektora, a błędne zapisy wyraźnie przekreśl.
7. Pamiętaj, że zapisy w brudnopisie nie będą oceniane.
8. Możesz korzystać z *Wybranych wzorów i stałych fizykochemicznych na egzamin maturalny z biologii, chemii i fizyki*, linijki oraz kalkulatora naukowego. Upewnij się, czy przekazano Ci broszurę z taką okładką, jak poniżej.



**Zadania egzaminacyjne są wydrukowane
na kolejnych stronach.**

Task 1. (0–1)

When bombarded with neutrons, the nuclei of some heavy elements undergo fission, that is, they split into smaller parts. The diagram below shows one of the possible fission reactions of the uranium ^{235}U nucleus.



Source: A. Bielański, *Podstawy chemii nieorganicznej*, Warszawa 2012.

Complete the table below. Write down the symbol of the element E and the number of neutrons (*a*) that are released during the fission reaction of a single uranium ^{235}U nucleus.

Symbol of the element E	Number of neutrons released (<i>a</i>)

Task 2.

A given set of metals is marked with the following symbols:

Al Mg K Na

Task 2.1. (0–2)

Choose and write down the symbol of one of the metals shown above

- whose atom has the greatest atomic radius.

.....

- whose atom has the highest electronegativity.

.....

- in whose atom in the ground state the electrons occupy the greatest number of orbitals

.....

- in whose atom in the ground state there are no unpaired electrons.

.....



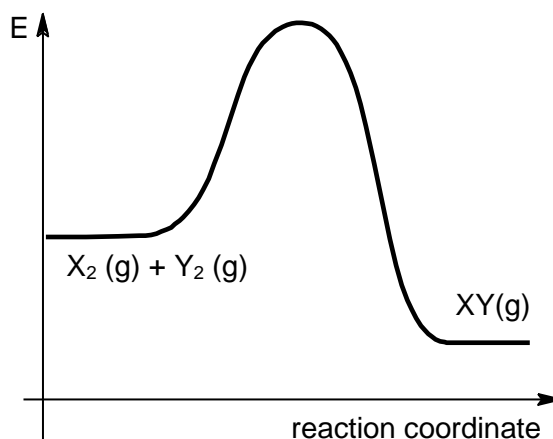
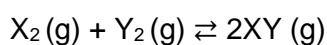
Task 2.2. (0–1)

Decide whether the sentences below are true (T) or false (F). Mark the appropriate letter.

1.	The formula $1s^2 2s^2 2p^6 3s^0 3p^1$ represents the electron configuration of an atom of one of the metals listed above, in an excited state.	T	F
2.	In donating valence electrons, the atoms of all the metals listed above form simple ions with the same noble gas configuration.	T	F

Task 3. (0–1)

The graph below illustrates the change of energy during the reaction described by the following equation:



Determine whether the yield of the reaction in which the product XY is obtained will increase, decrease or remain the same if, in a system at equilibrium,

- there is a decrease in temperature under isobaric conditions ($p = \text{const}$).

.....

- there is a decrease in pressure under isothermal conditions ($T = \text{const}$).

.....

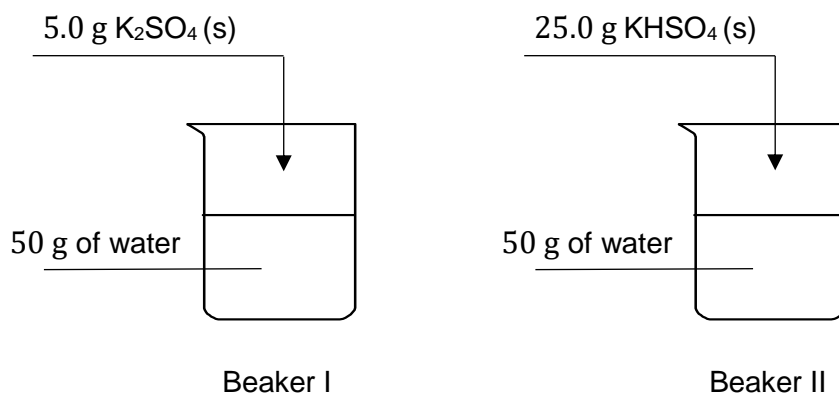
Task 4. (0–2)

The table below shows the solubility values of two potassium salts at a temperature of 293 K.

Temperature, K	Solubility, g per 100 g of water	
	K_2SO_4	$KHSO_4$
293	11.0	47.7

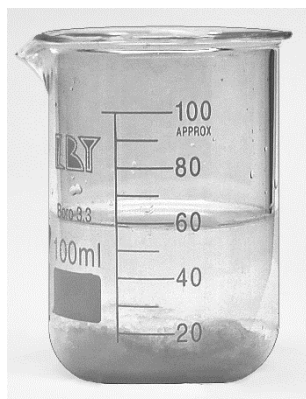
Source: W. Mizerski, *Tablice chemiczne*, Warszawa 2013.

