CENTRALNA KOMISJA EGZAMINACYJNA

Arkusz zawiera informacje prawnie chronione do momentu rozpoczęcia egzaminu.

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**-2305

DATA: **23 maja 2023 r.**

GODZINA ROZPOCZĘCIA: **12:10**

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 12 stron (zadania 1–13). 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 okładką taką jak widoczna poniżej.

Zadania egzaminacyjne są wydrukowane na następnych stronach.

Task 1.

The ground state electron configuration of the valence shell for an atom of the chemical element E is $4s^2 4p^3$.

Task 1.1. (0–1)

Complete the table below. Write the chemical symbol, group number and period number of the element E.

Chemical symbol	Group number	Period number

Task 1.2. (0–1)

Write the ground state electron configuration of an E^{3+} ion. Use the condensed electron configuration with the symbol of the noble gas.

.....

Task 2. (0–2)

The chemical formulas of sulphur(IV) oxide and carbon(IV) oxide have the same stoichiometry (AB_2), but their molecules have different geometry.

Complete the sentences below. Choose and underline the correct answer from the options given in each bracket.

1. The hybridization of the valence orbitals of the sulphur atom in sulphur(IV) oxide is described as (*sp* / sp^2 / sp^3). A molecule of sulphur(IV) oxide has (a linear / an angular / a tetrahedral) shape.
2. The hybridization of the valence orbitals of the carbon atom in carbon(IV) oxide is described as (*sp* / sp^2 / sp^3). A molecule of carbon(IV) oxide has (a linear / an angular / a tetrahedral) shape.

Task 3.

Hydrides are chemical compounds of hydrogen with other chemical elements. Hydrides can be divided, among others, into metal and non-metal hydrides as well as into basic, acidic and neutral hydrides, according to their chemical nature.

Task 3.1. (0–1)

Arrange the following hydrides

LiH HBr NH_3 H_2S

in order of increasing basicity.

.....

Task 3.2. (0–1)

Write <u>a molecular equation</u> for the reaction of lithium hydride with water.

.....

Task 4. (0–1)

Carbon and carbon(IV) oxide were put in a closed container with volume $1\ \mathrm{dm}^3$, at a temperature of T and under pressure p. Next, a chemical reaction was initiated. After some time, equilibrium was reached, as described below:

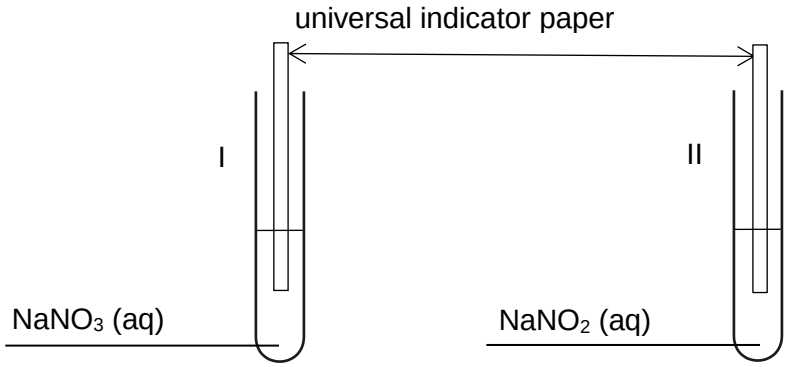
$$\mathrm{C\,(s)} + \mathrm{CO_2\,(g)} \rightleftarrows 2\mathrm{CO\,(g)} \qquad \Delta H > 0$$

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

1.	Reducing the reactor's volume under isothermal conditions ($T =$ const.) does <u>not affect</u> the point of equilibrium.	**T**	**F**
2.	When a catalyst is introduced, the yield of the reaction in which carbon(II) oxide is produced increases.	**T**	**F**

Task 5.

To determine the pH of aqueous solutions of $NaNO_2$ and $NaNO_3$, two pieces of yellow universal indicator paper were immersed in the solutions, as shown in the diagram below.



Task 5.1. (0–1)

The results of the experiment are shown in the photographs below.

