دورة العام ٢٠١٨ الاستثنائية	امتحانات الشهادة المتوسطة	وزارة التربية والتعليم العالي
الاربعاء ٨ آب ٢٠١٨		المديرية العامة للتربية
		دائرة الامتحانـات الرسمية

| الاسم:	مسابقة في مادة الكيمياء	
الرقم:	المدة: ساعة واحدة	

This Exam is Composed of Three Exercises. It is inscribed on Two Pages Numbered 1 and 2.
The Use of a Non- Programmable Calculator is allowed. Answer the Three Following Exercises.

Exercise 1 (7 points)   **The Unpleasant Odor of Fish**

The unpleasant odor of fish is partly due to the formation of a volatile compound, the methylamine of molecular formula CH_5N. To reduce this odor when cooking fish, vinegar which is a solution containing ethanoic acid is often added.

Document-1 represents two histograms showing the number of occupied energy levels and the number of valence electrons of the atoms nitrogen (N), carbon (C) and hydrogen (H).
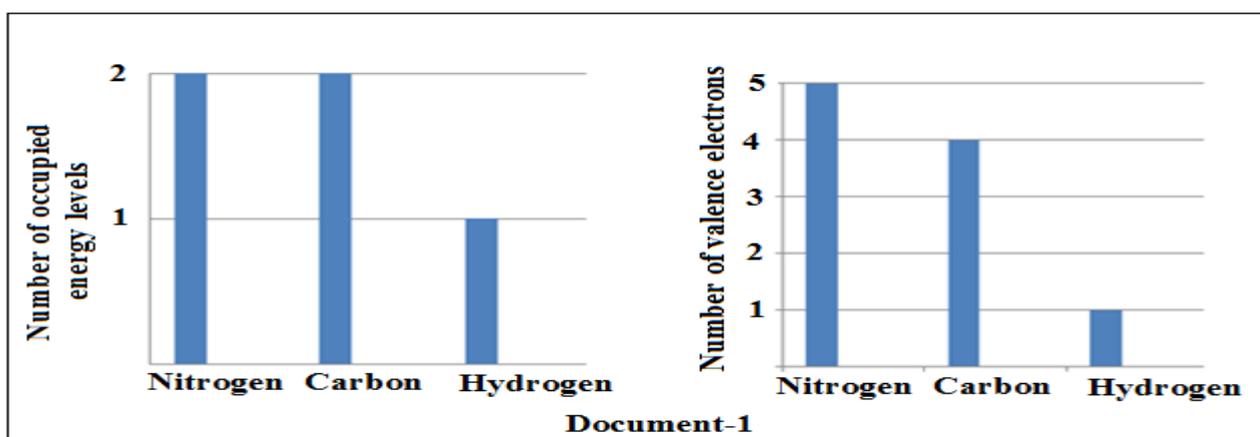
Document-1

1. By referring to **Document-1**:
   1.1 Correct the following propositions:
      a. The Lewis electron dot symbol of hydrogen atom is: $\ddot{H}$
      b. Carbon element belongs to the fourth period (row 4) in the periodic table.
   1.2 Determine the atomic number of nitrogen element.
   **1.3** Write the Lewis structure of the molecule CH_5N.
2. **Document-2** represents the Lewis structure of ethanoic acid molecule.
   By referring to **Document-2**:
   2.1 Give the molecular formula of ethanoic acid.
   2.2 Specify the type of chemical bonding between the carbon atom and each of the two oxygen atoms in ethanoic acid molecule.
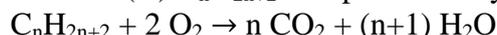   **2.3** Deduce the valence of oxygen atom.

Document-2
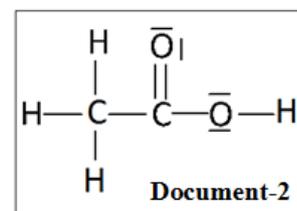
3. By referring to the text, indicate the solution that should be added to reduce the unpleasant odor when cooking fish.

**Exercise 2 (6 points)**   **Methane**

Methane is quite abundant in the natural environment; its complete combustion with oxygen gas releases a significant amount of heat energy. The products obtained are carbon dioxide gas and water vapor. The release of carbon dioxide can be a source of pollution.

1. The complete combustion of an alkane (A) C_nH_{2n+2} is represented by the following equation:
$$C_nH_{2n+2} + 2\ O_2 \rightarrow n\ CO_2 + (n+1)\ H_2O$$
   - By applying the law of conservation of matter on oxygen atoms, show that alkane A is methane.