An experiment was carried out as shown below.



The contents of the beakers were heated and stirred until the salts in both beakers dissolved. Next, the temperature was lowered to 293 K.

The photograph below shows the contents of one of the beakers after the experiment.



Complete the sentences below. Choose and mark the correct answer from among the options given in each set of brackets.

The photograph shows the contents of (Beaker I / Beaker II). The mixture obtained in this beaker is (homogeneous / heterogeneous).

(A saturated / An unsaturated) solution was formed in the beaker which is not shown in the photograph.



Task 5. (0–2)

An experiment was carried out to obtain a solution of sodium chloride at a molar concentration 10 times lower than the concentration of the starting solution.

The following were used in the experiment:

- distilled water
- an aqueous solution of sodium chloride at a concentration of $0.5 \text{ mol} \cdot \text{dm}^{-3}$
- appropriate laboratory equipment, including the glass measuring instruments shown in the photographs below.



Complete the sentences below. Choose and mark the correct answer from among the options given in each set of brackets.

1.

2.5 cm^3 of an aqueous solution of sodium chloride at a concentration of $0.5 \text{ mol} \cdot \text{dm}^{-3}$ was measured using (a pipette / a burette). The solution was transferred to (a beaker / a volumetric flask) with a volume of 250 cm^3 , i.e. 250 ml, topped up to the mark with distilled water and sealed with the stopper. Next, the contents were stirred.

2.

The objective of the experiment (was / was not) achieved because the concentration of the resulting solution was (4 times / 10 times / 100 times) lower than the concentration of the starting solution.

Task 6.

An experiment was conducted in which chemical reactions took place in two test tubes marked I and II. In one of the test tubes, copper reacted with nitric(V) acid and in the other test tube, magnesium reacted with hydrochloric acid. Gaseous products were formed in both test tubes during the reaction. They are described in the table below.

Test tube I	Test tube II
Colourless and odourless gas	Brown gas with a pungent, acrid odour

Task 6.1. (0–1)

Write down the symbol of the metal used in the experiment in test tube II.

.....

Task 6.2. (0–1)

Complete the sentence below. Choose and mark the correct answer from among the options given in brackets.

(Decantation / Evaporation in a fume hood / Centrifugation / Filtration) must be performed to isolate the ionic product obtained in test tube I from the reaction mixture.

Task 7. (0–2)

The equilibria described by the following equations are established in the standard half-cells A, B and C:

Half-cell A	$\text{BrO}_3^- + 6\text{H}^+ + 6\text{e}^- \rightleftharpoons \text{Br}^- + 3\text{H}_2\text{O}$
Half-cell B	$\text{SO}_4^{2-} + \text{H}_2\text{O} + 2\text{e}^- \rightleftharpoons \text{SO}_3^{2-} + 2\text{OH}^-$
Half-cell C	$\text{NO}_3^- + 4\text{H}^+ + 3\text{e}^- \rightleftharpoons \text{NO} + 2\text{H}_2\text{O}$

A cell was constructed from two of these half-cells. A reaction took place in the cell during its operation and gas was released.

Write the overall equation in the ionic form of the reaction taking place in the cell described above. Calculate the electromotive force (*EMF*) of this cell under standard conditions.

Overall equation of the chemical reaction:

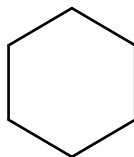
.....

EMF =



Task 8.

Cyclohexane is a cyclic hydrocarbon with the following chemical structure:



Its melting point is equal to 7 °C and its boiling point (at 1000 hPa) is 83 °C. This hydrocarbon reacts similarly to alkanes.

On an industrial scale, cyclohexane is produced by the hydrogenation of benzene in the presence of a catalyst. Under the right conditions, it can also be obtained by reacting a dibromo derivative of an alkane with sodium. The two halogen atoms present in this dibromo derivative are bonded to primary carbon atoms.

Source: R. Morrison, R. Boyd, *Chemia organiczna*, Warszawa 2008.

Task 8.1. (0–2)

Complete the sentences below. Choose and mark the correct answer from among the options given in each set of brackets.

The (*sp* / *sp*² / *sp*³) hybridisation is assigned to the valence orbitals of all carbon atoms in the cyclohexane molecule. Because of the spatial orientation of these orbitals, the molecule of this compound (is / is not) planar. The number of σ bonds in this hydrocarbon molecule is (6 / 12 / 18). At a temperature of 25 °C and a pressure of 1000 hPa, cyclohexane is (a solid / a liquid / a gas).

Task 8.2. (0–1)

Write down the systematic name of the dibromo derivative described in the introductory information that reacts with sodium to form cyclohexane.

.....

