

State of Israel
Ministry of Education

Exam Type: *Bagrut*

Exam date: Summer 2017

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 תשע"ז, 2017

מספר השאלון: 37381

נספחים: (1) הטבלה המחזורית

(2) טבלת אלקטרושליליות

(3) נוסחאות לחישובים

(4) קבוצות פונקציונליות

תרגום לאנגלית (3)

Chemistry
Reform for Meaningful
Learning Program

Instructions for examinees

א. Duration of the exam: Three hours

ב. Exam structure and breakdown of points:

This exam has two parts.

Part One — Required — 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) A Hebrew-foreign language/foreign language-Hebrew dictionary.

ד. Special instructions:

(1) **Note**: In Part I, there are two **required** questions.

Question 1 has eight items, א to ח. Four possible answers are given for each item and you must choose the correct answer for each one. Mark the correct answers on the answer sheet found at the end of the answer booklet (page 19).

You must answer all of the items for Question 2.

(2) **In Part Two, you must answer three of the five questions.**

Write all of your rough work (notes, calculations, etc.) on separate pages of the answer booklet only (outlines, calculations, etc.).

Write the word "טייטה" on the top of each of these pages.

If you write any sort of work outside the answer booklet, your exam may be disqualified!

כימיה
על פי הרפורמה ללמידה
משמעותית

הוראות לנבחן

א. משך הבחינה: שלוש שעות.

ב. מבנה השאלון ומפתח ההערכה:

בשאלון זה שני פרקים.

פרק ראשון – חובה – 40 נקודות

פרק שני – 60 נקודות

סה"כ – 100 נקודות

ג. חומר עזר מותר בשימוש:

(1) מחשבון (כולל מחשבון גרפי).

(2) מילון עברי-לועזי / לועזי-עברי.

ד. הוראות מיוחדות:

(1) **שים לב**: בפרק הראשון יש שתי שאלות

חובה.

בשאלה 1 יש שמונה סעיפים א-ח. לכל סעיף מוצגות ארבע תשובות, ומזה עליך לבחור בתשובה הנכונה. את התשובות הנכונות עליך לסמן בתשובון שבסוף מחברת הבחינה (עמוד 19).

בשאלה 2 יש לענות על כל הסעיפים.

(2) **בפרק השני יש לענות על שלוש מבין חמש השאלות.**

כתוב במחברת הבחינה בלבד, בעמודים נפרדים, כל מה שברצונך לכתוב כטייטה (ראשי פרקים, חישובים וכדומה).

רשום "טייטה" בראש כל עמוד טייטה. רישום טייטות כלשהן על דפים שמחוץ למחברת הבחינה עלול לגרום לפסילת הבחינה!

Good Luck!

בהצלחה!

Questions

Part One (40 points)

Answer **both** questions, 1-2 (each question – 20 points).

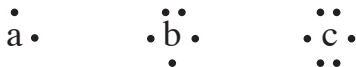
1. Answer all of the items א to ט (each item – 2.5 points).

Four possible answers, 1-4, are presented for each question. **Before you answer, read all of the possible answers** and choose the most appropriate one.

- * Indicate which answer you chose on the answer sheet printed on the inside cover at the end of the answer booklet (page 19).
- * For each item, mark an X with your pen in the box below the number (1-4) that represents the answer you chose.
- * Draw an X in only one box for each item.
- * 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 enter them into the answer sheet.**

א. The letters a, b, and c are arbitrary symbols representing three elements in the periodic table.

Below are the electron dot formulas for atoms of the elements a, b, and c.



Two of these elements can react with each other to produce an ionic compound.

What is the correct empirical formula of this compound?

1. a_5b_2
2. a_2b_3
3. ac
4. ac_3

- ב. Scientists have recently succeeded in artificially creating four new elements whose atomic numbers are: 113, 115, 117, and 118.

The element whose atomic number is 118 is located in the periodic table beneath the element radon, ${}_{86}\text{Rn}$.

Of the following four statements 1-4, which one is incorrect?

1. The four new elements are located in the same column of the periodic table.
 2. The atoms of the four new elements have an equal number of populated energy levels.
 3. The atom of the element with the atomic number 118 has 8 electrons at the highest energy level.
 4. The four new elements are located on the same row of the periodic table.
- ג. The following table presents information about the electrical conductivity of four solid substances.

Only some of the information is correct.

