State of Israel
Ministry of Education
Exam Type: *Bagrut*
Exam date: Summer 2024
Exam number: 37381
Attachments: (1) Periodic table
(2) Electronegativity table
(3) Formulas for calculations
(4) Functional groups
English translation (3)

מדינת ישראל
משרד החינוך
סוג הבחינה: בגרות
מועד הבחינה: קיץ תשפ"ד, 2024
מספר השאלון: 37381
נספחים: (1) הטבלה המחזורית
(2) טבלת אלקטרושליליות
(3) נוסחאות לחישובים
(4) קבוצות פונקציונליות
תרגום לאנגלית (3)

Note: This exam has special instructions. Answer the questions according to these instructions.

שימו לב: בבחינה זו יש הנחיות מיוחדות. יש לענות על השאלות על פי הנחיות אלה.

Chemistry

כימיה

Instructions

א. Duration of the exam: Three and a half hours

ב. Exam structure and breakdown of points:
This exam has two parts.
Part One – 40 points
Part Two – 60 points
Total – 100 points

ג. Material that may be used during the exam:
(1) A calculator (graphing calculators are permitted)
(2) Formula and data sheets (attached)
(3) A Hebrew–foreign language/ foreign language–Hebrew dictionary

ד. Special instructions:
(1) In Part One, there are nine questions.
For each of Questions 1–8, four possible answers are presented and you must choose the correct answer.
Mark the correct answers on the answer sheet at the end of the answer booklet (page 23).
Answer the items in Question 9 according to the instructions.
(2) In Part Two, there are five questions.
You must answer three of them.

Write in the answer booklet only. Write the word "טיוטה" at the top of each page you use as a draft page. If you write any draft material outside the answer booklet, your exam may be disqualified.

Good Luck!

הוראות

א. משך הבחינה: שלוש שעות וחצי.

ב. מבנה השאלון ומפתח ההערכה:
בשאלון זה שני פרקים.
פרק ראשון – 40 נקודות
פרק שני – 60 נקודות
סך הכול – 100 נקודות

ג. חומר עזר מותר בשימוש:
(1) מחשבון (כולל מחשבון גרפי).
(2) דפי נוסחאות ונתונים (מצורפים).
(3) מילון עברי–לועזי / לועזי–עברי.

ד. הוראות מיוחדות:
(1) בפרק הראשון יש תשע שאלות.
בכל אחת מן השאלות 1–8 מוצגות ארבע תשובות, ומהן יש לבחור בתשובה הנכונה.
את התשובות הנכונות יש לסמן בתשובון שבסוף מחברת הבחינה (עמוד 23).
בשאלה 9 יש לענות על הסעיפים לפי ההנחיות.
(2) בפרק השני יש חמש שאלות. יש לענות על שלוש מהן.

יש לכתוב במחברת הבחינה בלבד. יש לרשום "טיוטה" בראש כל עמוד המשמש טיוטה. כתיבת טיוטה בדפים שאינם במחברת הבחינה עלולה לגרום לפסילת הבחינה.

בהצלחה!

Questions

Part One (40 points)

Answer all eight questions 1–8 (20 points).

If you answer at least six questions correctly, you will receive the full 20 points.

Before you answer a question, read all the suggested answers.

Four answers are suggested for each question. Choose the correct answer.

* Mark the answer you chose on the answer sheet at the end of the answer booklet (page 23).
* For each question, use a pen to mark an × in the box below the letter (א–ד) that represents the answer you chose.
* Mark an × in only one box for each question.
* If you want to erase your answer, fill in the whole box like this: ■ .
* Do **not** use White-Out to erase answers.
* **Note: In order to limit the need to erase answers on the answer sheet, we recommend that you first mark the correct answers inside the exam booklet itself and only later mark them on the answer sheet.**

1. Items א–ד in the following table list data for four different atoms.

For which item is the information in that row fully consistent?

	Location of the element in the periodic table		Electron configuration	Lewis electron-dot formula
	Column	Row		
א.	7	2	2,7	
ב.	2	3	2,2,2	
ג.	3	2	2,8,3	
ד.	4	2	2,4	

/continued on page 3/

2. Consider the molecular formulas of these four molecules: CS_2 , C_2H_2 , $C_2C\ell_2$, CO_2.
All four molecules are linear.
Which statement is correct?

