State of Israel
Ministry of Education
Exam Type:
א. *Bagrut* for high schools
ב. *Bagrut* for external examinees
Exam date: Summer 2011
Exam number: 037303, 27
Attachments: (1) Answer booklet
(2) Periodic table
(3) Electronegativity table
English translation (3)

Chemistry

3 points

Instructions for examinees

א. Duration of the exam: Three hours.

ב. Exam structure and breakdown of points:
This exam has two parts.

Part I —	required	— (2×20) —	40 points
Part II		— (3×20) —	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**: Question 1 in the first part of the exam includes eight items א-ח. Four possible answers are presented for each item and you must choose the correct answer for each one. Mark the correct answers in your answer booklet.
(2) **Attach your answer booklet to the test booklet.**
(3) **In Part I, you must answer both questions. In Part II, you must answer three of the six questions.**

Write all of your rough work (calculations, notes, etc.) on separate pages of the answer booklet only. Write the word טיוטה on the top of each of these pages. If you write any sort of work outside the answer booklet, your test may be disqualified!

Good Luck!

/continued on the next page/

מדינת ישראל
משרד החינוך
סוג הבחינה:
א. בגרות לבתי ספר על-יסודיים
ב. בגרות לנבחנים חיצוניים
מועד הבחינה: קיץ תשע"א, 2011
מספר השאלון: 037303, 27
נספחים: (1) גיליון תשובות
(2) המערכה המחזורית
(3) טבלת אלקטרושליליות
תרגום לאנגלית (3)

כ י מ י ה

3 יחידות לימוד

הוראות לנבחן

א. משך הבחינה: שלוש שעות.

ב. מבנה השאלון ומפתח ההערכה:
בשאלון זה שני פרקים.
פרק ראשון – חובה –
(20×2) – 40 נקודות
פרק שני – (20×3) – 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:** בשאלה 1 שבפרק הראשון שמונה סעיפים א-ח. לכל סעיף מוצגות ארבע תשובות, ומהן עליך לבחור בתשובה הנכונה. סמן את התשובות הנכונות בגיליון התשובות.
(2) **הדק את גיליון התשובות למחברת הבחינה.**
(3) **בפרק הראשון יש לענות על שתי השאלות, ובפרק השני יש לענות על שלוש מבין שש השאלות.**

כתוב במחברת הבחינה בלבד, בעמודים נפרדים, כל מה שברצונך לכתוב כטיוטה (ראשי פרקים, חישובים וכדומה). רשום "טיוטה" בראש כל עמוד טיוטה. רישום טיוטות כלשהן על דפים שמחוץ למחברת הבחינה עלול לגרום לפסילת הבחינה!

ב ה צ ל ח ה !

/המשך מעבר לדף/

Questions

Part One (40 points)

Answer both questions 1 and 2 (each question – 20 points).

1. Answer all of the items א-ח on the attached answer sheet (each item – 2.5 points).

For each item, circle the number that corresponds to the correct answer.

Before you answer, read all of the possible answers.

א. Four statements, I-IV, regarding atoms of elements in the periodic table are presented below:

I. Atoms of elements in the second column have the same number of valence electrons [אלקטרוני ערכיות].

II. In atoms of elements in the second column, the electrons are distributed among the same number of energy levels.

III. Atoms of elements in the second period (in the second row) have the same number of valence electrons.

IV. In atoms of elements in the second period, the electrons are distributed among the same number of energy levels.

Which statements are correct?

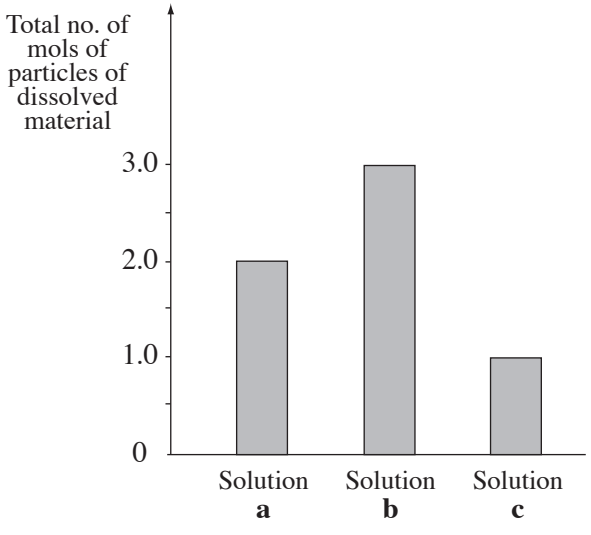
1. Statements I and III only.
2. Statements I and IV only.
3. Statements II and III only.
4. Statements II and IV only.