Substance	Electrical conductivity in the solid state	Electrical conductivity in the liquid state
Rubidium, $\text{Rb}_{(s)}$	+	+
Rubidium bromide, $\text{RbBr}_{(s)}$	+	—
Graphite, $\text{C}_{\text{graphite}(s)}$	—	+
Silicon dioxide, $\text{SiO}_{2(s)}$	—	—

For which of the substances is the information in the table correct?

1. $\text{Rb}_{(s)}$ and $\text{RbBr}_{(s)}$
2. $\text{RbBr}_{(s)}$ and $\text{C}_{\text{graphite}(s)}$
3. $\text{Rb}_{(s)}$ and $\text{C}_{\text{graphite}(s)}$
4. $\text{Rb}_{(s)}$ and $\text{SiO}_{2(s)}$

7. The solid ammonium carbonate $(\text{NH}_4)_2\text{CO}_{3(s)}$ decomposes when heated according to the reaction below:



A sample of $(\text{NH}_4)_2\text{CO}_{3(s)}$ was heated.

The volumes of the gases that were obtained were measured under the same conditions of temperature and pressure.

Which one of the following statements about the products obtained in this reaction is correct?

1. The number of $\text{NH}_{3(g)}$ molecules is equal to the number of $\text{H}_2\text{O}_{(g)}$ molecules.
 2. The volume of $\text{NH}_{3(g)}$ is twice the volume of $\text{CO}_{2(g)}$.
 3. The volume of $\text{H}_2\text{O}_{(g)}$ is equal to the volume of $(\text{NH}_4)_2\text{CO}_{3(s)}$.
 4. The mass of $\text{H}_2\text{O}_{(g)}$ is equal to the mass of $\text{CO}_{2(g)}$.
8. 400 ml of 0.4M $\text{KCl}_{(aq)}$ solution was mixed with 400 ml of 0.8M $\text{MgCl}_{2(aq)}$ solution. Which one of the following statements about the concentration of $\text{Cl}_{(aq)}^-$ ions in the obtained solution is correct?
1. 0.6M, because the solution's volume doubled and as a result the concentration of $\text{Cl}_{(aq)}^-$ ions decreased by half.
 2. 0.8M, because there are 0.8 moles of $\text{Cl}_{(aq)}^-$ ions in the obtained solution.
 3. 1.0M, because there are 0.8 moles of $\text{Cl}_{(aq)}^-$ ions in the obtained solution.
 4. 1.0M, because the solution's volume doubled and the total number of moles of $\text{Cl}_{(aq)}^-$ ions is 2 moles.
9. Two solutions were mixed in a container made of the metal silver, $\text{Ag}_{(s)}$: silver nitrate solution, $\text{AgNO}_{3(aq)}$, and magnesium nitrate solution, $\text{Mg}(\text{NO}_3)_{2(aq)}$.
Given: $\text{Ag}_{(aq)}^+$ ions are stronger oxidizers than $\text{Mg}_{(aq)}^{2+}$ ions.
Which of the following statements is correct?
1. $\text{Ag}_{(aq)}^+$ ions oxidize the $\text{Mg}_{(aq)}^{2+}$ ions.
 2. $\text{Mg}_{(aq)}^{2+}$ ions oxidize the $\text{Ag}_{(aq)}^+$ ions.
 3. $\text{Mg}_{(aq)}^{2+}$ ions oxidize the metal $\text{Ag}_{(s)}$.
 4. Both solutions can be stored in a container made of silver, $\text{Ag}_{(s)}$.

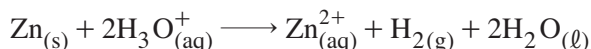
- ז. 50 ml were prepared of each of the solutions $\text{Ca(OH)}_{2(aq)}$, $\text{HNO}_{3(aq)}$, and $\text{Ca(NO}_3)_2(aq)$, and their pH was measured.

50 ml of water were added to each of the solutions.

Which of the lines 1-4 in the table below correctly represents the change in pH in each of the solutions?

	$\text{Ca(OH)}_{2(aq)}$	$\text{HNO}_{3(aq)}$	$\text{Ca(NO}_3)_2(aq)$
1	Increased	Decreased	Unchanged
2	Decreased	Increased	Unchanged
3	Increased	Decreased	Decreased
4	Decreased	Increased	Increased

- ח. The metal zinc, $\text{Zn}_{(s)}$, reacts with an acid solution according to the reaction:



A strip of zinc with a mass of 3 grams was placed in a glass container that contained 50 ml of hydrochloric acid, $\text{HCl}_{(aq)}$, at a concentration of 1.0M. In the resulting reaction, gas was emitted and the mass of the zinc strip decreased.