א. Each molecule has a single covalent bond.

ב. Only two of these molecules have double covalent bonds.

ג. The bond between a carbon atom and a sulfur atom in a CS_2 molecule is more polar than the bond between a carbon atom and an oxygen atom in a CO_2 molecule.

ד. The bonds between the carbon atoms in the C_2H_2 molecule are pure covalent bonds, but the molecule is polar.

3. Consider the molecules א–ד below; which molecule can form **hydrogen bonds** with both water molecules, H_2O , and acetone molecules, CH_3COCH_3 ?

א. $CH_3CH_2OCH_2CH_3$

ב. $CH_3CH(OH)CH_2CH_3$

ג. $CH_3CH_2CHFCH_2CH_3$

ד. $(CH_3)_2CHF$

4. The boiling point of water, $H_2O_{(\ell)}$, is higher than the boiling point of hydrogen sulfide, $H_2S_{(\ell)}$.
What is the **main** reason for this?

א. The electron cloud of a hydrogen sulfide molecule is larger than the electron cloud of a water molecule.

ב. Van der Waals interactions between hydrogen sulfide molecules in the liquid state are weaker than van der Waals interactions between water molecules in the liquid state.

ג. Van der Waals interactions are the main interactions between molecules of hydrogen sulfide in the liquid state, whereas hydrogen bonds are the main interactions between molecules of water in the liquid state.

ד. Hydrogen bonds between hydrogen sulfide molecules in the liquid state are weaker than the hydrogen bonds between molecules of water in the liquid state.

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5. A certain substance was added to a beaker of distilled water, and a solution was obtained. Adding the substance to the water did not cause a change in pH.

Which substance was added to the water?

א. $C_2H_5OH_{(\ell)}$

ב. $CH_3COOH_{(\ell)}$

ג. $HBr_{(g)}$

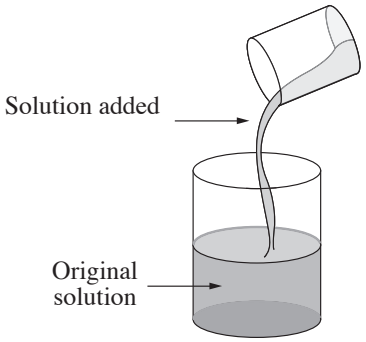
ד. $KOH_{(s)}$

6. Four experiments were conducted as described in the table below.

In each experiment, the investigators took 100 ml of original solution and checked its pH. To this original solution they then added 100 ml of another solution (see figure), mixed, and checked the pH of the resulting solution.

The concentration of each of the solutions before the addition was 1M .

Experiment	Original solution	Added solution
1	$HC\ell_{(aq)}$	$H_2SO_{4(aq)}$
2	$NaOH_{(aq)}$	$HC\ell_{(aq)}$
3	$Ba(OH)_{2(aq)}$	$NaOH_{(aq)}$
4	$H_2SO_{4(aq)}$	$Ba(OH)_{2(aq)}$



The investigators found that the pH of the resulting solution was different from that of the original solution.

Which of the four possibilities א–ד is correct?

א. In Experiment 1 the pH of the resulting solution was **higher** than the pH of the original solution.

ב. In Experiment 2 the pH of the resulting solution was **higher** than the pH of the original solution.

ג. In Experiment 3 the pH of the resulting solution was **lower** than the pH of the original solution.

ד. In Experiment 4 the pH of the resulting solution was **lower** than the pH of the original solution.

7. Consider the following molecular formulas of several molecules that contain an atom of nitrogen (N):

HNO_3 , N_2O , N_2O_5 , NO_2 , N_2O_4 , NO

Which statement is correct?

א. In N_2O and NO molecules, the nitrogen atoms can only undergo oxidation.

