

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. Answer the Following Three Exercises.

Exercise 1 (7 points)

Alert from Methane!

When talking about global warming, people think immediately about the release of carbon dioxide gas (CO₂), but few think about methane. Methane is responsible of one third of global warming since 1750. While the emissions of carbon dioxide start to become stable in certain countries that of methane increase since few years in a worrying rhythm.

Translated from www.les4verites2brane.com/climat-alerte-au-methane

Document-1 represents a table showing the sectors responsible of the emissions in 2012, of methane gas in kilotons (Kt).

Name of the sectors	Wastes	Biomass	Agriculture of rice	Fossil Energy	Breeding
Quantity in Kt	59.2	29.6	29.6	134	107

Document- 1

1. Refer to the text and to **Document-1**, answer the following questions:

- 1.1 Name two gases responsible of global warming.
- 1.2 Which sector emits the highest quantity of methane gas in 2012?

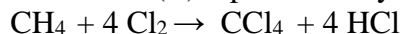
2. **Document-2** represents the molecular formulas of carbon dioxide and methane.

	Description
Model A	- Carbon is bonded to four hydrogen atoms. - There is a sharing of one pair of electrons between carbon atom and each hydrogen atom.
Model B	- Carbon is bonded to two oxygen atoms. - There is a sharing of two pairs of electrons between carbon atom and each oxygen atom.

Document- 2

- Refer to **Document-2**, answer the following questions:

- 2.1 Verify that model A corresponds to methane molecule.
 - 2.2 Identify the type of bond established by the carbon atom in each of the models A and B.
3. Oxygen atom has certain characteristics.
- Choose, among the propositions given below, the one(s) that correspond(s) to the oxygen atom ¹⁶O.
Justify your choice.
 - a) Electrons of oxygen atom occupy three energy levels in the ground state.
 - b) The valence of oxygen atom is 2.
 - c) Oxygen atom has 16 charged particles.
4. Methane is one of the raw materials used in organic industry. When exposed to light, methane can react with chlorine gas according to a reaction (R) represented by the following equation:



Given: The oxidation number of the element carbon in the compound CCl₄ is equal to +IV.

- 4.1 Calculate the oxidation number of carbon element in the compound CH₄.
- 4.2 Deduce that methane is the reductant in reaction (R).

Exercise 2 (6 points)

Aluminum – Zinc Cell

Redox reactions involve the transfer of electrons from one chemical species to another.

In the laboratory, a group of students construct an aluminum- zinc electrochemical cell (G), in order to study the variation in mass of the zinc strip during the functioning of this cell.

Document -1 is a table that represents the obtained result.

	Before functioning	After a time t of functioning
Mass of the zinc strip in grams (g)	3	3.2

Document- 1

- Refer to **Document-1**, answer the following questions:
 - Show that the zinc strip is the cathode of the cell (G).
 - Identify among the metals zinc and aluminum, the one that has the greater tendency to lose electrons.
- A grade 9 student gives the following propositions about the cell (G).
 - Aluminum strip is dipped in a solution containing Al^{3+} ions and Zinc strip is dipped in a solution containing Zn^{2+} ions.
 - The two solutions are connected by a salt bridge.
 - In the salt bridge, the positive ions (K^+) move toward the Al^{3+} solution whereas the negative ions (NO_3^-) move toward the Zn^{2+} solution.
 - The electrons flow from the zinc strip toward the aluminum strip.

- Pick out from the above propositions the errors committed by this student. Justify.
- Write the oxidation and the reduction half- reactions of the cell (G).
- Deduce the overall equation of the reaction of this cell.

Exercise 3 (7 points)

Petroleum

Petroleum is a viscous liquid composed of different hydrocarbons, the majority of which are open chain alkanes and cycloalkanes. This mixture should be treated before it is used.

Document-1 shows a table of the fractions of crude oil (petroleum) arranged from the lightest to the heaviest obtained in each part of a fractionating tower.

	Name of the fraction
The first released fraction	Refinery gas
Plate A	Gasoline
Plate B	Naphtha
Plate C	Kerosene
Plate D	Diesel
Plate E	Fuel oil
Document- 1	

- Refer to **Document-1** and to your knowledge, answer the following questions:
 - Indicate the lightest petroleum fraction.
 - The temperatures in $^{\circ}\text{C}$ at the plates B and C are respectively $T_1 = 110$ and T_2 . Choose the correct answer.
 - $T_2 = T_1$
 - $T_2 > T_1$
 - $T_2 < T_1$
- Gasoline contains hydrocarbons having 5 to 10 carbon atoms. Fractional distillation and different treatments lead to the production of hexane and 2,3-dimethylpentane.
 - Choose the corresponding molecular formula of each of the hydrocarbons mentioned above.
 - Hexane: C_6H_{14} - C_5H_{12}
 - 2,3-dimethylpentane: C_8H_{18} - C_7H_{16}
 - Identify which of these two compounds (hexane and 2,3-dimethylpentane) is a branched chain hydrocarbon.
- A hydrocarbon C_xH_y , obtained in one of the fractions, burns completely with oxygen gas in air. The balanced equation of the complete combustion reaction of C_xH_y is:

$$\text{C}_x\text{H}_y + 11 \text{O}_2 \rightarrow x \text{CO}_2 + 8 \text{H}_2\text{O}$$
 - Determine the value of y.
 - Deduce the molecular formula of this hydrocarbon knowing that it is an alkane.
- Decane $\text{C}_{10}\text{H}_{22}$ undergoes cracking to produce heptane and a hydrocarbon of molecular formula C_3H_6 .
 - Distinguish between cracking and fractional distillation.
 - The molecular formula C_3H_6 corresponds to two possible isomers **1** and **2**.
Replace the letters a, b, c, d, e and f by the corresponding missing terms.

	Type of bonds between carbon atoms	Name according to (IUPAC)	Saturated or unsaturated hydrocarbon	Name of the family
Isomer 1	(a)	(c)	Saturated	(e)
Isomer 2	(b)	Propene	(d)	(f)