What is the most suitable way to increase the reaction rate?

1. Carry out the reaction in a container with a larger volume.
2. Carry out the reaction in a closed container that is connected to a syringe.
3. Increase the volume of the $\text{HCl}_{(aq)}$ solution to 100 ml.
4. Place 3 grams of zinc powder in the container instead of the zinc strip.

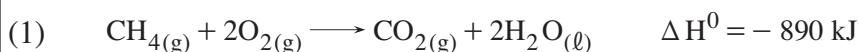
Analysis of a Passage from a Scientific Article - Required

2. Read the passage below and answer all of the items that follow, ה-א (required question – 20 points).

The Discovery of Natural Gas — A Historic Opportunity

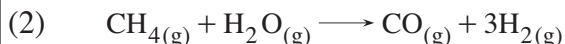
In the early 21st century a large reservoir of natural gas was discovered in Israel's exclusive economic zone [מים כלכליים]. The natural gas that was discovered contains 99% methane, $\text{CH}_{4(g)}$.

Natural gas currently serves as a fuel for generating electricity in power stations, instead of coal, $\text{C}_{(s)}$, and petroleum-based fuels. Petroleum is a mixture of hydrocarbons (carbon and hydrogen compounds). In a combustion reaction, hydrocarbons react with oxygen, $\text{O}_{2(g)}$. Carbon dioxide, $\text{CO}_{2(g)}$, and water, $\text{H}_2\text{O}_{(l)}$, are formed, and the energy that is emitted is utilized to generate electricity. Reaction (1) is the combustion reaction of methane.



Methane has the advantage over other hydrocarbons because for the same amount of energy produced, it has the lowest volume of $\text{CO}_{2(g)}$ emissions. $\text{CO}_{2(g)}$ is a gas that contributes to the greenhouse effect, so switching to using natural gas as a fuel will reduce $\text{CO}_{2(g)}$ emissions into the atmosphere. Methane from natural gas can be used not only as a fuel but also as a precursor (raw material) in the chemical industry for producing hydrogen, $\text{H}_{2(g)}$, and methanol, $\text{CH}_3\text{OH}_{(l)}$.

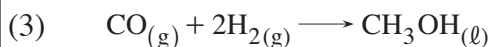
Methane reacts with steam, $\text{H}_2\text{O}_{(g)}$, according to Reaction (2):



The mixture of gases $\text{CO}_{(g)}$ and $\text{H}_{2(g)}$ obtained in Reaction (2) is called syngas, and it is a source of hydrogen for the chemical industry.

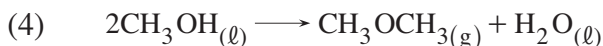
This hydrogen is used, among other things, to produce ammonia, $\text{NH}_{3(g)}$, which is a precursor in the fertilizer industry.

Syngas can also be used to produce methanol, $\text{CH}_3\text{OH}_{(l)}$ according to Reaction (3):



Methanol can be used to produce materials that serve as raw materials in the plastic, textile, dye, and pharmaceutical industries.

Methanol can also be used to produce dimethyl ether, $\text{CH}_3\text{OCH}_3(\text{g})$, according to Reaction (4):



In the future, dimethyl ether will replace diesel engine fuel in heavy vehicles and in industry.

The discovery of natural gas makes it possible to reduce the State of Israel's dependence on coal and crude oil imports from other countries and creates an opportunity for developing a society based on advanced science and technology.

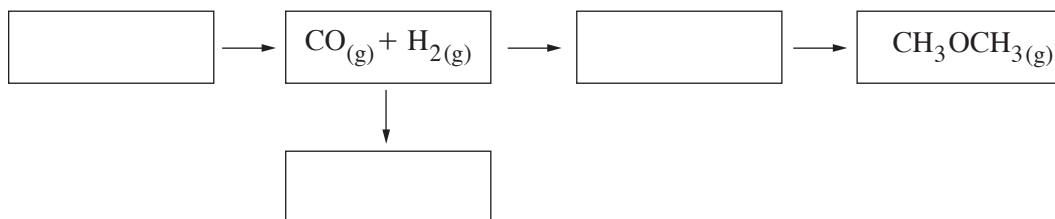
Sources: <http://www.ynet.co.il/articles/0,7340,L-4386628,00.html>

טישור, א', הרט, ד' (2012) הקמת מפעל לייצור מתאנול מגז טבעי ברמת חובב, תקציר מנהלים.