/continued on page 3/

ב. Three covalent bonds were arranged in order of bond length.
What is the correct order?

1. $C=O > C=C > C-C$
2. $C=C > C=O > C-C$
3. $C=C > C-C > C=O$
4. $C-C > C=C > C=O$

ג. There are three containers. One mol of material is placed in each container. Water is then added to the containers until there is 1 liter of solution in each container.
The graph below presents the total number of mols of particles of dissolved material in each of the three solutions, **a**, **b** and **c**:



In which of the rows 1-4 are the materials that were dissolved in Solutions **a**, **b** and **c** arranged in a way that corresponds to the diagram?

	a	**b**	**c**
1.	$NaNO_3$	Na_2SO_4	CH_3OH
2.	CH_3OH	Na_2SO_4	$NaNO_3$
3.	$NaNO_3$	CH_3OH	Na_2SO_4
4.	Na_2SO_4	$NaNO_3$	CH_3OH

/continued on page 4/

ד. The recommended daily allowance of potassium ions, K^+, is 4.7 grams. The main dietary source of potassium ions is potassium chloride, KCℓ.

What is the (approximate) mass of KCℓ that must be consumed each day, in order for a person to get the recommended amount of potassium ions?

1. 7.5 grams
2. 9.0 grams
3. 39.0 grams
4. 74.5 grams

ה. The metal nickel, $Ni_{(s)}$, reacts with lead ions, $Pb^{2+}_{(aq)}$, but does not react with chromium ions, $Cr^{3+}_{(aq)}$.

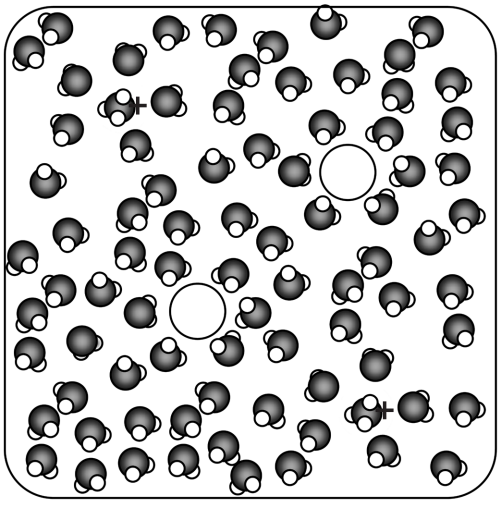
Which statement is correct?

1. Nickel ions, $Ni^{2+}_{(aq)}$, attract electrons more strongly than lead ions, $Pb^{2+}_{(aq)}$.
2. Chromium ions, $Cr^{3+}_{(aq)}$, are a stronger oxidant [מחמצן] than lead ions, $Pb^{2+}_{(aq)}$.
3. A solution containing nickel ions, $Ni^{2+}_{(aq)}$, can be stored in a container made out of the metal chromium, $Cr_{(s)}$.
4. When a bar of chromium, $Cr_{(s)}$, is dipped into a solution containing lead ions, $Pb^{2+}_{(aq)}$, a reaction occurs.

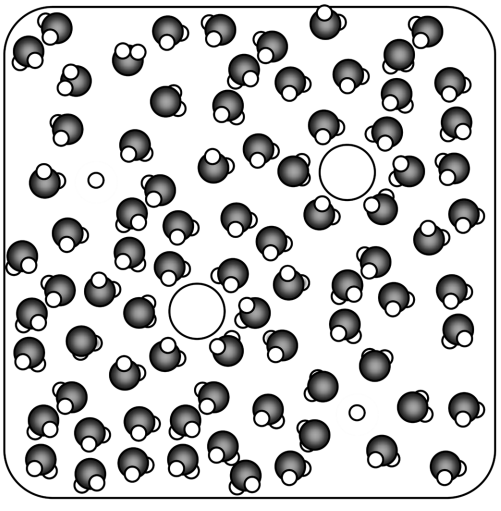
/continued on page 5/

1. Which of the illustrations below, 1-4, is a schematic description of the aqueous solution that is formed when hydrogen chloride, $HC\ell_{(g)}$, is added to water?