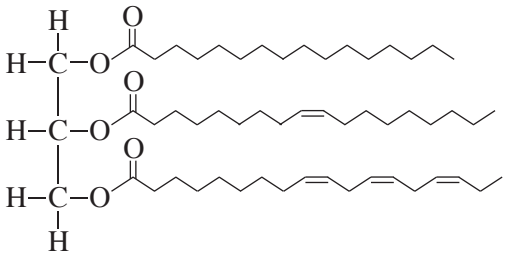
ב. In HNO_3 and N_2O_5 molecules, the nitrogen atoms can only undergo reduction.

ג. When N_2O_4 molecules are formed from NO_2 molecules, the nitrogen atoms are reduced.

ד. When NO_2 molecules are formed from NO molecules, the nitrogen atoms are reduced.

/continued on page 5/

8. Consider the abbreviated structural formula of the following triglyceride molecule:



Which fatty acids is this triglyceride composed of?

א.	C18:3ω3cis,cis,cis	C18:1ω9cis	C16:0
ב.	C17:3ω3cis,cis,cis	C17:1ω9cis	C15:0
ג.	C17:3ω3trans,trans,trans	C17:1ω9trans	C15:0
ד.	C18:3ω3trans,trans,trans	C18:1ω9trans	C16:0

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Analysis of a passage from a scientific article — Required

9. Read the following passage and answer the items that follow, as directed (required question – 20 points).

Is Your Food Fresh? Check the Packaging!

Intelligent food packaging design is a growing field of research. Intelligent food packages are designed to inform shoppers about the food's freshness, and in this way ensure the quality of food they consume. Intelligent packaging conveys information about the food in the package using different types of systems.

These systems may be indicators or sensors placed inside the food packages. Indicators change color when they detect the products of undesirable chemical reactions happening in the food after it is packaged. This is a way to prevent consumption of spoiled food.

Here are some examples:

- Spoiled meat products emit the gas hydrogen sulfide, $H_2S_{(g)}$. Scientists recently developed a label that contains silver granules, $Ag_{(s)}$. This label is placed inside the meat package. When the meat spoils it emits the gas hydrogen sulfide, which reacts with the silver granules. This causes a gradual change in label color from yellow to brown, according to the following reaction:

  $2Ag_{(s)} + H_2S_{(g)} \longrightarrow Ag_2S_{(s)} + H_{2(g)}$

- When fish spoils several nitrogen compounds can form. The following table lists information about such compounds.

Nitrogen compound	Boiling point (^oC)	Molecular formula
Ammonia	–33	NH_3
TMA	3	$(CH_3)_3N$
DMA	7	$(CH_3)_2NH$

These compounds react with water forming a basic solution, which makes their presence detectable as the pH of the liquid inside the food package changes. The indicator that detects these compounds is part of the label placed in the package, and it changes color when there is a substantial change in the pH of the liquid inside. The indicator contains substances that are sensitive to changes in acidity (such as anthocyanins found in purple cabbage), so that the indicator changes color when the food spoils.

(Continued on the next page.)

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- As they ripen, some fruits emit the gas ethylene , $C_2H_{4(g)}$. Ethylene makes the fruit ripen faster, shortening the period during which the fruit remains fresh and fit for consumption. Ethylene concentration is a measure of fruit ripeness.
  Potassium permanganate, $KMnO_{4(s)}$, can be used to detect how ripe a fruit is. $KMnO_{4(s)}$ is a purple substance, but when it reacts with ethylene one of the products of this reaction is a brown solid called manganese dioxide, $MnO_{2(s)}$. $KMnO_{4(s)}$ is used in fruit packaging indicators: when the concentration of ethylene in the package increases, the indicator changes color.
  Researchers in the field of intelligent food packaging continue to search for effective, sensitive, and cheap methods of safeguarding the quality of the food we eat.

Adapted chiefly from:
Smart choices: Mechanisms of intelligent food packaging. Azeredo; Correa. Current Research in Food Science 4 (2021) 932–936.
Journal home page: www.sciencedirect.com/journal/current–research–in–food–science

Answer the items א, ד, ה, ו and ז, and one of the optional items ב **or** ג.

א. In a package of meat, a total of 6.02×10^{17} molecules of hydrogen sulfide, $H_2S_{(g)}$, were detected.
What mass of silver, $Ag_{(s)}$, is required to react with all the hydrogen sulfide in the package of meat? Provide detailed calculations.

