وزارة التربية والتعليم العالي المديرية العامة للتربية دائرة الامتحانات	الشهادة المتوسطة	دورة سنة 2009 العادية
	مسابقة في مادة الكيمياء المدة: ساعة واحدة	الاسم: الرقم:

This Exam Is Composed of Three Exercises. It Is Inscribed on 2 Pages.
Answer the Three Following Exercises:

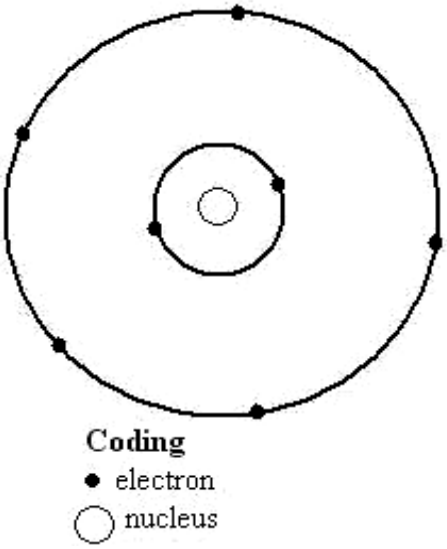
First Exercise (7 points)
Ionic Compounds

Ionic compounds such as NaCl, K_2S… are solids at room temperature and they have very high melting points. They conduct electricity when they are molten or dissolved in water and for this reason they are called electrolytes.

1 - The diagram given at the right represents the electron distribution on the energy levels for the nitrogen atom N.

1.1 - Indicate the placement: row (period) and column (group) of nitrogen in the periodic table.

1.2 - Write the Lewis electron dot symbol of nitrogen atom and the Lewis dot structure of nitrogen molecule N_2.



2 - The placement of potassium K is on row four of the periodic table. A potassium atom loses the single electron of its outer energy level to become a stable potassium ion K^+.

2.1 - Translate this statement into an equation form.

2.2 - Determine the atomic number of potassium K.

3 - The Lewis electron dot symbol of sulphur atom is :

Sulfur reacts with potassium to form the compound, potassium sulfide K_2S.

3.1 - Explain the bond formation in the compound K_2S.

3.2 - Specify whether the compound potassium sulphide is, or is not, an electrolyte.

4 – The reaction between sodium and chlorine is an oxidation-reduction reaction. The equation of the reaction is: $2Na + Cl_2 \longrightarrow 2NaCl$

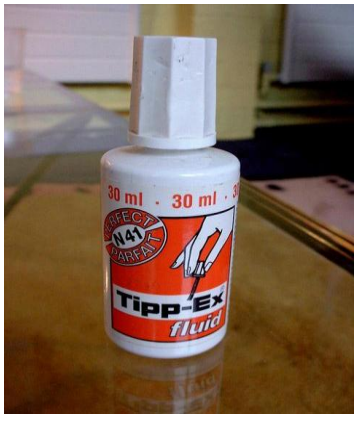
4.1- Write the oxidation half-reaction.

4.2- Identify the oxidizing agent in this reaction.

N.B: The oxidation number of chlorine in NaCl is -1.

Second Exercise (7 points)
ChloroAlkanes

Chloroalkanes are very important organic compounds, they are synthesized in the industry. However, chloromethane besides being synthesized in the industry, also it is produced naturally by marine algae. Dichloromethane is used as solvent to extract perfumes, caffeine… Trichloromethane is used as anaesthetic and 1,1,1-trichloroethane is used as solvent in correction liquid such as (Tipp-Ex).



1-Write the structural formula of the chloroalkane produced naturally by marine algae.

2- Indicate which of the following condensed structural formulas represents 1,1,1-trichloroethane.

a) $CH_3 - CHCl - CHCl_2$, **b)** $CH_3 - CCl_3$, **c)** $CH_2Cl - CHCl_2$

3- A compound **(A)** of molecular formula **B** is obtained according to the reaction given by the following equation:

$$C_2H_6 + 2\ Cl_2 \longrightarrow \mathbf{B} + 2\ HCl$$

3.1-Determine the molecular formula **B.**

3.2-Write all possible structural formulas of compounds having the molecular formula **B.**

4- Based on the text, specify why chloroalkanes are important.

5- A student named a compound **(D)** as: 3-chlorobutane.

5.1- Write the condensed structural formula corresponding to this name.