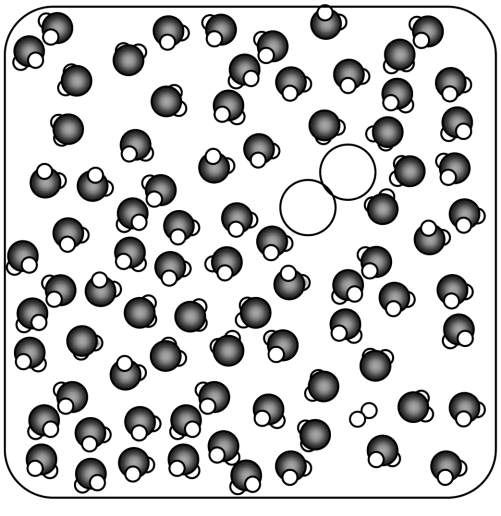
Legend : chloride ion; chlorine atom; hydrogen atom; oxygen atom



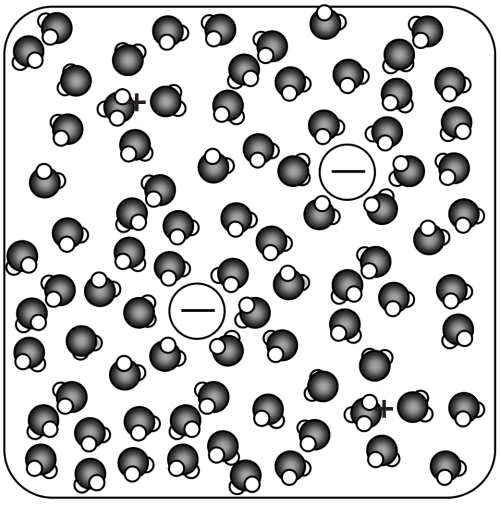
2



1



4



3

/continued on page 6/

ז. In a laboratory, there are three unlabeled bottles that contain different solutions.

Bottle One contains 100 milliliters of a nitric acid solution, $HNO_{3(aq)}$, that has a concentration of 1 M.

Bottle Two contains 100 milliliters of a sodium sulfate solution, $Na_2SO_{4(aq)}$, that has a concentration of 1 M.

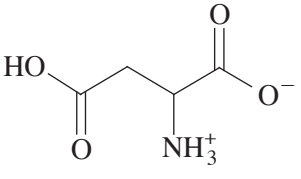
Bottle Three contains 100 milliliters of a sulfuric acid solution, $H_2SO_{4(aq)}$, that has a concentration of 1 M.

In order to distinguish between the three solutions, four tests (1-4) were carried out.

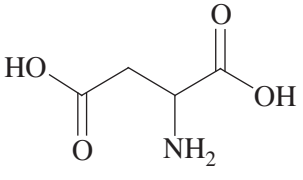
What can we do to accurately identify the contents of each of the bottles?

1. Check whether the electrical conductivity of each solution is good or negligible.
2. Measure the pH of each solution.
3. Add sodium bicarbonate, $NaHCO_{3(s)}$, to each solution.
4. Add sodium hydroxide, $NaOH_{(s)}$, to each solution.

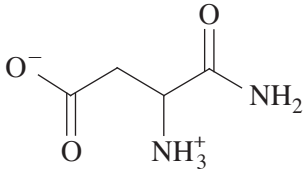
ח. Aspartic acid is an amino acid that contains an additional carboxyl (–COOH) group as its side group. Which of the structures below, 1-4, correctly depicts the structure of aspartic acid in an aqueous solution at pH = 7?



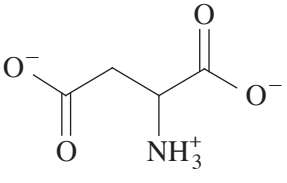
2



1



4



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/continued on page 7/

Analysis of a Passage from a Scientific Article

2. Read the passage below and answer all of the items that follow it.

Proteins in the Headlines

The year 2011 has been declared the International Year of Chemistry. In honor of this, it was decided to issue two new postage stamps honoring the accomplishments of the three Israeli scientists who have won the Nobel Prize for Chemistry in the past decade.
Professors Avraham Hershko and Aaron Ciechanover from the Technion won a Nobel Prize in 2004 for their discovery of the mechanism responsible for breaking down defective proteins in living cells.
This degradation is carried out with the help of the protein ubiquitin, which binds the defective protein. The defective protein undergoes hydrolysis and is broken down into smaller peptide molecules that are secreted from the cell.