- א. Based on the passage, list three advantages of using the natural gas discovered in Israel's exclusive economic zone.
- ב. During peak electricity consumption hours, power stations also burn petroleum-based fuels such as diesel and fuel oil [מזוט]. One of the components of diesel is a hydrocarbon with the formula $\text{C}_{13}\text{H}_{28}$. The combustion reaction of $\text{C}_{13}\text{H}_{28}(\ell)$ is:
- $$\text{C}_{13}\text{H}_{28}(\ell) + 20\text{O}_{2(\text{g})} \longrightarrow 13\text{CO}_{2(\text{g})} + 14\text{H}_2\text{O}(\ell) \quad \Delta H^0 = -8740 \text{ kJ}$$
- i Calculate the number of moles of $\text{CO}_{2(\text{g})}$ that are generated in a combustion reaction of $\text{C}_{13}\text{H}_{28}(\ell)$ which emits 890 kJ.
Write out your calculations.
- ii How many moles of $\text{CO}_{2(\text{g})}$ are produced in a combustion reaction of $\text{CH}_4(\text{g})$ which emits 890 kJ?
- iii Determine whether your answers to Sub-items i and ii match the information in the passage about the volume of $\text{CO}_{2(\text{g})}$ generated in a combustion reaction of $\text{CH}_4(\text{g})$, compared with the combustion of other hydrocarbons. Explain.

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

- ג. A mixture of 15% methanol and 85% gasoline (petrol) is a high-quality car fuel known as M15. Gasoline is a mixture of hydrocarbons. Explain why methanol dissolves in gasoline.
- ד. The diagram below is a schematic representation of some of the processes mentioned in the passage. Copy the diagram to your notebook and in each of the boxes write the formula of the appropriate substance.



- ה. Some people believe that the natural gas discovered in Israel should only be used as a fuel in power stations and in industry. Write one argument supporting this opinion or one argument against it. Explain.

Note: The questions continue on page 10

Part Two (60 points)

Answer three of the questions 3-7 (each question – 20 points).

Atomic Structure and Properties of Substances

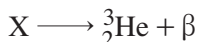
3. This question discusses the element hydrogen and some of its uses.

- א. The element hydrogen has three natural isotopes and each has its own name: hydrogen, H, deuterium, D, and tritium, T. The chemical symbol of the hydrogen atom is ${}^1_1\text{H}$.

D atoms are twice as heavy as H atoms, and T atoms are 3 times as heavy as H atoms.

- i Write the chemical symbol for the D atom and the T atom.
ii Only one of the three isotopes H, D, and T emits radioactive radiation. Let X denote this isotope.

Below is the formula of the process in which X emits radioactive radiation.



Determine which hydrogen isotope is denoted by X. Explain.

- ב. The boiling point, T_b , of liquid hydrogen, $\text{H}_{2(\ell)}$, is very low, $T_b = 20\text{K}$. Explain the reason for this.
ג. Hydrogen gas, $\text{H}_{2(\text{g})}$, is used to prevent emissions of toxic sulfur compounds into the air during combustion of fuels produced from crude oil.

These fuels contain sulfur compounds such as pentanethiol $\text{CH}_3(\text{CH}_2)_3\text{CH}_2\text{SH}_{(\ell)}$.

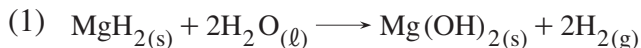
Under suitable conditions, hydrogen reacts with pentanethiol.

The reaction products are hydrogen sulfide, $\text{H}_2\text{S}_{(\text{g})}$, and pentane, $\text{CH}_3(\text{CH}_2)_3\text{CH}_3_{(\ell)}$.

- i Formulate and balance the reaction between $\text{H}_{2(\text{g})}$ and $\text{CH}_3(\text{CH}_2)_3\text{CH}_2\text{SH}_{(\ell)}$.
ii Determine whether $\text{H}_{2(\text{g})}$ reacts as an oxidizer or a reducer in this reaction. Explain.

7. Hydrogen gas, $\text{H}_{2(g)}$, can also be used as a fuel for cars.

$\text{H}_{2(g)}$ can be produced by having magnesium hydride, $\text{MgH}_{2(s)}$, react with water, $\text{H}_2\text{O}_{(l)}$, according to Reaction (1).



i Determine whether there is a transfer of electrons in Reaction (1).