5.2- Show that this name is not correct. Give the correct name of the compound **(D)**.

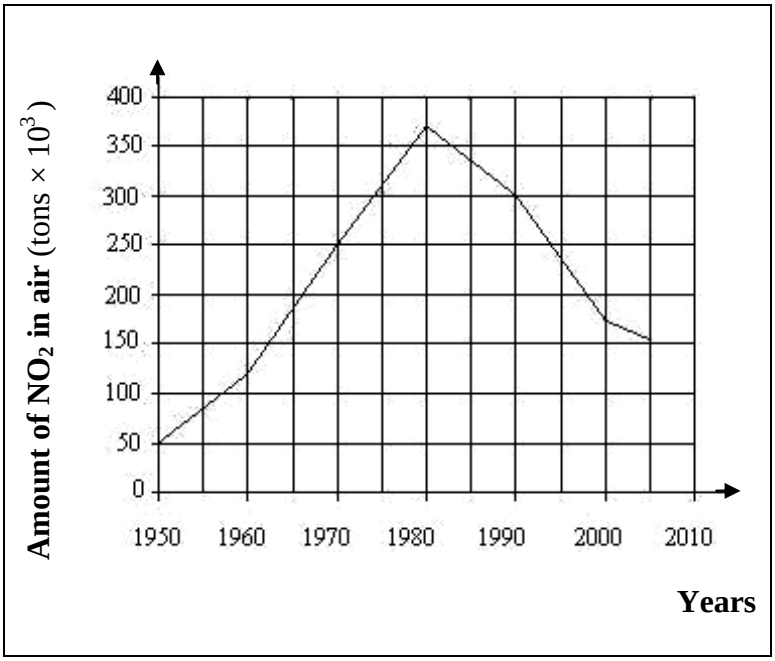
Third Exercise (6 points)
Air Pollution

Industrial activity and transportation use fossil fuel as a main source of energy. They are considered as two sources of air pollution due to the release of nitrogen dioxide NO_2 from smokestacks of factories and from cars exhausts.

Nitrogen dioxide gas molecules react with moisture in the air to produce nitric acid HNO_3, and thus contribute to the formation of acid rain.

To reduce the amount of nitric acid in acid rain, car producers equipped cars exhausts with catalytic converters, to change NO_2 into nitrogen N_2 gas.

The graph given at the right shows the change of the amount of NO_2 in 10^3 tons between the years 1950 and 2005.



1 - Complete the equation of the reaction which takes place in the catalytic converter.

$$2NO_2 \longrightarrow N_2 + \ldots\ldots$$

2 - Based on the text, state how car producers have contributed to reduce the amount of nitrogen dioxide released into the air.

3 - Refer to the graph:

3.1 - Indicate the year when the amount of nitrogen dioxide in the air started to decrease.

3.2-Compare the value of the amount of nitrogen dioxide in 10^3 tons, released into the air in the year 1970 to that released in the year 2005**.**

3.2 – Relate the change in the amount of NO_2 released to the amount of HNO_3 formed. Draw a conclusion.

4 - Give two possible harmful effects that can be caused by acid rain.