Professor Ada Yonat from the Weizmann Institute won a Nobel Prize in 2009 for her research into the structure and function of ribosomes, which are the special bodies in which proteins are produced in living cells. This deciphering of the ribosome's structure was made possible by Professor Yonat's development of a method for crystallizing ribosomes.

There are different methods for crystallizing materials. One of them is crystallization from solution. This method has two stages:
In the first stage, the material is dissolved in an appropriate solvent.
In the second stage, the solvent is slowly evaporated and the solute is crystallized.

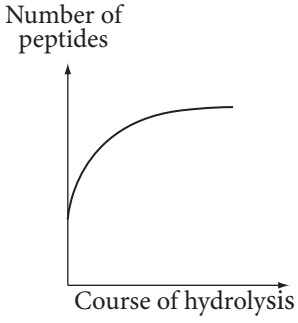
Adapted from: http://nobelprize.org/nobel_prizes/chemistry/laureates/2004
http://nobelprize.org/nobel_prizes/chemistry/laureates/2009

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

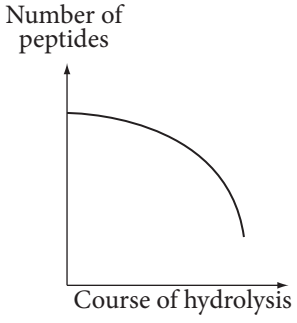
/continued on page 8/

Answer all of the items below.

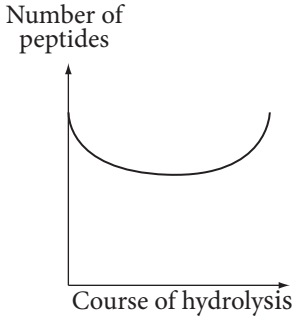
א. Which of the graphs below, I, II or III, could correctly describe the change in the number of peptides during the course of the hydrolysis of the defective protein? Explain your answer.



I



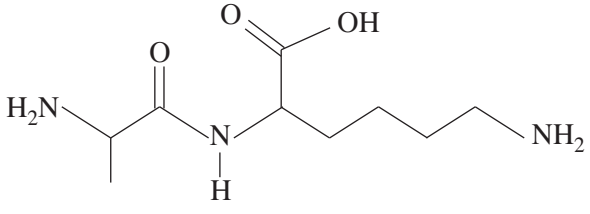
II



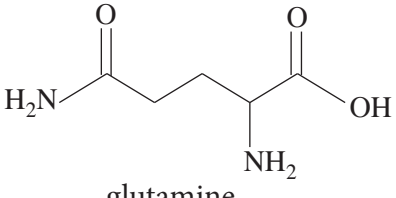
III

ב. During the course of the hydrolysis of the defective protein, Dipeptide A is obtained, among other things.

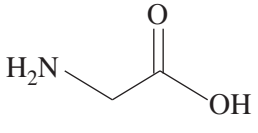
An abbreviated structural formula of Dipeptide A is presented below:



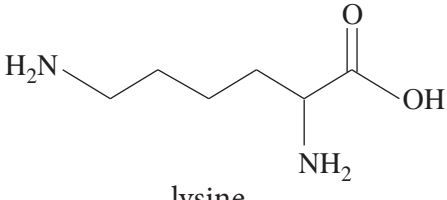
Here are abbreviated structural formulas of four amino acids:



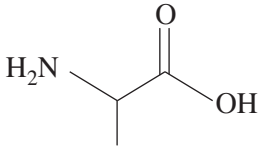
glutamine



glycine



lysine



alanine

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

/continued on page 9/

i Residues of which two amino acids are bound to each other in Dipeptide A?

ii Dipeptide B is made up of residues of the two given amino acids that are not found in Dipeptide A. Draw the full structural formula of Dipeptide B.

The material copper sulfate pentahydrate, $CuSO_4 \cdot 5H_2O_{(s)}$, contains ions and molecules of water.

In a laboratory, an experiment was carried out in which $CuSO_4 \cdot 5H_2O_{(s)}$ crystals were formed in an aqueous solution.

