وزارة التربية والتعليم العالي المديرية العامة للتربية دائرة الامتحانات	امتحانات الشهادة المتوسطة	دورة سنة ٢٠٠٦ العادية
	مسابقة في مادة الكيمياء المدة : ساعة واحدة	الاسم : الرقم :

This Exam Consists of Three Exercises. It Is Inscribed on Two Pages 1 & 2.
Answer the Following Three Exercises

First Exercise (6 Points)
Covalent and Ionic Compounds

Inorganic ionic compounds have high melting points and are electrolytes. Whereas, almost all organic compounds are covalent compounds of low melting points and are non-electrolytes.

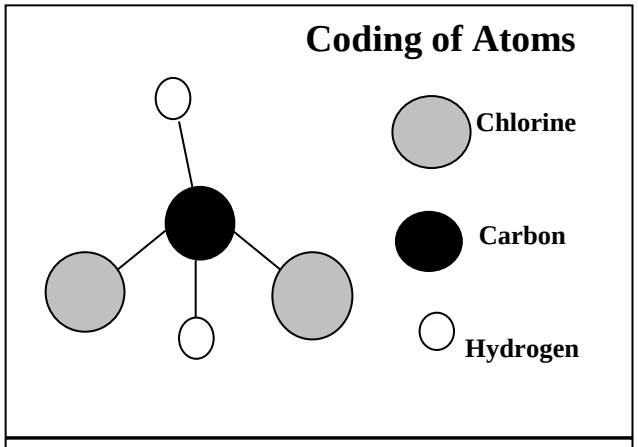


Figure -1: Ball-and-Stick model of dichloromethane.

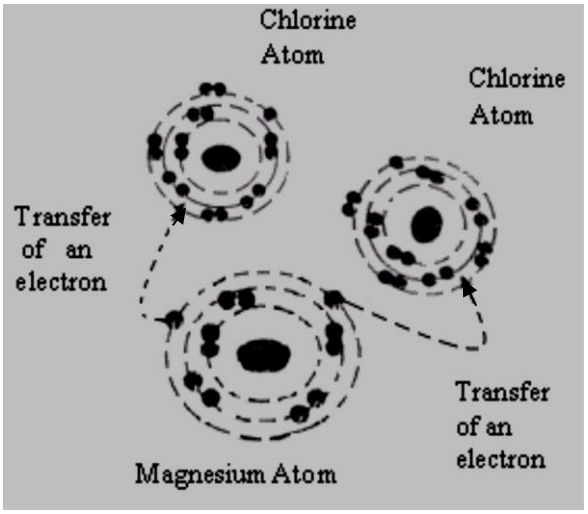


Figure - 2: Schematic representation of transfer of electrons from magnesium atom to chlorine atoms.

Given: $_{1}H$: K^1 ; $_{6}C$: $K^2\ L^4$
$_{12}Mg$: $K^2\ L^8\ M^2$; $_{17}Cl$: $K^2\ L^8\ M^7$

1- Write the Lewis electron dot symbol of the atoms C, Mg and Cl.
2- Explain, based on ***Figure -1*** and ***Figure - 2,*** how the chlorine atom attains stable octet in each of the compounds dichloromethane and magnesium chloride.
3- Justify which of the two compounds dichloromethane or magnesium chloride has higher melting point.
4- The reaction of compound **(A)** with chlorine gas, under suitable conditions, produces dichloromethane and hydrogen chloride (HCl) according to the equation :

$$\mathbf{(A) + Cl_2 \rightarrow CH_2Cl_2 + HCl}$$

Determine the molecular formula of compound **(A)**.

Second Exercise (7 Points)
Organic Compounds

Open chain aliphatic hydrocarbons can be alkanes, alkenes and alkynes. The first member of the alkane family contains one carbon atom in its molecule, its name is methane .The first member of the alkene family contains two carbon atoms in its molecule, its name is ethene.

1- Write the condensed structural formula of the second member of the alkyne family, which contains three carbon atoms in its molecule and give its name.

2- Three reactions **(A), (B)** and **(C)** are represented by the following three equations **(I), (II)** and **(III)**.

Reaction **(A) :** $CH_4 + 2Cl_2 \longrightarrow CH_2Cl_2 + 2HCl$ Equation **(I)**

Reaction **(B) :** $CH_2 = CH_2 + H_2 \longrightarrow CH_3 — CH_3$ Equation **(II)**

Reaction **(C) :** $CH_2 = CH_2 + H_2O \longrightarrow CH_3 — CH_2OH$ Equation **(III)**

a) Give the IUPAC name of the organic product obtained in each of the reactions **(A)** and **(C).**

b) Identify which of the reactions **(A)** or **(C)** is an addition reaction and which reaction is not an addition reaction.