Task 8.3. (0–2)

Write the equation of the monochlorination of cyclohexane, which occurs in the presence of light. Use the semi-structural (condensed) formulae for the organic compounds. Determine the type (addition, elimination, substitution) and mechanism (electrophilic, nucleophilic, radical) of this reaction.

Reaction equation:

.....

Reaction type:

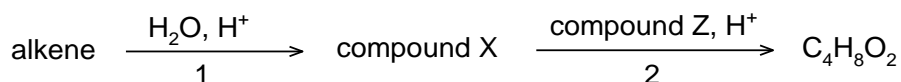
Reaction mechanism:

.....

Introductory information for Tasks 9.–10.

Compound X is obtained from the reaction of a certain alkene with water in an acidic medium. This compound reacts with compound Z in the presence of sulphuric(VI) acid. The reaction produces an organic product whose molecular formula is given in the diagram, and the by-product is water.

It is known that compounds X and Z have the same number of carbon atoms in their molecules.



Task 9. (0–1)

Complete the table below. Write down the semi-structural (condensed) formulae of the compounds labelled as X and Z.

Formula of compound X	Formula of compound Z

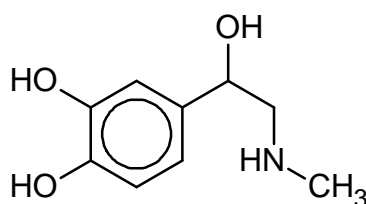
Task 10. (0–1)

Decide whether the sentences below are true (T) or false (F). Mark the appropriate letter.

1.	The compound whose molecular formula is given in the diagram is the result of a series of reactions and can be hydrolysed in an acidic or alkaline environment.	T	F
2.	2-Methylpropanoic acid is one of the isomers of a compound that is obtained when compound X reacts with compound Z.	T	F

Task 11.

The chemical structure of adrenaline is given below.



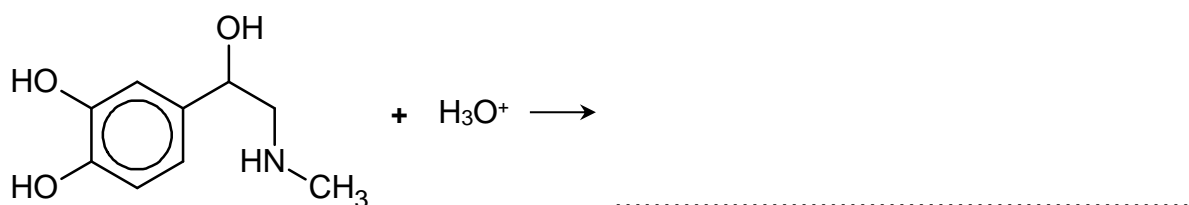
Task 11.1. (0–2)

Decide whether the sentences below are true (T) or false (F). Mark the appropriate letter.

1.	Adrenaline can act as a Brønsted-Lowry acid under the right conditions.	T	F
2.	Adrenaline can react with sodium hydroxide at a molar ratio of: $n_{\text{adrenaline}} : n_{\text{NaOH}} = 1 : 3$.	T	F
3.	There is an amide (peptide) bond in the adrenaline molecule.	T	F
4.	Adrenaline reacts with iron(III) chloride to form a coloured compound.	T	F

Task 11.2. (0–1)

Complete the diagram below to obtain the net ionic equation of the reaction of adrenaline and hydrochloric acid.

**Task 11.3. (0–1)**

Decide whether the adrenaline molecule is chiral. Give the reasoning behind your answer.

Decision:

Reasoning:

.....

.....

Task 12. (0–1)

An alkaline suspension of copper(II) hydroxide was prepared. The appearance of the contents of the test tube is shown in the photograph to the right. Next, an experiment was carried out: an aqueous solution of fructose was added to the test tube containing the suspension, and the contents of the test tube were stirred (Phase I). The test tube was then heated (Phase II).



The photographs below show the appearance of the contents of the test tube after each of the two phases of the experiment.

After Phase I



After Phase II



Decide whether the sentences below are true (T) or false (F). Mark the appropriate letter.

1.	If an aqueous solution of propane-1,2,3-triol (glycerol) were used in the experiment instead of an aqueous solution of fructose, the result of Phase I would be the same, since the molecules of both compounds have more than one hydroxyl group in their structure.	T	F
2.	If an aqueous solution of propane-1,2,3-triol (glycerol) were used in the experiment instead of an aqueous solution of fructose, the result of Phase II would be the same, since both fructose and glycerol have reducing properties in alkaline solutions.	T	F

NOTES (*not subject to evaluation*)

CHEMIA

Poziom rozszerzony

Formuła 2023



CHEMIA

Poziom rozszerzony

Formuła 2023



CHEMIA

Poziom rozszerzony

Formuła 2023