In the first step of the experiment, 90 grams of $CuSO_4 \cdot 5H_2O_{(s)}$ powder were dissolved in water.

The volume of the obtained solution was 200 milliliters.

A formula showing the process by which the solid was dissolved is shown below:

$$CuSO_4 \cdot 5H_2O_{(s)} \xrightarrow{\text{water}} Cu^{2+}_{(aq)} + SO^{2-}_{4(aq)} + 5H_2O_{(\ell)}$$

ג. i Describe the solution that was obtained at the microscopic level (in words).

ii What is the total concentration of <u>all</u> of the ions in the obtained solution? <u>Show detailed calculations</u>.
Given: The molar mass of the solid is 249.5 grams per mol.

ד. After a week, some of the water had evaporated and a large crystal had formed.

The formula below describes the process by which the $CuSO_4 \cdot 5H_2O_{(s)}$ crystal was obtained:

$$Cu^{2+}_{(aq)} + SO^{2-}_{4(aq)} + 5H_2O_{(\ell)} \rightarrow CuSO_4 \cdot 5H_2O_{(s)}$$

The crystal was removed from the solution and 0.06 mols of $Cu^{2+}_{(aq)}$ ions remained in the solution, along with other substances.

Determine whether <u>each</u> of the statements below, i-ii, is true or false.
<u>Explain each of your answers</u>.

i As the water evaporates, the attracting forces between the ions become stronger.

ii The mass of the crystal that was removed is 15 grams.

/continued on page 10/

Part Two (60 points)

Answer three of the questions 3-8 (each question – 20 points).

Structure and Bonding

3. Each of the four statements below, I-IV, concerns the properties of one of the materials: bromine, Br_2; hydrogen bromide, HBr; graphite, C; silver, Ag.

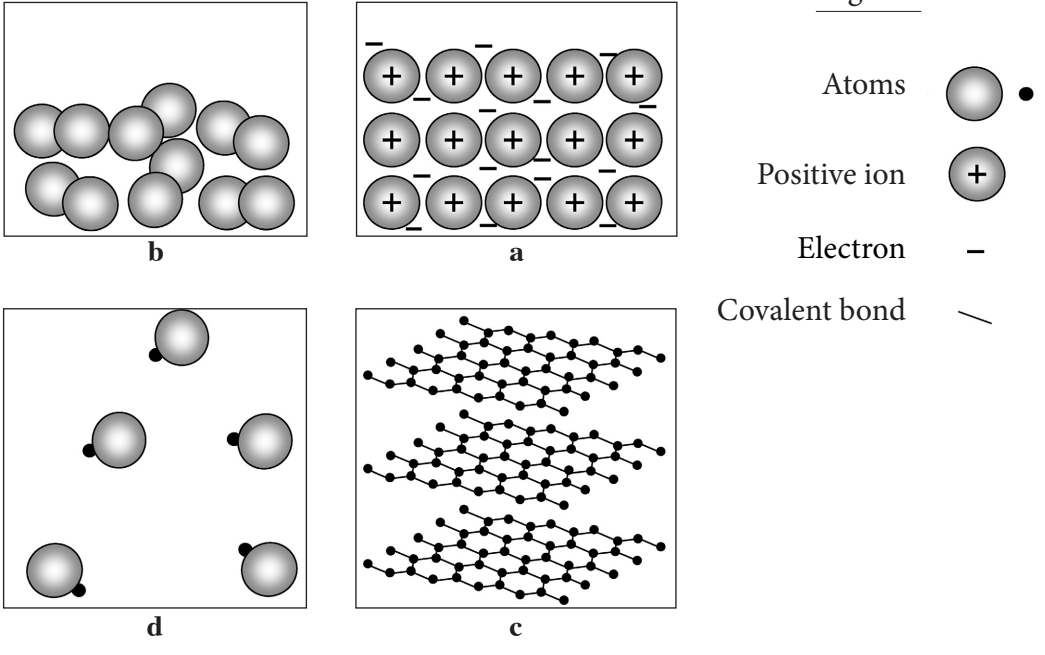
I. The material conducts electricity in its liquid and solid states and can be flattened into a metal sheet [ניתן לריקוע].