3- The product obtained in reaction **(C)** can react with a mono-carboxylic acid.
Write the general formula of the mono-carboxylic acid and give the name of this reaction.

4- The organic compound of molecular formula $C_2H_4Cl_2$ admits two possible isomers. Write the structural formula and give the IUPAC name of each isomer.

Third Exercise (7 points)
Sulfur Dioxide and Acid Rain

The graph given below shows the average amount of sulfur dioxide SO_2 gas emitted into the air from the combustion of fuel containing sulfur as impurity. SO_2 gas contributes to the formation of acid rain. The maximum tolerable level of SO_2 in air is 75 μg /m^3.

Combustion of sulfur to sulfur dioxide occurs according to the equation:

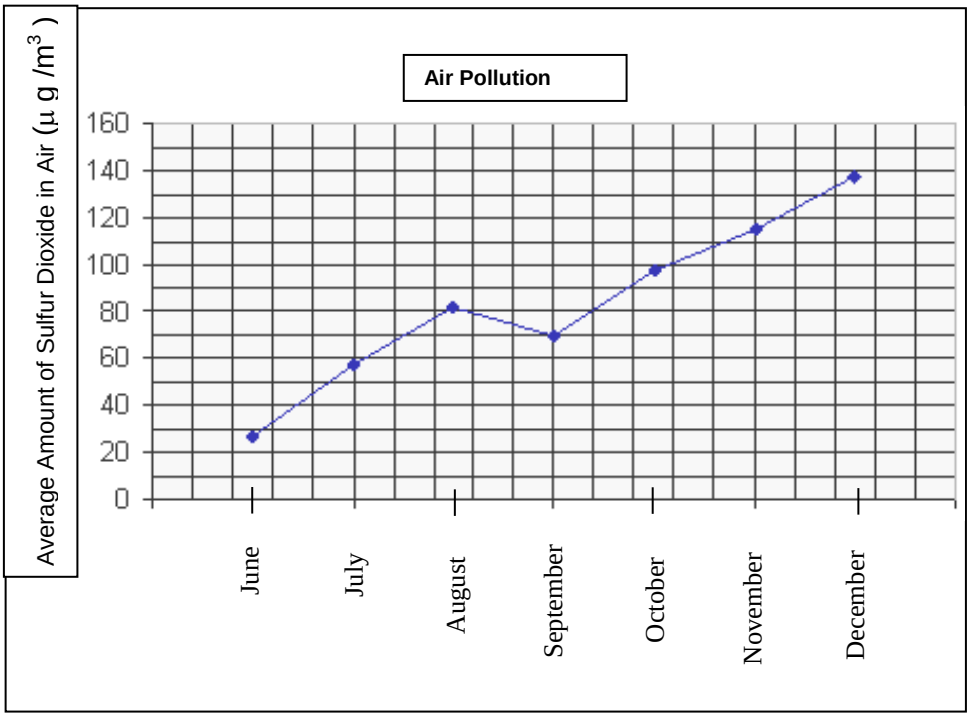
$S + O_2 \rightarrow SO_2$ **(E_1)**

SO_2 changes in the air to sulfur trioxide SO_3 according to the equation:

$2SO_2 + O_2 \rightarrow 2\,SO_3$ **(E_2)**

In the clouds and in the presence of humidity, SO_3 forms sulfuric acid H_2SO_4 according to the equation:

$SO_3 + H_2O \rightarrow H_2SO_4$ **(E_3)** .



1- Calculate the oxidation number of sulfur in each of the following compounds : SO_2 , SO_3 and H_2SO_4 .

2- Using oxidation number :

a) Show that the reaction represented by equation **(E_3)** is not an oxidation-reduction reaction.

b) Specify whether sulfur is reduced or oxidized in the oxidation-reduction reaction represented by equation **(E_1)**.

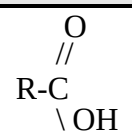
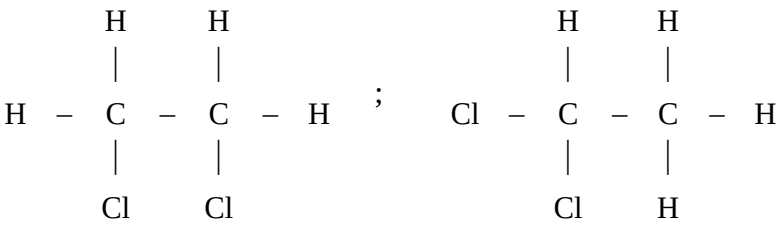
3- Indicate and justify during which months air is polluted due to sulfur dioxide emission.