Item **ב** is an optional item. If you choose to answer it, do not answer Item **ג**.

ב. Explain why the boiling point of TMA is higher than the boiling point of ammonia.

Item **ג** is an optional item. If you choose to answer it, do not answer Item **ב**.

ג. Explain why the boiling point of DMA is close to the boiling point of TMA .

ד. Consider the following two equations for a reaction. Based on the passage, determine which equation describes the reaction of the compound DMA with water. Explain your answer.

I $(CH_3)_2NH_{(g)} + H_2O_{(\ell)} \longrightarrow (CH_3)_2N^-_{(aq)} + H_3O^+_{(aq)}$

II $(CH_3)_2NH_{(g)} + H_2O_{(\ell)} \longrightarrow (CH_3)_2NH^+_{2(aq)} + OH^-_{(aq)}$

(Note: This question continues on the next page.)

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ה. When leaves of purple cabbage are boiled, a blue solution containing anthocyanins is obtained.
We know that:

- when we add a solution of vinegar [acetic acid], $CH_3COOH_{(aq)}$, to the blue solution of cabbage water, the blue solution turns red;
- when we add a solution of sodium hydroxide, $NaOH_{(aq)}$, to the blue solution of cabbage water, the blue solution turns green;
- there is a blue indicator that is based on anthocyanins (like those in the blue cabbage water) in a package of fish.

Based on the information in the passage and the items of information above, what color will the indicator in the fish package be when the fish inside spoils? Explain your answer.

ו. In a package of fruit containing an indicator based on potassium permanganate, $KMnO_{4(s)}$, the color of the indicator changed from purple to brown.
Based on the passage, determine whether the substance $KMnO_{4(s)}$ was an oxidizer or a reducer in the reaction that took place.
Explain your answer.

ז. Fruit contain a lot of water. The gas ethylene, $C_2H_{4(g)}$, that fruit discharge as they ripen is not water-soluble, so it builds up inside the fruit packages.
Explain why ethylene does not dissolve in water.

/continued on page 9/

Part Two (60 points)

Answer three of the questions 10–14 (each question – 20 points).

Atomic Structure, Structure and Bonding

10. Answer the items א, ב, ה and ו, and one of the optional items ג **or** ד.

This is a question about the element sulfur.

א. i Three different particles are arbitrarily labelled X , Y , Z .

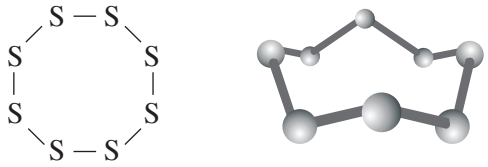
$^{31}_{15}X$, $^{32}_{15}Y$, $^{34}_{16}Z$

Determine which particle is an isotope of the sulfur atom, $^{32}_{16}S$. Explain your answer.

ii Provide the electron configuration for the sulfur atom, $^{32}_{16}S$.

ב. The sulfur molecule, S_8 , has eight atoms arranged in a ring.

The following illustrations describe the sulfur molecule.



i Are the bonds between the sulfur atoms of the S_8 molecule pure covalent bonds or polar covalent bonds?

Explain your answer.

ii Explain why each atom of sulfur in the S_8 molecule has two single covalent bonds.

Item ג is an optional item. If you choose to answer it, do not answer Item ד.

ג. The substances sulfur, $S_{8(s)}$, and white phosphorus, $P_{4(s)}$, are solid at room temperature.

Explain why the melting point of sulfur is higher than the melting point of white phosphorus.

Item ד is an optional item. If you choose to answer it, do not answer Item ג.

ד. Explain why sulfur, $S_{8(s)}$, is highly soluble in hexane, $C_6H_{14(\ell)}$.

ה. A reaction between sulfur, $S_{8(s)}$, and sodium, $Na_{(s)}$, produces a single, solid product – sodium sulfide.

i. Provide the empirical formula of sodium sulfide.

ii Provide the Lewis electron dot formula of the particles in the compound sodium sulfide.

iii Provide the equation for the reaction of sulfur and sodium which produces sodium sulfide.