A.

B.

Write which universal indicator paper (A or B) was immersed in the aqueous solution in test tube I.

.....

Task 5.2. (0–1)

Write <u>a net ionic equation</u> for the reaction in which the pH of one of the test solutions turned basic. Use the Brønsted–Lowry theory of acids and bases.

.....

Task 6.

Sulphuric(IV) acid is a weak acid which undergoes gradual dissociation. The dissociation constants for this acid at a temperature of $25\ °C$ are $Ka_1 = 1.23 \cdot 10^{-2}$ and $Ka_2 = 6.61 \cdot 10^{-8}$, respectively.

The relationship between the acid dissociation constant Ka and the dissociation constant of a conjugated base Kb is given by the formula: $Kw = Ka \cdot Kb$, where Kw is the ionic product of water. This relationship means that the stronger the Brønsted–Lowry acid, the weaker the conjugated base.

Source: W. Mizerski, *Tablice szkolne*. *Chemia*, Warszawa 2010.

Task 6.1. (0–1)

Which of the ions produced during the protolysis (dissociation) of sulphuric(IV) acid has the <u>highest</u> concentration? Write the formula of this ion.

.....

Task 6.2. (0–1)

Complete the diagram below with the formulas of appropriate particles to form the equation of the reaction between the strongest base present in an aqueous solution of sulphuric(IV) acid and water. Use the Brønsted–Lowry theory of acids and bases.

base 1		acid 2	⇄	acid 1		base 2
	+				+	

Task 7. (0–2)

Aqueous solutions of two monoprotic acids, with a concentration of $0.1\ \mathrm{mol \cdot dm^{-3}}$, were prepared at a temperature of $20\ °C$, and the dissociation degree was determined for each solution. The results are given in the table below.

acid	molar concentration	dissociation degree
HA	$0.1\ \mathrm{mol \cdot dm^{-3}}$	3 %
HR	$0.1\ \mathrm{mol \cdot dm^{-3}}$	1 %

Determine if HA acid is stronger or weaker than HR acid. Give the reasoning behind your answer. From the options below, choose and circle the appropriate dissociation constant for HR acid at a temperature of $20\ °C$.

Decision: .....

Reasoning: .....

.....

Dissociation constant for HR acid:

$1.0 \cdot 10^{-1}$ $1.0 \cdot 10^{-3}$ $1.0 \cdot 10^{-5}$

Task 8. (0–2)

Two unlabelled beakers, A and B, contain samples of distilled water and tap water, which is a diluted solution of various salts. To distinguish between the contents of the beakers, an experiment was carried out using an aqueous solution of silver(I) nitrate(V) as a reagent. The photographs below show beakers A and B after adding the reagent.

Beaker A

Beaker B

Determine which beaker (A or B) contained tap water.
From the ions listed below

K^+ Cl^- Ca^{2+} CH_3COO^- Fe^{3+}

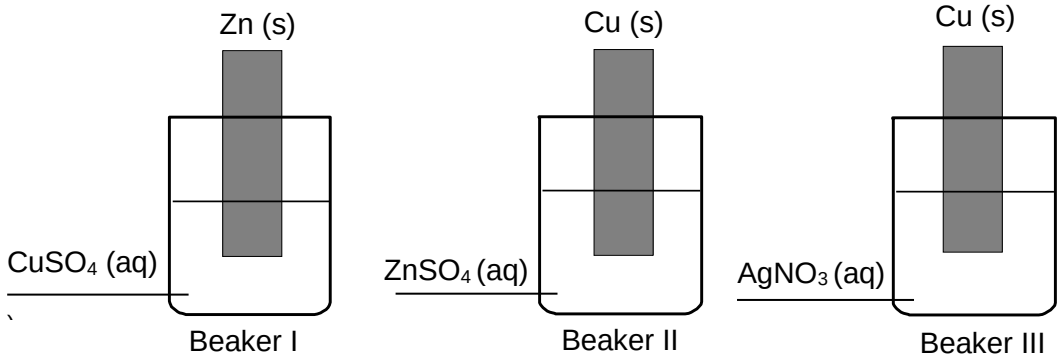
choose the one which may have been present in the test sample of tap water and write <u>a net ionic equation</u> for the reaction of this ion during the experiment.