2. The products of the substitution reactions of methane with chlorine gas Cl_2, under appropriate experimental conditions, are widely used. It is required to prepare chloromethane of molecular formula CH_3Cl from methane.

2.1 Write, using molecular formulas, the equation of the reaction allowing the preparation of chloromethane from methane.

2.2 Justify that this reaction is a substitution reaction.

3. The boiling point of methane at atmospheric pressure $P = 1atm$ is $t = -164^oC$. Specify the physical state of methane at the same pressure and at temperature 20^oC.

4. The total amount of water in earth remains unchanged, because even if it circulates, it always follows the same cycle. Human activities such as burning fossil fuels affect the water cycle because some gases such as CO_2, NO_2 and SO_2 dissolve in water to form acid rain.
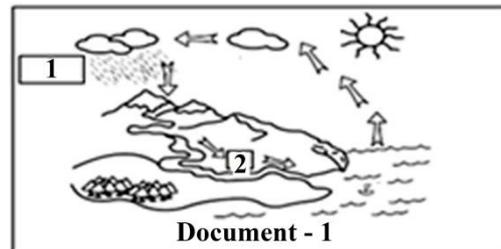
Document-1 represents the water cycle.

4.1 By referring to Document-1, indicate in which stage 1 or 2, acid rain is formed.

4.2 Give two consequences of acid rain on the environment.

Document - 1

Exercise 3 (7 points)   Classification of Metals

Spontaneous redox reactions occurring between a metal X and a metallic ion Y^{n+} release chemical energy. In these reactions, the more active reactant acts as the reducing agent (reductant).

1. Document-1 represents the procedure and the results of an experiment realized in a laboratory.

> A copper strip (Cu) is immersed in a colorless solution of silver nitrate ($Ag^+ + NO_3^-$).
> A deposit of silver (Ag) covers this strip and the solution turns to blue.
> **Document-1**

By referring to Document-1, answer the following questions:

1.1 The oxidation half-reaction taking place is: $Cu \rightarrow Cu^{2+} + 2e^-$
Choose, among the half-reactions given below, the one that corresponds to the reduction half-reaction taking place.
   a. $Ag \rightarrow Ag^+ + 1\,e^-$ **b.** $Ag^+ + 1\,e^- \rightarrow Ag$ **c.** $Ag^{2+} + 2e^- \rightarrow Ag$ **d.** $Ag^+ \rightarrow Ag + 1e^-$

1.2 Indicate among the following metals Cu and Ag, the one that is more active.

2. Document-2 represents the schema of the cell (G) Al-Cu in functioning as well as the axis showing the increasing order of the tendencies of Al and Cu metals to lose electrons.

By referring to Document-2, answer the following questions:

2.1 Using the list given below, Name the numbered parts 1, 3, and 4 of the electrochemical cell (G).
List: Aluminum strip (Al), Copper strip (Cu), salt bridge, aluminum sulfate solution ($2Al^{3+} + 3SO_4^{2-}$), copper II sulfate solution ($Cu^{2+} + SO_4^{2-}$).

2.2 Write the oxidation and the reduction half-reactions that take place at the electrodes of the electrochemical cell (G).

2.3 Deduce the equation of the overall reaction of the cell (G).

2.4 Answer by true or false. Justify the true statement(s) and correct the false one(s):

a- The solution 5 contains copper (II) ions Cu^{2+}.

b- Potassium ions K^+ present in part 3 of the cell (G) migrate towards solution 5.

c- During reaction, the quantity of aluminum ions Al^{3+} decreases.
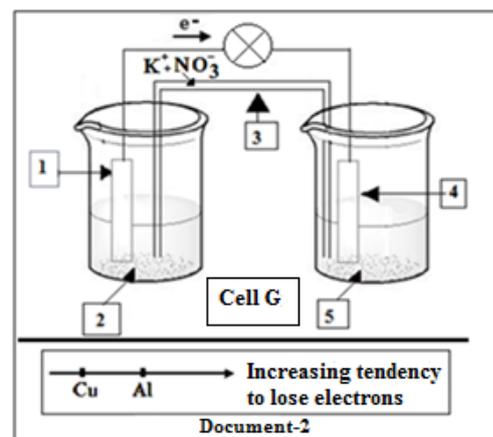
Document-2
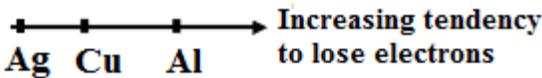
3. Classify the three metals Al, Ag and Cu in increasing order of their tendencies to lose electrons.