Explain.

ii Scientists propose using $\text{MgH}_{2(s)}$ as a 'storage substance' from which to produce hydrogen.

Calculate the mass of $\text{MgH}_{2(s)}$ that is required to obtain 10,000 liters of $\text{H}_{2(g)}$.

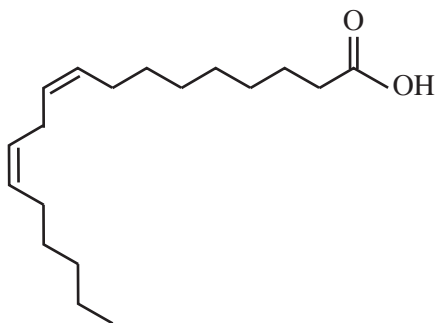
Write out your calculations.

Given: Under the conditions of this reaction the volume of 1 mole of gas is 25 liters.

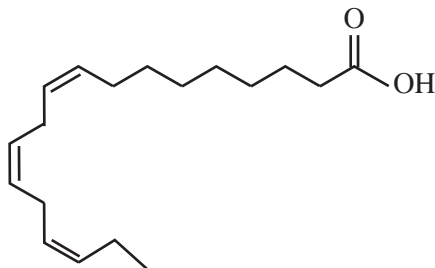
Food Chemistry

4. Nutrition experts recommend eating nuts every day, because they are rich in polyunsaturated fatty acids which help prevent illness.

א. Below are the skeletal formula of two fatty acids, I and II.



II



I

- i Write the abbreviated notation for each of the fatty acids, I and II.
- ii Formulas I and II are the skeletal formulas for the structural formulas of two fatty acids found in nuts: linoleic acid and alpha-linolenic acid.

The melting point of alpha-linolenic acid is lower than the melting point of linoleic acid.

Determine which of the formulas, I or II, is the skeletal formula for the structural formula of alpha-linolenic acid.

Explain your answer.

- א. Determine whether each of the statements i and ii, below, is true or false. Explain each of your answers.
 - i Alpha-linolenic acid is an isomer of linoleic acid.
 - ii Linoleic acid can be obtained from alpha-linolenic acid in a process of controlled hydrogenation (adding hydrogen).

- ג. The following table presents information about the mass of the main fatty acids in 100 grams of three types of nuts: brazil nuts, walnuts, and peanuts.

Type of nut	Fatty acid mass (gram)		
	Alpha-linolenic acid	Linoleic acid	Oleic acid
Brazil nuts	0.04	20.5	24.2
Walnuts	9.1	38.1	8.8
Peanuts	0.003	15.7	24.0

The abbreviated notation for oleic acid is: C18:1 ω 9cis.

Which of the three nuts is the richest in polyunsaturated fatty acids?

Write out your calculations and explain.

- ד. Nuts are also rich in antioxidants such as vitamin E.

Of the statements (1)-(4) below, indicate which statements are appropriate for describing vitamin E's activity as antioxidant.

Vitamin E:

- (1) reacts as an oxidizer in oxidation-reduction processes.
- (2) neutralizes the harmful activity of free radicals.
- (3) becomes oxidized as it reacts.
- (4) prevents undesirable oxidation processes in the body.

Structure and Bonding and the Gaseous State

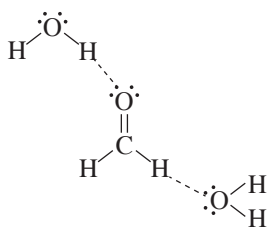
5. The gases ethane, $C_2H_6(g)$, and methanal, $H_2CO(g)$ are used as source materials in the plastics industry.

א. List two microscopic-level properties of a gas in a closed container.

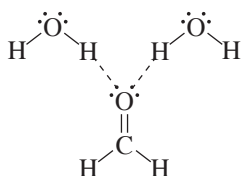
ב. Methanal, $H_2CO(g)$, dissolves in water, $H_2O(l)$, as well as in benzene, $C_6H_6(l)$.

i Determine which of the illustrations I-III below is a correct schematic description of the hydrogen bonds that can form between a molecule of methanal and water molecules.

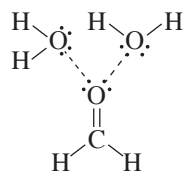
Explain why you ruled out the other two illustrations.