Tap water was in Beaker: .....

Reaction equation: .....

Task 9.

To compare the properties of zinc, copper, and silver, an experiment was carried out, as shown in the figure below.



The results of the experiment are shown in the photographs below.


Beaker I


Beaker II


Beaker III

Task 9.1. (0–1)

Complete the sentences below. Choose and circle the correct answer from the options given in each bracket.

1. The mass of the plate immersed in the aqueous solution of $AgNO_3$ (increased / did not change / decreased).
2. Based on the experiment results, it can be concluded that (Zn (s) / Cu (s) / Ag (s)) is the strongest reducing agent.

Task 9.2. (0–1)

Write <u>a net ionic equation</u> for the reaction which occurred in Beaker I.

.....

Task 10.

The reaction between iron(II) ions and manganate(VII) ions in an acidic environment occurs according to the formula:

$$5Fe^{2+} + 8H^{+} + MnO_4^{-} \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$$

Task 10.1. (0–1)

Give the molar ratio of the oxidizing agent to the reducing agent in the reaction.

Molar ratio of the oxidizing agent to the reducing agent: …… : ……..

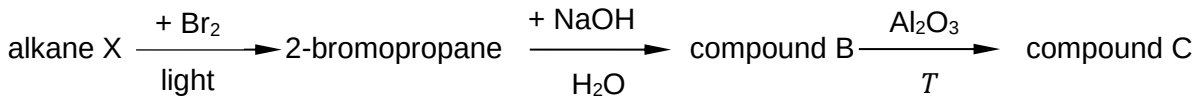
Task 10.2. (0–1)

Write how many moles of electrons are bonded to one mole of manganate(VII) ions in this reaction.

The number of moles of electrons: …….....

Task 11.

Given below is a reaction sequence.



Task 11.1. (0–1)

Determine the type (addition, elimination, substitution) and mechanism (electrophilic, nucleophilic, radical) of the reaction in which compound B is produced.

Type of the reaction: .....

Mechanism of the reaction: .....

Task 11.2. (0–1)

Write the semi-structural (condensed) formula for alkane X and give the systematic name of compound C.

Alkane X formula:

Systematic name of compound C: ……

Task 12.

In the reaction between 3-methylbutan-2-on and hydrogen in the presence of a catalyst, an alcohol is produced.

Task 12.1. (0–1)

Complete the table. Write the semi-structural (condensed) formula for the alcohol produced and classify it as a primary, secondary or tertiary alcohol.

Alcohol formula	Alcohol type (primary, secondary, tertiary)

Task 12.2. (0–1)

Decide if molecules of the alcohol produced are chiral. Give the reasoning behind your answer.

Decision: .....

Reasoning: .....

.....

Task 13. (0–1)

Diazomethane (CH_2N_2) is a popular reagent used in organic synthesis as a methylating agent that introduces a methyl group into the molecule of an organic compound. For example, the reaction between diazomethane and a carboxylic acid produces the respective methyl ester as well as a colourless, odourless, and non-flammable gas.

Task 13.1. (0–1)

Write <u>the molecular equation</u> for the reaction in which methyl benzoate (a methyl ester of benzenecarboxylic acid) is produced using the method described above. Use semi-structural (condensed) or structural formulas for the organic compounds.

.....

Task 13.2. (0–1)

Explain why the yield of the reaction for ester synthesis – the reaction between a carboxylic acid and diazomethane – can be higher than that of the reaction in which the same ester is obtained from a carboxylic acid and an alcohol.

.....

.....

.....

NOTES (*not subject to evaluation*)

CHEMIA

Poziom rozszerzony

Formuła 2023

CHEMIA

Poziom rozszerzony

Formuła 2023

CHEMIA

Poziom rozszerzony

Formuła 2023