Part	Exercise 1 (7 points) The Unpleasant Odor of Fish Expected Answers	Mark
1.1	**a.** The Lewis dot symbol of the hydrogen atom is: Ḣ **(0.75pt)** **b.** Carbon element belongs to the second period (row 2) in the periodic table. **(0.75pt)**	1.5
1.2	Nitrogen (N) has 2 occupied energy levels K and L **(0.25pt)**. It has 5 valence electrons on its valence level L. **(0.25pt)** The level K must be saturated by $2e^-$. Then the electron configuration of nitrogen is: K^2, L^5 **(0.25pt)**. nitrogen has : 2+5=7 electrons **(0.25)** As atom is electrically neutral then the number of electrons is equal to number of protons Number of protons = atomic number Z =7 **(0.5pt)**	1.5
1.3		0.5
2.1	The molecular formula of ethanoic acid is: $C_2H_4O_2$	0.5
2.2	One oxygen atom forms a single covalent bond with the carbon atom **(0.25pt)** because these atoms share one bonding pair of electrons. **(0.5pt)** The other oxygen atom forms a double covalent bond with the carbon atom **(0.25pt)** because these atoms share two bonding pairs of electrons. **(0.5pt)**	1.5
2.3	As oxygen shares two electrons **(0.5pt)** by two single covalent bonds or one double covalent bond then its valence is 2 **(0.5pt).**	1
3	Vinegar solution is added when cooking fish to reduce the unpleasant odor.	0.5

Part	Exercise 2 (6 points) Methane Expected Answers	Mark
1.	By applying the law of conservation of matter on oxygen atom: 4 =2n +n+1 thus 4-1 =3n then n = 1 **(0.5 pt)** The molecular formula of the alkane (A) is CH_4. **(0.25 pt)** CH_4 is an alkane having one carbon atom (n=1) then it is methane. **(0.5 pt)**	1.25
2.1	$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$	1
2.2	This reaction is a substitution reaction because a Chlorine atom replaces a hydrogen atom in methane to form CH_3Cl.	1
3.	A 20°C, methane is in the gaseous state **(0.5pt)** because the given temperature (20°C) is greater than its boiling temperature t = -164°C. **(0.5 pt)**	1

4.1	In **Document-1**, acid rain is formed at stage 1.	0.75
4.2	Consequences of acid rain on the environnement : - Acid rain attacks trees in forests. **(0.5pt)** - Acid rain destroys the aquatic life in lakes. **(0.5pt)**	1

Part	Exercise 3 (7 points) Classification of Metals Expected Answers	Mark
1.1	Reduction half- reaction is: (b) $Ag^+ + 1e^- \rightarrow Ag$.	0.5
1.2	Copper metal (Cu) is more active than silver metal (Ag).	0.5
2.1	**1** : aluminum strip **(0.25 pt)** **3** : salt bridge **(0.25 pt)** **4** : copper strip **(0.25 pt)**	0.75
2.2	At cathode, the reduction half-reaction is: $Cu^{2+} + 2e^- \rightarrow Cu$ **(0.5 pt)** At anode, the oxidation half-reaction is: $Al \rightarrow Al^{3+} + 3e^-$ **(0.5 pt)**	1
2.3	The electronic half-reactions will take place simultaneously. The number of gained electrons is equal to the number of lost electrons **(0.25 pt)**. Multiply the reduction half-reaction by 3 and the oxidation half-reaction by 2. $(Cu^{2+} + 2e^- \rightarrow Cu) \times 3$ **(0.25 pt)** $(Al \rightarrow Al^{3+} + 3e^-) \times 2$ **(0.25 pt)** The equation of the overall reaction is: $2\ Al\ +\ 3Cu^{2+} \rightarrow 2Al^{3+}\ +\ 3Cu$ **(0.5 pt)**	1.25
2.4	a. True **(0.25 pt)** because the Cu strip should be immersed in a solution containing Cu^{2+} ions. **(0.5 pt)** b. True **(0.25 pt)** because Cu^{2+} ions are reduced into Cu metal then K^+ ions of the salt bridge migrate toward the solution 5 to compensate its deficiency in positive charges. **(0.5 pt)** c. False **(0.25 pt)**, the quantity of Al^{3+} ions increases. **(0.5 pt)** (Al strip is oxidized into Al^{3+} ions).	2.25
3.	 Ag Cu Al Increasing tendency to lose electrons **(0.5 pt)** Copper metal (Cu) is more active than silver metal (Ag) then Cu has greater tendency to lose electrons than Ag. **(0.25 pt)**	0.75