III



II



I

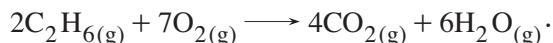
ii Write out the formula for the process of dissolving methanal in benzene.

ג. Two gases, $C_2H_6(g)$ and $H_2CO(g)$, are gradually cooled, each gas in a separate container.

Methanal, $H_2CO(g)$, is the first one to condense (turn liquid).

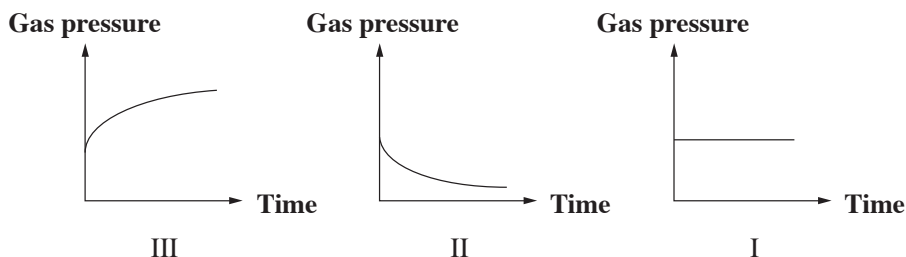
Explain why the gas $H_2CO(g)$ condenses first.

Ethane, $\text{C}_2\text{H}_{6(g)}$, reacts with oxygen, $\text{O}_{2(g)}$, according to the reaction:



Two experiments were conducted. In each of the experiments, a sample of $\text{C}_2\text{H}_{6(g)}$ and a suitable amount of $\text{O}_{2(g)}$ were placed in a container, and the mixture of gases was ignited.

7. In the first experiment, the reaction was conducted in a closed container with a fixed volume. A constant temperature was maintained during the experiment and gas pressure in the container was measured. Determine which of the graphs I-III, below, correctly describes the change in gas pressure in the container. Explain.



7. In the second experiment the reaction was conducted in a closed syringe-shaped container. 0.02 moles of $\text{C}_2\text{H}_{6(g)}$ were placed in the container with a suitable amount of $\text{O}_{2(g)}$, and the gas mixture was ignited. The gases reacted completely.

During the experiment, constant pressure and temperature were maintained.

At the end of the reaction, the volume of the container was measured. Under the conditions of this experiment, the volume of 1 mole of gas is 30 liters.

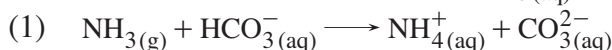
- Calculate the volume of oxygen that reacted.
Write out your calculations.
- What is the volume of the container as measured at the end of the experiment? Write out your calculations and explain.

Oxidation-Reduction, Acids and Bases, and Stoichiometry

6. This question relates to the reactions of two substances: ammonia, $\text{NH}_3(\text{g})$, and nitric acid, $\text{HNO}_3(\text{l})$.

Both substances are used in the chemical industry, for example for manufacturing fertilizers.

- א. Under certain conditions, ammonia, $\text{NH}_3(\text{g})$, reacts with a solution that contains hydrogen carbonate ions, $\text{HCO}_3^-(\text{aq})$, according to Reaction (1):



- i Reaction (1) is an acid-base reaction. Explain why.
- ii 750 ml of $\text{NH}_3(\text{g})$ reacted with 150 ml of a sodium hydrogen carbonate solution, $\text{NaHCO}_3(\text{aq})$. The reactants reacted completely. Under this reaction's conditions, the volume of 1 mole of gas is 25 liters.

Calculate the molar concentration of $\text{HCO}_3^-(\text{aq})$ ions in the solution.

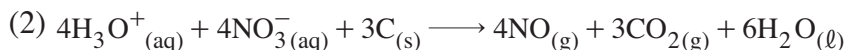
Write out your calculations.

- ב. Two substances, $\text{NH}_3(\text{g})$ and $\text{HNO}_3(\text{l})$, react in oxidation-reduction reactions.

- i Referring to the N atoms, determine which of the two substances can react only as a reducer. Explain.
- ii Ammonia, $\text{NH}_3(\text{g})$, reacts with a solution of hydrogen peroxide, $\text{H}_2\text{O}_2(\text{aq})$.

Determine which substance could be one of this reaction's products: $\text{O}_2(\text{g})$ or $\text{H}_2\text{O}(\text{l})$. Explain.

