وزارة التربية والتعليم العالي المديرية العامة للتربية دائرة الامتحانات	الشهادة المتوسطة	دورة سنة ٢٠١٢ 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 pts)
Calcium Carbide

Calcium carbide is a compound of chemical formula CaC2. The most common use of calcium carbide is in the production of ethyne gas. Also, it is used in steel manufacturing and to determine the humidity* content of soil. The equation of the reaction to produce ethyne is given as:

$$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$$

1- Show, using oxidation numbers, that the reaction represented by the above given equation is not an oxidation-reduction reaction.
The element calcium belongs to group II.

2- The placement of carbon in the periodic table is on period 2 (row 2) and in group IV (column14).

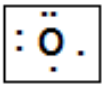
2.1-Indicate among the given electron configurations the one that corresponds to the electron configuration of carbon atom. Justify.

a) K^2, L^3, M^1 **b)** K^2, L^4 **c)** K^1, L^3, M^2 **d)** K^2, L^{14}

2.2-Determine the relative charge of the electron cloud of carbon atom.
(*Relative charge of an electron = -1)*

2.3-Deduce the relative charge of the nucleus of the carbon atom.

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



The element oxygen combines with the element carbon to form the molecular compound carbon dioxide.
-Explain the bond formation in a molecule of carbon dioxide.

4- The bond in the compound calcium carbide is an ionic bond.
-Distinguish ionic bond formation from double covalent bond formation.

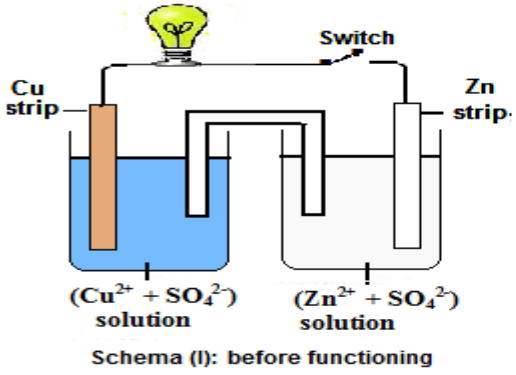
5- Give, based on the text, a reason why calcium carbide should be stored in dry containers and not in humid containers.

Remark: Humidity* content of soil: water content of soil.

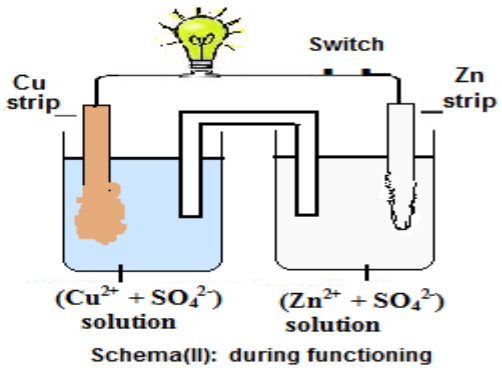
Second Exercise (6points)
Functioning Galvanic Cell

A galvanic cell converts the energy of a spontaneous redox reaction into electricity. It is used as source of electric power. The electrons flow through the external circuit from the anode to the cathode.

- The schemas **(I)** and **(II)** given below represent a zinc-copper galvanic cell.



Schema (I): before functioning



Schema(II): during functioning

1- Describe the construction of the galvanic cell represented by schema **(I)**.

2- The galvanic cell is set to function.

2.1-Write the half-reaction that takes place at the cathode and the half-reaction that takes place at the anode of this galvanic cell .

2.2-Deduce the equation of the overall reaction.

3- The salt bridge contains jellified ammonium nitrate solution (NH_4^+ + NO_3^-) .

- Explain why the NO_3^- ions of the salt bridge move towards the anodic half-cell.

4- The mass of copper strip used in constructing this galvanic cell is 16g.

After functioning for T hours the switch is opened. The copper strip is removed and dried. Its mass is found to be 16.32g.

4.1- Calculate the mass of copper deposited.

4.2- Determine the number of moles of copper deposited.

Given: M (Cu) = 64 $g.mol^{-1}$

5- Choose among the given written cell representations the one that corresponds to the written representation of this cell. Justify your answer.