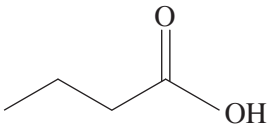
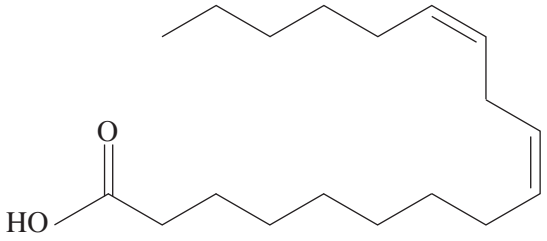
ו. When a sulfur-rich fuel burns, one of the products is the gas sulfur dioxide, $SO_{2(g)}$, which causes air pollution. Provide the equation for the combustion reaction of sulfur, $S_{8(s)}$, in which the gas sulfur dioxide is produced.

/continued on page 10/

Fatty Acids

11. Answer the items א, ב, ה and ו, and one of the optional items ג **or** ד.

Myristic acid is a **saturated fatty acid**. Each molecule of myristic acid contains 14 carbon atoms. The acid was first extracted from nutmeg (*Myristica fragrans*) and was named accordingly.
The following table contains partial information about several fatty acids. The missing items of information are numbered 1–5.

Fatty acid	Abbreviated structural formula of the molecule	Abbreviated notation for the fatty acid
Myristic acid	1	2
Butyric acid		3
Oleic acid	4	C18 : 1ω9 cis
Linoleic acid		5

א. In your answer booklet, provide the items of information 1, 2, 3, 4, 5 that are missing from the table.

ב. Which of the fatty acids in the table is a **mono-unsaturated** fatty acid?

Item ג is an optional item. If you choose to answer it, do not answer Item ד.

ג. Which acid—oleic acid or linoleic acid—has a higher melting point? Specify the factor that causes this.

Item ד is an optional item. If you choose to answer it, do not answer Item ג.

ד. Which acid, myristic or butyric, has a higher melting point? Specify the factor that causes this.

ה. Only one of the four fatty acids in the table is water-soluble. Which acid is water-soluble?

ו. A mixture was prepared using all four fatty acids in the table above.
The mixture contained **1 mole** of each of the acids.
A large quantity of hydrogen, $H_{2(g)}$, was streamed into the mixture under conditions that are suitable for a hydrogenation reaction. When the reaction was complete, the mixture contained only saturated fatty acids.

i Of the fatty acids listed in the table, which ones reacted with $H_{2(g)}$ in a hydrogenation reaction? Explain your answer.

ii Give the abbreviated notation of the fatty acids that were present in the mixture when the hydrogenation reaction was complete.

iii How many moles of $H_{2(g)}$ reacted in the complete reaction with the mixture of acids? Explain your answer.

/continued on page 11/

Acids and Bases, Stoichiometry (calculations)

12. Answer the items א, ג, ד, ו, and ז, and one of the optional items ב **or** ה.

Many household cleaning fluids contain acids or bases.

To prepare a certain liquid toilet cleaner, water is mixed with hydrogen chloride, $HC\ell_{(g)}$.

א. Provide the equation for the reaction of $HC\ell_{(g)}$ with water.

Item **ב** is an optional item. If you choose to answer it, do not answer Item **ה**.

ב. The concentration of $HC\ell_{(aq)}$ in a certain liquid toilet cleaner is 2.5M.
Calculate the mass of hydrogen chloride, $HC\ell_{(g)}$, in 100 ml of this liquid.
Provide detailed calculations.

A certain grease remover is an aqueous solution containing sodium hydroxide.

ג. Provide the equation for the reaction in which sodium hydroxide, $NaOH_{(s)}$, dissolves in water.

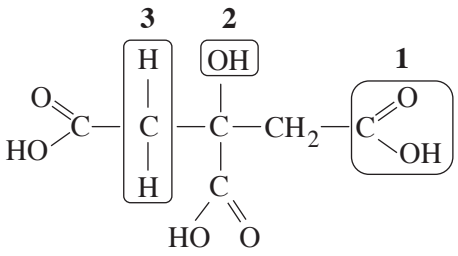
To check the concentration of $NaOH_{(aq)}$ in the grease remover solution, sulfuric acid, $H_2SO_{4(aq)}$, was added to the solution.