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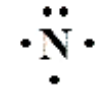
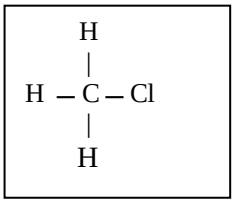
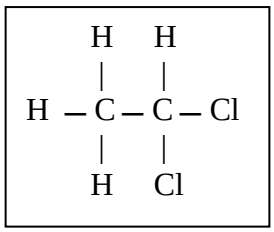
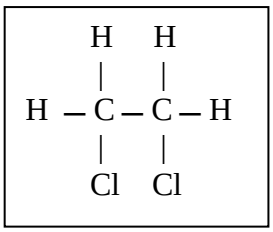
Q	Answer	Mark
	First Exercise (7 points)	
1.1	The placement of nitrogen in the periodic table: Row 2 (period 2) and Column 15 (group 5). * K^2, L^5 row 2 and column 15. **2(0.25pt)**	**0.5**
1.2	The electron dot symbol of nitrogen atom is : **(0.50 pt)**  The Lewis dot structure of nitrogen molecule N_2 is : **(0.50 pt)**  or 	**1**
2.1	$K \longrightarrow K^+ + 1e^-$.	**0.50**
2.2	K atom has four energy levels (K, L, M and N).The number of occupied energy level is equal to the number of the period. **(0.25pt)** K atom has one electron on its outer energy level. Its electron configuration is : K^2 , L^8, M^8 , N^1 **(0.25pt)** Total number of electrons is : 2 + 8 + 8 + 1 = 19. **(0.25pt)** An atom contains equal number of protons and electrons **(0.25pt)** $\Rightarrow$ Number of protons = 19 $\Rightarrow$ Atomic number Z = Number of protons = 19.**(0.25pt)**	**1.25**
3.1	K atom loses the single electron of its outer energy level to become stable potassium K^+ ion. S atom has 6 electrons on its outer energy level. It needs two electrons to have octet of electrons.**(0.25pt)** It gains two electrons from two potassium atoms to become stable S^{2-} ion.**(0.50pt)** The oppositely charged K^+ and S^{2-} ions attract each other mutually by an electrostatic force to form the ionic compound potassium sulphide K_2S. **(0.50pt)** * Using equation is acceptable: $S + 2\,e^- \longrightarrow S^{2-}$ **(0.50 pt)**	**1.25**
3.2	K_2S is an electrolyte because it is an ionic compound, and ionic compounds conduct electricity when they are molten or dissolved in water.	**0.50**
4.1	The oxidation half-reaction is : $Na \longrightarrow Na^+ + 1e^-$	**1**
4.2	The oxidizing agent in this reaction is chlorine, because the oxidation number of Cl decreased from 0 (Cl_2) to -1 in NaCl. 0 0 +1 -1 *$Na + Cl_2 \longrightarrow Na\,Cl$ * $Cl + 1e^- \longrightarrow Cl^-$	**1**

Q		
	Second Exercise (7 points)	
1	The structural formula of chloromethane is**: (0.5pt)**  **(0.5pt)**	**1**
2	The condensed structural formula of 1,1,1- trichloroethane is: $CH_3 - CCl_3$	**1**
3.1	Law of conservation of mass (atoms). Number of atoms of an element is conserved. **(0.25pt)** - Number of carbon atoms in **B** is: 2 **(0.25pt)** - Number of hydrogen atoms is : $6 = n_H + 2$, therefore $n_H = 4$ **(0.25pt)** - Number of chlorine atoms is: $2x2 = n_{Cl} + 2$, therefore $n_{Cl} = 2$.**(0.25 pt)** The molecular formula **B** is: $C_2H_4Cl_2$ **(0.5 pt)** * Molecular Formula without justification **(0.5pt)** * $C_2H_6 + 2Cl_2 \longrightarrow C_2H_4Cl_2 + 2\ HCl$ **(1pt)**	**1.50**
3.2	Possible structural formulas of compounds having the molecular formula **B** are:   **(0.5 pt)** **(0.5 pt)**	**1**
4	Chloroalkanes are important because they are used as solvents, anesthetics.	**1**
5.1	$CH_3 - CHCl - CH_2 - CH_3$ * $CH_3 - CH(Cl) - CH_2 - CH_3$	**0.50**
5.2	This name is not correct, because the main chain is numbered in such a way the carbon atom holding the substitution receives the lowest possible number. **(0.5 pt)** The correct name is 2-chlorobutane. **(0.5 pt**)	**1**
	Third Exercise (6 points)	
1	The equation is: $2NO_2 \longrightarrow N_2 + 2O_2$	**1**
2	Car producers equipped cars exhausts with catalytic converters, to change NO_2 into nitrogen N_2 gas.	**1**
3.1	The amount of nitrogen dioxide in the air started to decrease starting theyear1980.	**0.50**
3.2	The amount of nitrogen dioxide, released into the air on 1970 is : $250x10^3$ tons.**(0.5pt)** The amount of nitrogen dioxide, released into the air on 2005 is : $150x10^3$ tons. **(0.5pt)** 250×10^3 tons > 150×10^3 tons. **(0.5pt)**	**1.50**
3.3	Amount of nitrogen dioxide released on 1970 is less than the amount released on 2005 $\Rightarrow$ Less amount of nitric acid is formed **(0.5pt)**, and thus less contribution to the formation of acid rain. **(0.5pt)**	**1**
4	Acid rain damages buildings, statues, lakes, living organisms, trees, forests...**2(0.5pt)**	**1**