4- Suggest one way to reduce sulfur dioxide emission into the air.

BE-Grade 9 **Marking Scheme** **1st session 2006**

Chemistry

Expected Answer	Mark	Comments
First Exercise (6 pts.)		
1 – The Lewis electron dot symbol of the atoms C, Mg and Cl are respectively: $\cdot C \cdot$; $\cdot Mg \cdot$ and $:\ddot{Cl}\cdot$	½ x 3	• A dash instead of an electron pair is accepted.
2 – The chlorine atom has 7 electrons on its valence energy level. It needs 1 electron to attain stable octet. *Based on figure-1, the chlorine atom shares a pair of electrons with the carbon atom. *Based on figure-2, the chlorine atom gains 1 electron from magnesium atom.	¾ ¾	• Simple covalent bond is accepted.
3 – Dichloromethane is a covalent compound. Magnesium chloride is an ionic compound. Ionic compounds have high boiling points while covalent compounds have low boiling points. Therefore, magnesium chloride has the higher boiling point.	½ ½	
4 – According to the law of conservation of atoms (matter), the number of atoms of each element in a chemical reaction is conserved. The number of carbon atoms in the products is equal to 1. Therefore, the number of carbon atoms in the molecule of (A) is equal to 1. The number of hydrogen atoms in the products is equal to 3. Therefore, the number of hydrogen atoms in the molecule of (A) is equal to 3. The number of chlorine atoms in the products is equal to 3. The number of chlorine atoms in the molecule of (A) should be equal to (3-2=1). Hence, the molecular formula of (A) is CH_3Cl.	½ ¼ ¼ ½ ½	• CH_3Cl without justification (zero) • $C_xH_yCl_z + Cl_2 \rightarrow CH_2Cl_2 + HCl$ x = 1 ; y = 3 and z = 1 Formula CH_3Cl (1 ½ pt)) • $CH_3Cl + Cl_2 \rightarrow CH_2Cl_2 + HCl$ (1 pt)
Second Exercise (7 pts.)		
1 – The condensed structural formula of the second alkyne is $CH \equiv C - CH_3$. Its name is propyne.	½ ½	• prop-1-yne is accepted C_3H_4 + correct name (½)
2 – a) In reaction **(A),** the organic product is dichloromethane. In reaction **(C),** the organic product is **e**thanol. b) *The reaction **(C)** is an addition reaction because the double bond in $CH_2 = CH_2$ molecule is broken and simple covalent bonds are formed in $CH_3 - CH_2OH$. *The reaction **(A)** is not an addition reaction because two hydrogen atoms are replaced by two chlorine atoms.	½ ½ ¾ ¾	• Non systematic name is not accepted. • Two reactants producing one product (accepted) • Addition of atoms to the initial molecule. (accepted). • The number of atoms in the initial molecule did not change. • This is a substitution reaction. Therefore , it is not an addition reaction.

Expected Answer	Mark	Comments
3- The general formula of mono-carboxylic acid is  The name of this reaction is esterification.	¾ ¾	• R-COOH and C_nH_{2n+1} - COOH $R-CO_2H$ are accepted.
4- The structural formulas of the two isomers are :  1,2 – dichloroethane ; 1,1 - dichloroethane	2 x ½ 2 x ½	• Condensed structural formula (zero)
Third Exercise (7 pts.)		
1 – The oxidation number of sulfur * For SO_2 : x + 2 (-2) = 0 ⇒ x = 4 ; oxidation number of (S) is +4 * For SO_3 : x + 3 (-2) = 0 ⇒ x = 6 ; oxidation number of (S) is + 6 * For H_2SO_4 : 2 (+1) + x + 4 (-2) ⇒ x = 6 ; oxidation number of (S) is + 6.	½ ½ ½	• + IV or IV • + VI or VI • + VI or VI are accepted.
2– a) $\overset{+6\ -2}{S\,O_3} + \overset{+1\ -2}{H_2O} \rightarrow \overset{+1\ +6\ -2}{H_2\,S\,O_4}$ **(E_3)** The oxidation number of each element did not change, therefore this reaction is not oxidation reduction reaction. b) $\overset{0}{S} + O_2 \rightarrow \overset{+4}{SO_2}$ **(E_1)** The oxidation number of sulfur atom increase from 0 to +4, therefore sulfur is oxidized.	¾ ¾ ½ ½	
3– Air is polluted during: August, October, November and December. The average quantity of SO_2 in air exceeds the tolerable maximum level which is 75 μ g/m^3.	¼ x 4 1	
4– A method to reduce the emission of sulfur dioxide into air is by removing sulfur from fuels.	1	• A convenient method (filters, green fuel..) except catalytic converter .