a) $Zn|Zn^{2+}$ – salt bridge – $Cu^{2+}|Cu$

b) $Cu|Cu^{2+}$ – salt bridge – $Zn^{2+}|Zn$

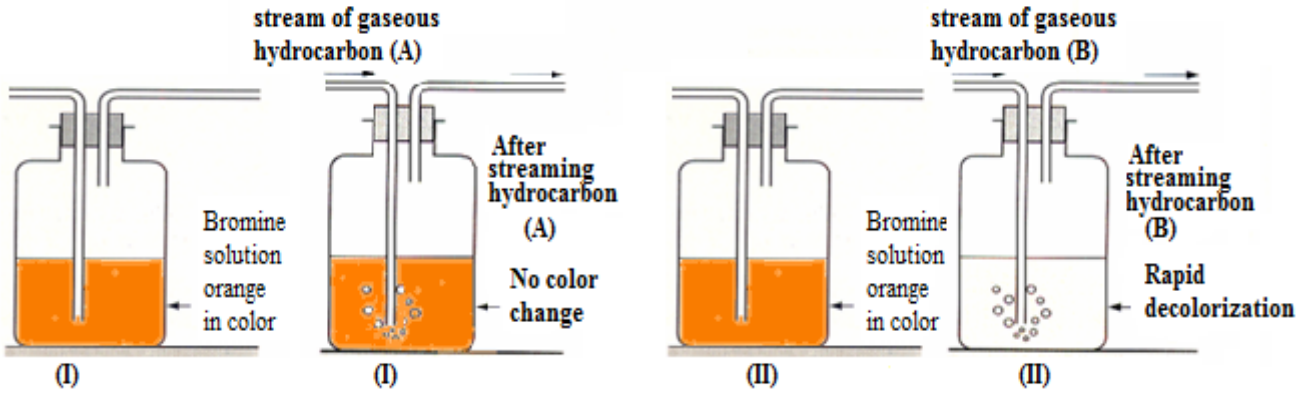
c) $Zn^{2+}|Zn$ – salt bridge – $Cu^{2+}|Cu$

Third Exercise (7 points)

Saturated and Unsaturated Aliphatic Hydrocarbons

Hydrocarbons can be classified as saturated and unsaturated hydrocarbons. Alkanes are saturated hydrocarbons and alkenes are unsaturated hydrocarbons.

Two colorless gaseous hydrocarbons (**A)** and (**B**) are streamed respectively into two bottles **(I)** and **(II)** each containing bromine solution orange in color. Two different results are obtained as indicated on the schemas below.



1-Specify which of the two hydrocarbons (**A)** or (**B)** is an alkene.

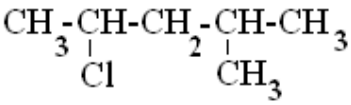
2-A hydrocarbon **(C)** satisfies the general formula C_nH_{2n}.

2.1- Give the molecular formula of hydrocarbon **(C)** for n= 3.

2.2- Write the two possible structural formulas of hydrocarbon **(C).**

2.3- Indicate the type of bonds between the carbon atoms in each of the two possible structural formulas of hydrocarbon **(C).**

3-The condensed structural formula of a haloalkane **(E)** is:



3.1- Give the IUPAC name of the haloalkane **(E).**

3.2- Indicate whether the carbon chain of haloalkane **(E)** is linear chain or branched chain.

4-Hydrocarbon (**A**) is an alkane, it satisfies the general formula $C_nH_{(2n+2)}$.

- Choose among the equations given below the one that corresponds to the equation of the complete combustion reaction of an alkane.

a) $C_nH_{(2n+2)} + (3n+1)O_2 \rightarrow CO_2 + (n+1)H_2O$

b) $C_nH_{(2n+2)} + (3n+2)O_2 \rightarrow nCO_2 + (n+1)H_2O$

c) $C_nH_{(2n+2)} + \frac{(3n+1)}{2}O_2 \rightarrow CO_2 + (n+1)H_2O$

d) $C_nH_{(2n+2)} + \frac{(3n+1)}{2}O_2 \rightarrow nCO_2 + (n+1)H_2O$

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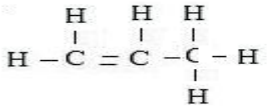
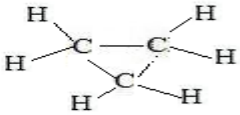
First Exercise (7 points)