II. The material reacts with water and its aqueous solution conducts electricity.

III. The material does not conduct electricity in its liquid or solid state and is not very soluble in water.

IV. The material conducts electricity in its solid state and does not dissolve in water.

Illustrations a-d are schematic descriptions of the structures of the materials.



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

/continued on page 11/

א. Copy the Hebrew table below into your answer booklet and fill it in.

מצב הצבירה של החומר כפי שמתואר באיור Physical state of the material as described in the illustration (solid, liquid, gas)	האות המסמלת את האיור המתאים לחומר (d - a) Letter indicating the illustration that corresponds to the material (a-d)	מספר ההיגד המתאים לחומר (IV - I) No. of the statement that corresponds to the material (I-IV)	החומר Material
			ברום Bromine
			מימן ברומי Hydrogen bromide
			גרפיט Graphite
			כסף Silver

ב. i Write out the Lewis electron-dot structure [נוסחת ייצוג אלקטרונית] for <u>each</u> of the molecules HBr and Br_2.

ii The covalent bond between the H and Br atoms in a HBr molecule is stronger than the covalent bond between the atoms of Br in a Br_2 molecule.
Provide <u>two</u> reasons for the difference in the strength of these bonds. <u>Explain</u>.

ג. i Write out a formula for the process that takes place when the material described in Statement II is added to water.

ii Explain why the solution formed in Sub-item ג-i conducts electricity.

ד. i The material corresponding to Statement I can be flattened to form a sheet of metal [ניתן לריקוע]. Explain why.

ii The material corresponding to Illustration c conducts electricity in its solid state. Explain why.

/continued on page 12/

Structure and Bonding

4. The chlorofluorocarbons or "freons" used in refrigerators and air conditioners are gases under room conditions.

The formulas of three chlorofluorocarbons are shown below:

$CC\ell F_2CC\ell F_{2(g)}$, $CC\ell_2F_{2(g)}$, $CHC\ell F_{2(g)}$

א. i Write out the Lewis electron-dot structure [נוסחת ייצוג אלקטרונית] for the molecule $CHC\ell F_2$.

ii Describe <u>two</u> differences between $CHC\ell F_{2(g)}$ and $CHC\ell F_{2(\ell)}$ at the microscopic level.

ב. Molecules of the two chlorofluorocarbons $CHC\ell F_{2(g)}$ and $CC\ell_2F_{2(g)}$ have a tetrahydral spatial structure. Determine whether <u>each</u> of the statements i-ii is true or false. <u>Explain each answer</u>.

i The electronegativity of fluorine atoms, F, is greater than the electronegativity of atoms of chlorine, $C\ell$. Therefore, the chlorine atoms, $C\ell$, in a molecule of $CC\ell_2F_{2(\ell)}$ have a partial positive charge.

ii The interactions between molecules of $CC\ell_2F_{2(\ell)}$ are stronger than the interactions between molecules of $CHC\ell F_{2(\ell)}$.

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

/continued on page 13/

ג. i Determine whether each of the covalent bonds between the atoms in a molecule of $CC\ell F_2CC\ell F_2$ is nonpolar [טהור] or polar [קוטבי].

ii Which bond is longer: C—C or C—F? Explain.

iii Formulas of three compounds are shown below:

$CC\ell_2FCC\ell_2F_{(g)}$, $CF_3CC\ell_2F_{(g)}$, $CC\ell_3CF_{3(g)}$

Determine which of the compounds is an isomer of the compound $CC\ell F_2CC\ell F_{2(g)}$.

Explain your answer.

ד. i Freon, $CC\ell_2F_{2(g)}$, dissolves in mineral oil whose formula is $C_{18}H_{38(\ell)}$.

Explain this fact.

ii Write out a formula for the process by which freon, $CC\ell_2F_{2(g)}$, dissolves in the mineral oil.

/continued on page 14/

Oxidation-Reduction and Stoichiometry

5. Copper tools have been used since Biblical times and, today, there are many uses for copper and copper salts.

וְצִלָּה גַם הִוא יָלְדָה אֶת תּוּבַל קַיִן
לֹטֵשׁ כָּל חֹרֵשׁ נְחֹשֶׁת וּבַרְזֶל
(בראשית, ד, כ"ב)

א. i Describe the structure of copper, $Cu_{(s)}$, at the microscopic level.

ii What are <u>two</u> properties of copper?

Copper is found in nature in different compounds.