ד. Write the net equation for the reaction that took place.

Item **ה** is an optional item. If you choose to answer it, do not answer Item **ב**.

ה. 12.5 ml of 1M $H_2SO_{4(aq)}$ solution was needed for a complete reaction with 20 ml of the grease remover solution.
Calculate the molar concentration of $NaOH_{(aq)}$ in the grease remover solution.
Provide detailed calculations.

Consider the following full structural formula of a citric acid molecule, showing three groups of atoms **1–3**.



ו. Determine which group of atoms in the molecule—**1**, **2**, or **3**—allows citric acid to react as an acid.

(Note: This question continues on the next page.)

/continued on page 12/

Citric acid can be used to remove lime-scale that builds up in some home appliances.

The main ingredient in lime-scale is calcium carbonate $CaCO_{3(s)}$.

Citric acid was dissolved in water to form a solution. The solution was poured into a kettle that had a layer of lime-scale.

Consider the net equation of the resulting reaction shown below:

$$CaCO_{3(s)} + 2H_3O^+_{(aq)} \longrightarrow Ca^{2+}_{(aq)} + CO_{2(g)} + 3H_2O_{(\ell)}$$

٢. When the reaction in the kettle ended, was the pH of the solution higher, lower, or equal to the pH of the prepared solution of citric acid? Explain your answer.

/continued on page 13/

Oxidation-Reduction, Structure and Bonding

13. Answer the items א, ב, ג, and ד, and one of the optional items ה **or** ו.

Several experiments were conducted with metals and ionic solutions.

The following metals were used:

copper, $Cu_{(s)}$; silver, $Ag_{(s)}$; iron, $Fe_{(s)}$; magnesium, $Mg_{(s)}$.

The positive ions in the solutions were:

copper ions, $Cu^{2+}_{(aq)}$; silver ions, $Ag^{+}_{(aq)}$; iron ions, $Fe^{3+}_{(aq)}$; magnesium ions, $Mg^{2+}_{(aq)}$; hydronium ions, $H_3O^{+}_{(aq)}$.

Provided:

- an aqueous solution of silver nitrate, $AgNO_{3\,(aq)}$, which is colorless
- a copper coil, $Cu_{(s)}$, which is a brownish orange.

א. An electrical conductivity test showed that both the copper coil and the solution were conductive.

i Explain why the copper coil was conductive.

ii Explain why the silver nitrate solution was conductive.

Experiment 1

The copper coil was immersed in an aqueous solution of silver nitrate, $AgNO_{3\,(aq)}$. After a while, the copper coil was seen to have a shiny, silvery coating, and the solution turned blue. This reaction was complete.

ב. Write the net equation for the reaction that took place in Experiment 1.

Experiment 2

The coated copper coil was taken out of the solution obtained in Experiment 1, and the solution was filtered to remove any solids. This produced a clear, blue solution.

Next, a piece of steel wool, which contains mainly iron, $Fe_{(s)}$, was immersed in the blue solution. After a while, the steel wool was seen to have a brownish orange coating, and the color of the solution had changed.

ג. Write the net formula for the reaction that took place in Experiment 2.

/continued on page 14/

We know that:

– Dead Sea water is rich in magnesium ions, $Mg^{2+}_{(aq)}$;

– metallic magnesium, $Mg_{(s)}$, cannot be extracted from Dead Sea water using any of the following metals: iron, $Fe_{(s)}$; silver, $Ag_{(s)}$; or copper, $Cu_{(s)}$.

ד. The four metals are ranked below in three possible orders of reduction strength, I–III:
Based on the information from the entire question, determine which is the correct ranking.
Explain your answer.

I $Mg_{(s)} > Fe_{(s)} > Cu_{(s)} > Ag_{(s)}$

II $Ag_{(s)} > Cu_{(s)} > Fe_{(s)} > Mg_{(s)}$

III $Mg_{(s)} > Cu_{(s)} > Ag_{(s)} > Fe_{(s)}$

Item **ה** is an optional item. If you choose to answer it, do not answer Item **ו**.