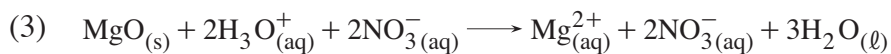
- iii. An $\text{HNO}_3(\text{aq})$ solution reacts with carbon, $\text{C}(\text{s})$, according to Reaction (2):



Determine how many moles of electrons are transferred in a reaction with 0.15 moles of $\text{C}(\text{s})$.

Write out your calculations.

- ג. An $\text{HNO}_{3(\text{aq})}$ solution reacts with magnesium oxide, $\text{MgO}_{(\text{s})}$, according to Reaction (3).



Each of the containers A and B contains 200 ml of an $\text{HNO}_{3(\text{aq})}$ solution at a concentration of 0.5M.

1.0 grams of $\text{MgO}_{(\text{s})}$ were placed in Container A.

1.5 grams of $\text{MgO}_{(\text{s})}$ were placed in Container B.

When the reaction ended, the pH of the solutions in both containers, A and B, was still acidic.

Determine which of the containers, A or B, had a lower pH at the end of the reaction.

Explain your answer.

Structure and Bonding, and Energy

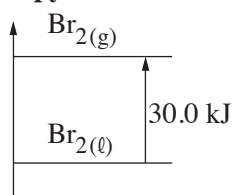
7. This question discusses energy-related aspects of elements that are members of the halogen family.

- א. The enthalpy of vaporization, ΔH_v^0 , for bromine, $\text{Br}_{2(\ell)}$, at boiling point is $\Delta H_v^0 = 30.0 \frac{\text{kJ}}{\text{mol}}$.

Determine which of the three graphic descriptions I-III below correctly represents the change in enthalpy during vaporization of $\text{Br}_{2(\ell)}$.

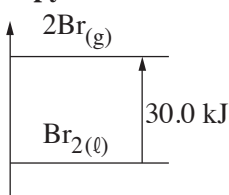
Explain your answer.

Enthalpy



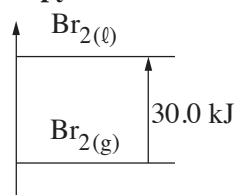
III

Enthalpy



II

Enthalpy



I

- ב. The table below presents ΔH_v^0 values for three elements of the halogen family.

Element	Enthalpy of vaporization, ΔH_v^0 ($\frac{\text{kJ}}{\text{mol}}$)
$\text{Cl}_{2(\ell)}$	20.4
$\text{Br}_{2(\ell)}$	30.0
$\text{I}_{2(\ell)}$	41.8

Here are two values of enthalpy of vaporization, ΔH_v^0 : $6.6 \frac{\text{kJ}}{\text{mol}}$ and $26.4 \frac{\text{kJ}}{\text{mol}}$.

Determine which of these two values is the appropriate one for ΔH_v^0 of fluorine, $\text{F}_{2(\ell)}$. Explain your answer.

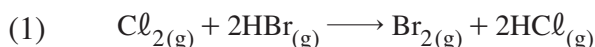
/continued on page 19/

The following table presents values of bond enthalpy.

Bond	H–Cl	Br–Br	H–Br	Cl–Cl
Bond enthalpy ($\frac{\text{kJ}}{\text{mol}}$)	431	193	366	242

- ג. i Explain why the enthalpy value for the bond Br–Br is greater than the value of bromine's, $\text{Br}_{2(\ell)}$, enthalpy of evaporation, ΔH_v^0 .
- ii What causes the enthalpy value for the bond Cl–Cl to be greater than the enthalpy of the bond Br–Br?

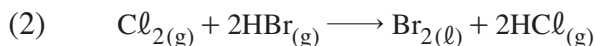
- ד. i Chlorine, $\text{Cl}_{2(\text{g})}$, reacts with hydrogen bromide, $\text{HBr}_{(\text{g})}$, according to Reaction (1):



Use the data in the table to calculate the value of ΔH^0 for Reaction (1).

Write out your calculations.

- ii Chlorine, $\text{Cl}_{2(\text{g})}$, also reacts with hydrogen bromide, $\text{HBr}_{(\text{g})}$, according to Reaction (2):



Use the data given in the question to calculate the value of ΔH^0 for Reaction (2).

Write out your calculations.

Good Luck!

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בהצלחה!

זכות היוצרים שמורה למדינת ישראל
 אין להעתיק או לפרסם אלא ברשות משרד החינוך