Formulas of five copper-containing compounds are shown below:

$Cu_2O_{(s)}$, $CuO_{(s)}$, $CuC\ell_{2(s)}$, $Cu_2S_{(s)}$, $CuS_{(s)}$

ב. i Determine the charge of the copper ions in each of the compounds.

ii Determine in which (one or more) of the compounds the copper ions can act as both an oxidant [מחמצן] and a reductant [מחזר]. <u>Explain your answer</u>.

Items ג and ד concern the extraction of copper.

ג. The extraction of copper from $Cu_2S_{(s)}$ proceeds via Reaction (1):

(1) $Cu_2S_{(s)} + O_{2(g)} \longrightarrow 2Cu_{(s)} + SO_{2(g)}$

i Determine whether the copper, $Cu_{(s)}$ in Reaction (1) is a product of oxidation or reduction? <u>Explain your answer</u>.

ii What mass of copper can be extracted from 5000 mols of $Cu_2S_{(s)}$? <u>Show detailed calculations</u>.

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

/continued on page 15/

ד. The extraction of copper from a solution containing $Cu^{2+}_{(aq)}$ ions proceeds via Reaction (2):

(2) $3Cu^{2+}_{(aq)} + 2Fe_{(s)} \longrightarrow 3Cu_{(s)} + 2Fe^{3+}_{(aq)}$

i Determine whether the mass of the copper obtained from 5000 mols of $Cu^{2+}_{(aq)}$ ions that reacted with a sufficient quantity of $Fe_{(s)}$, as described in Reaction (2), is greater than, smaller than or the same as the mass of copper that you calculated for Sub-item ג-ii. Explain your answer.

ii The concentration of $Fe^{3+}_{(aq)}$ ions in the obtained solution is 4 M. Calculate the volume of the solution.
Show detailed calculations.

/continued on page 16/

Oxidation-Reduction

6. Iron oxide, $Fe_2O_{3(s)}$, is the main component of rust.

Rust, $Fe_2O_3 \cdot 3H_2O_{(s)}$, is a product of the corrosion of iron, $Fe_{(s)}$.

Rust is produced through an oxidation-reduction reaction in which iron reacts with oxygen and water, as shown in Reaction (1):

(1) $2Fe_{(s)} + \frac{3}{2} O_{2(g)} + 3H_2O_{(\ell)} \longrightarrow Fe_2O_3 \cdot 3H_2O_{(s)}$

א. Determine whether <u>each</u> of the statements below, i-ii, is true or false. <u>Explain each answer</u>.

i The oxidation level of the iron in the oxide $Fe_2O_{3(s)}$ is $\textcircled{+6}$.

ii In Reaction (1), the iron is oxidized.

ב. i Iron plates were submerged in two containers I-II.
Container I contains oil.
Container II contains tap water.
After several hours, spots of rust appeared on one of the two plates. In which container were the rust spots observed? <u>Explain</u>.

ii Iron plates were submerged in two containers III-IV.
Container III contains tap water through which oxygen, $O_{2(g)}$, is flowing.
Container IV contains tap water through which carbon dioxide, $CO_{2(g)}$, is flowing.
After several hours, spots of rust appeared on one of the two plates. In which container were the rust spots observed? <u>Explain</u>.

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

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ג. In the Middle Ages, when rust stains needed to be removed from swords, blacksmiths would set the rusty swords on top of burning charcoal, $C_{(s)}$. The charcoal reacted with the oxygen in the iron oxide to produce carbon dioxide, $CO_{2(g)}$.

i Write a balanced equation for the reaction between iron oxide, $Fe_2O_{3(s)}$, and charcoal, $C_{(s)}$.

ii According to the formula that you wrote out for Sub-Item ג-i, how many mols of electrons are transferred in the reaction of 1 mol of $Fe_2O_{3(s)}$? Explain.

ד. Today, different methods are used to protect iron against corrosion. In order to protect an iron pipe against corrosion, a plate made of a different metal is attached to it.

The formulas of three metals are listed below in the order of their ability to reduce [לחזר]:

$$Zn_{(s)} > Fe_{(s)} > Cu_{(s)}$$

i Which metal — zinc, $Zn_{(s)}$, or copper, $Cu_{(s)}$ — can be used to protect an iron pipe against corrosion? Explain.

ii Propose another method for protecting an iron pipe against corrosion. Explain how the method that you are proposing prevents the corrosion of the iron.