ה. Metallic magnesium, $Mg_{(s)}$, reacted with an aqueous solution of hydrochloric acid, $HC\ell_{(aq)}$.
The net equation of the reaction that occurred is shown below:

$$Mg_{(s)} + 2H_3O^+_{(aq)} \longrightarrow Mg^{2+}_{(aq)} + H_{2(g)} + 2H_2O_{(\ell)}$$

Based on this information, determine whether each of the following statements is true or false.
Explain your answers.

i The gas hydrogen, $H_{2(g)}$, produced in this reaction is the product of a reduction process.

ii The oxygen atoms in the hydronium ions, $H_3O^+_{(aq)}$, are the oxidants.

Item **ו** is an optional item. If you choose to answer it, do not answer Item **ה**.

ו. Metallic magnesium, $Mg_{(s)}$, reacted with an aqueous solution of hydrochloric acid, $HC\ell_{(aq)}$.
The net equation of the reaction that occurred is shown below:

$$Mg_{(s)} + 2H_3O^+_{(aq)} \longrightarrow Mg^{2+}_{(aq)} + H_{2(g)} + 2H_2O_{(\ell)}$$

Based on this information, determine whether each of the following statements is true or false.
Explain your answers.

i The water molecules, $H_2O_{(\ell)}$, are a product of a reduction process.

ii The magnesium ions, $Mg^{2+}_{(aq)}$, are a product of an oxidation process.

/continued on page 15/

Stoichiometry (calculations)

14. Answer the items א, ב, ג, ד, ה, and ו, and one of the optional items ז **or** ח.

Consider a mixture of two water-soluble solids: sodium chloride, $NaC\ell_{(s)}$, and sodium sulfate, $Na_2SO_{4(s)}$.

An experiment was conducted to discover the composition of the mixture.

2.59 grams of the mixture of solids were dissolved in water, to form 200 ml of Solution A.

א. Write the equation for the dissolution reaction of $NaC\ell_{(s)}$ in water.

ב. Write the equation for the dissolution reaction of $Na_2SO_{4(s)}$ in water.

40 ml of Solution A were reacted with a solution of silver nitrate, $AgNO_{3(aq)}$. All the chloride ions, $C\ell^-_{(aq)}$, in the solution reacted.

0.574 grams of silver chloride, $AgC\ell_{(s)}$, were produced.

The net equation of the reaction that occurred (Reaction 1) is shown below:

(1) $Ag^+_{(aq)} + C\ell^-_{(aq)} \longrightarrow AgC\ell_{(s)}$

ג. Calculate how many moles of $AgC\ell_{(s)}$ were produced in the reaction.
Provide detailed calculations.

ד. Calculate how many moles of $C\ell^-_{(aq)}$ ions were in the 200 ml of Solution A.
Provide detailed calculations.

ה. Calculate what the mass of $NaC\ell_{(s)}$ was in the solids mixture dissolved in water to produce 200 ml of Solution A. Provide detailed calculations.

ו. i Calculate what the mass of $Na_2SO_{4(s)}$ was in the mixture dissolved in water to produce 200 ml of Solution A. Provide detailed calculations.

ii Calculate how many moles of $Na_2SO_{4(s)}$ were in the mixture dissolved in water to produce 200 ml of Solution A. Provide detailed calculations.

Item ז is an optional item. If you choose to answer it, do not answer Item ח.

ז. Calculate the concentration of sodium ions in 200 ml of Solution A.
Provide detailed calculations.

Item ח is an optional item. If you choose to answer it, do not answer Item ז.

ח. 40 ml of Solution A were reacted with a solution of barium nitrate, $Ba(NO_3)_{2(aq)}$, and barium sulfate, $BaSO_{4(s)}$, was produced.

We know that the sulfate ions, $SO^{2-}_{4(aq)}$, in the 40 ml of Solution A reacted completely.

The net equation of the reaction that occurred is shown below (Reaction 2).

(2) $Ba^{2+}_{(aq)} + SO^{2-}_{4(aq)} \longrightarrow BaSO_{4(s)}$

What is the mass of $BaSO_{4(s)}$ that was produced in the experiment?
Provide detailed calculations.

Good Luck!

בהצלחה!