Part of the Q	Answer	Mark
1	$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$ +2 -1 +1 -2 The oxidation number of Ca is +2, of H is +1, of O is -2 before and after the reaction. **0.25 pt** Let x be the oxidation number of C in CaC_2. The oxidation number of C in CaC_2: +2 +2(x) = 0 => x= -1 **0.25 pt** Let y be the oxidation number of C in C_2H_2: The oxidation number of C in C_2H_2: 2(y) +2(+1) = 0 => y= -1 **0.25 pt** The reaction does not involve a change in the oxidation number of Ca, H, O and C => the reaction involved is not a redox reaction. **0.25 pt**	**1**
2.1	Carbon has two occupied energy levels. (The number of occupied energy levels determines the period). **0.25 pt** Carbon has four electrons on the valence energy level. (The number of electrons on the valence energy level determines the group; (the number of the unit digit of the column number determines the number of electrons on the valence energy level). **0.25 pt** The electron configuration of C is **(b)** or K^2, L^4 **0.5 pt**	**1**
2.2	The charge of the electron cloud: $Q_{electron\ cloud}$ = Total number of electrons x Relative charge of an electron. **0.25 pt** Total number of electrons = 2+4 = 6 electrons; Q= 6(-1) = -6 **0.75 pt**	**1**
2.3	An atom is electrically neutral => Q nucleus + Q electron cloud = 0 **0.25 pt** Q nucleus **+ (-6) = 0** => Q nucleus = +6 **0.75 pt**	**1**
3	The electron configuration of C is K^2, L^4 . Carbon atom has 4 valence electrons, it needs four electrons to attain octet. **0.5 pt** Based on the Lewis electron dot symbol, an oxygen atom needs two more electrons on its valence energy level to attain octet. **0.5 pt** Carbon atom forms a double covalent bond with each of the two oxygen atoms by sharing two pairs of electrons with each oxygen atom forming carbon dioxide molecule CO_2. **0.5 pt**	**1.5**
4	Ionic bond formation is due to transfer of one or more electrons from one atom to another atom or more atoms. **0.5 pt** Double covalent bond formation is due to sharing of two pairs of electrons between two atoms; (where, half the number of shared electrons is contributed by each of the two atoms) **0.5 pt**	**1**
5	Calcium carbide reacts with humidity (water) to produce ethyne gas and calcium hydroxide; as a result it will be consumed up when kept in humid containers.(In dry containers it remains intact). **0.5 pt**	**0.5**

Second Exercise (6 points)

Part of the Q	Answer	Mark
1	The steps for construction are: **a-**Into a beaker, pour a small amount of zinc sulfate solution ($Zn^{2+} + SO_4^{2-}$) and dip the Zn strip in it. **0.5 pt** **b-** Into another beaker, pour a small amount of cupric sulfate solution ($Cu^{2+} + SO_4^{2-}$) and dip the Cu strip in it **0.5 pt** **c-**Associate the two solutions by a salt bridge **0.25 pt** the Zn strip and the Cu strip are connected using connecting wires containing a lamp and a switch. **0.25 pt**	**1.5**
2.1	The half-reaction at the cathode is: $Cu^{2+} + 2e^- \rightarrow Cu$ **0.5 pt** The half-reaction at the anode is: $Zn \rightarrow Zn^{2+} + 2e^-$ **0.5 pt**	**1**
2.2	The two half-reactions occur simultaneously during which electrons exchanged are conserved. Electrons lost are equal to electrons gained. $Cu^{2+} + 2e^- \rightarrow Cu$ $Zn \rightarrow Zn^{2+} + 2e^-$ The equation of the overall reaction is: $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$ **0.5 pt**	**0.5**
3	In the anodic half-cell zinc atom is oxidized, in the solution the amount of positive charge (Zn^{2+}) increases; to balance the increased positive charge, the nitrate ions of the salt bridge move into the solution of this half-cell**. 0.5 pt**	**0.5**
4.1	The mass of copper deposited = 16.32- 16 = 0.32g **0.5 pt**	**0.5**
4.2	Number of moles of copper deposited n = (m/M) = **0.5 pt** = 0.32g / 64g.mol^{-1} = 0.005 mol **0.5 pt**	**1**
5	The written cell representation is **a)** $Zn\|Zn^{2+}$ – salt bridge – $Cu^{2+}\|Cu$ **0.5 pt** Zinc being more reactive metal than copper, conventionally, it is written on the left. **0.5 pt**	**1**

Third Exercise (7 points)

Part of the Q	Answer	Mark
1	Hydrocarbon (**B**) is an alkene; when bromine solution orange in color is streamed, a rapid decolorization occurs indicating that a reaction has occurred(due to the presence of double covalent bond**)** **1 pt**	**1**
2.1	For n=3, the molecular formula of hydrocarbon (C) is: C_3H_6 **0.5 pt**	**0.5**
2.2	The two possible structural formulas for hydrocarbon(C) are**:** **0.75pt/0.75pt**  (I)  (II)	**1.5**
2.3	The type of bonds between two consecutive carbon atoms in structure **(I)** are double covalent bond **0.5 pt** and a single covalent bond. **0.25 pt** All the bonds between consecutive carbon atoms in structure **(II)** are single covalent bonds. **0.75 pt**	**1.5**
3.1	The IUPAC name of the haloalkane **(E)** is: 2-chloro-4-methylpentane	**0.75**
3.2	It is a branched chain alkane	**0.75**
4	The equation for the complete combustion reaction of alkane is **:** **d)** $C_nH_{(2n+2)} + \frac{(3n+1)}{2}O_2 \rightarrow nCO_2 + (n+1)H_2O$	**1**