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Acids, Bases and Stoichiometry

7. Burnt lime (quicklime) [סיד שרוף] — calcium oxide, $CaO_{(s)}$ — is an important component of concrete, cement and other building materials. Slaked lime [סיד כבוי] — calcium hydroxide, $Ca(OH)_{2(s)}$ — is used in construction and painting.

א. i Burnt lime is produced by roasting limestone — calcium carbonate, $CaCO_{3(s)}$ — as shown in Reaction (1):

(1) $CaCO_{3(s)} \xrightarrow{\text{heat}} CaO_{(s)} + CO_{2(g)}$

What mass of $CaCO_{3(s)}$ is required for the production of 112 kilograms of $CaO_{(s)}$?
Show detailed calculations.

ii Slaked lime is produced when burnt lime reacts with water.
Write out a chemical equation for this reaction.

Clear lime water, which is a solution of $Ca(OH)_{2(aq)}$, is used to detect carbon dioxide, $CO_{2(g)}$, as described in Reaction (2):

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

ב. i What visible change in the clear lime water indicates the presence of $CO_{2(g)}$?

ii A $Ca(OH)_{2(aq)}$ solution with a concentration of 0.015 M was prepared. The solution reacted with 1.188 grams of $CO_{2(g)}$. The reactants reacted completely.
What was the volume of the $Ca(OH)_{2(aq)}$ solution that reacted?
Show detailed calculations.

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

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ג. Two containers, I and II, each contain 200 milliliters of a $Ca(OH)_{2(aq)}$ solution with a concentration of 0.02 M.
200 milliliters of an aqueous solution of hydrobromic acid, $HBr_{(aq)}$, with a concentration of 0.02 M were added to Container I.
A reaction occurred.

i Write out and balance an equation for the reaction that occurred in Container I.

ii Determine whether the pH of the solution obtained in Container I following the reaction is higher than 7, equal to 7 or lower than 7. Explain your conclusion.

iii 200 milliliters of an aqueous solution of sulfuric acid, $H_2SO_{4(aq)}$, with a concentration of 0.02 M is added to Container II.
A reaction occurred.
Determine whether the pH of the solution in Container II after the reaction is higher, lower or the same as the pH of the solution obtained after the reaction in Container I. Explain your answer.

ד. After work was completed at a construction site, 444 grams of slaked lime, $Ca(OH)_{2(s)}$, remained. This material was neutralized using an aqueous solution that contained 6 mols of Acid A.
A reaction occurred in which all of the reactants reacted completely.
Determine whether the solution of Acid A was a $HNO_{3(aq)}$ solution or a $H_2SO_{4(aq)}$ solution.
Show detailed calculations and explain your work.

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Lipids

8. Olive oil is an important part of the Mediterranean diet.
The triglyceride triolein is the main component of olive oil. Triolein is produced in a reaction between oleic acid and glyceride, $CH_2OHCHOHCH_2OH$.

א. The abbreviated formula for oleic acid is C18:1ω9 cis.

i Write out an abbreviated representation of the structural formula of oleic acid.

ii Write out the molecular formula of oleic acid.

ב. The abbreviated formula for stearic acid is C18:0.
Determine whether the interactions between the molecules of oleic acid are stronger or weaker than the interactions between the molecules of stearic acid. Explain your conclusion.

ג. i Write out the formula for the reaction between glyceride and oleic acid in which triolein is produced.

ii The solubility of triolein in water is negligible. Explain this fact.

ד. Olive oil is also used to make soap. This soap is produced in a reaction between triolein and a $NaOH_{(aq)}$ solution. The formula of the soap that is produced is:

$$CH_3(CH_2)_7CHCH(CH_2)_7COONa_{(s)}$$

This soap can be used to remove grease stains from clothing. As the soap is rubbed against the clothing, it binds the oily stains. To remove the soap and the stain, the clothing is rinsed in water.
Three statements, i-iii, concerning soap made from olive oil are presented below. Determine whether each statement is true or false. Explain each answer.

i The soap is a molecular material.

ii Van der Waals interactions are formed between the greasy stain and the soap.

iii When the soapy clothing is rinsed in water, forces of electrical attraction are created between the particles of soap and the water molecules.

Good Luck! **בהצלחה!**