المركز التربوي للبحوث والإنماء	الهيئة الأكاديميّة المشتركة قسم : العلوم	المادة: الكيمياء الشهادة: المتوسطة نموذج: رقم -٣- المدّة : ساعة واحدة

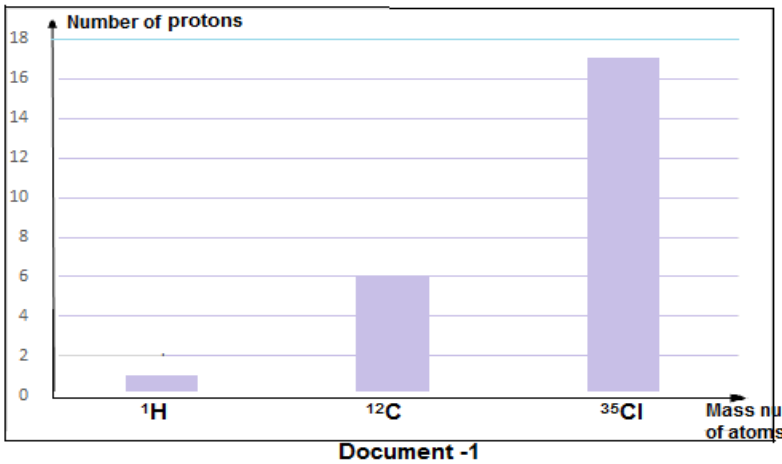
نموذج مسابقة (يراعي تعليق الدروس والتوصيف المعدّل للعام الدراسي 2016-2017 حتى صدور المناهج المطوّرة)

This exam is composed of three exercises. It is inscribed on two pages. The use of non-programmable calculator is allowed. Answer the two following questions.

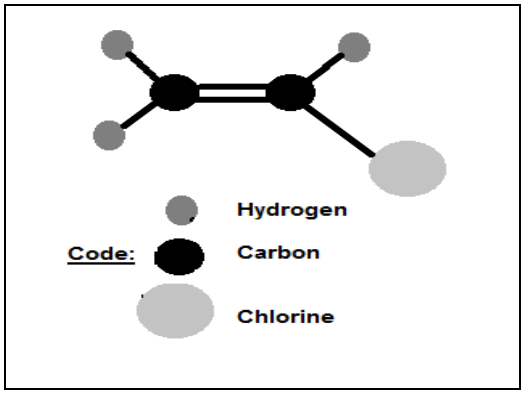
Exercise I (7 points)

Polyvinyl Chloride (PVC)

Polyvinyl chloride, known as PVC, is one of the most used plastics in the world. This polymer is widely used for pipes.



Document -1



Document - 2

1- **Document-1** shows the atomic composition of vinyl chloride molecule.

1.1 Recopy and complete the adjacent table:

Atoms	H	C	Cl
Number of neutrons			
Electron configuration			

1.2 Write the Lewis dot symbol for carbon atom.

1.3 For the following statements, choose the right answer. Justify.

1.3.1 Knowing that the relative charge of an electron = 1-, the relative charge of the electron cloud of carbon atom is:

i -6 ii. +6 iii. -12

1.3.2 The valence of carbon atom is:

i. 4 ii. 1 iii. 0

2- **Document-2** shows the molecular model of vinyl chloride compound.

2.1 Write the structural formula of vinyl chloride.

2.2 Give the molecular formula of this compound.

2.3 Specify the type of the bond between the two carbon atoms.

3- The polyvinyl chloride (PVC) of chemical formula $-(CH_2\text{-}CHCl)_n-$ is made from vinyl chloride monomer through polymerization reaction.

3.1 Give the condensed structural formula of the repeating unit.

3.2 Write, using the condensed structural formula, the equation of the polymerization reaction of vinyl chloride.

Exercise 2 (7 points)

Crude oil Refining

Crude oil is treated in the refinery and it is separated into various hydrocarbons fractions.

1- Referring to **document -1**, answer the following questions:

1.1 Give the name of the separation technique used to separate the crude oil into different fractions.

1.2 Indicate the substance that will condense at the highest point in the column and the one that condenses at the lowest point.

2- Specify whether the following statements are true or false:

2.1 The boiling points of propane C_3H_8 and pentane C_5H_{12} are respectively 36°C and - 42°C.

2.2 Knowing that the boiling temperature of heptane is 98°C, then its physical state is liquid at ambient temperature (25°C).

3- Propane (C_3H_8) burns completely when it combines with oxygen gas in air. Write the balanced equation for the complete combustion of propane.

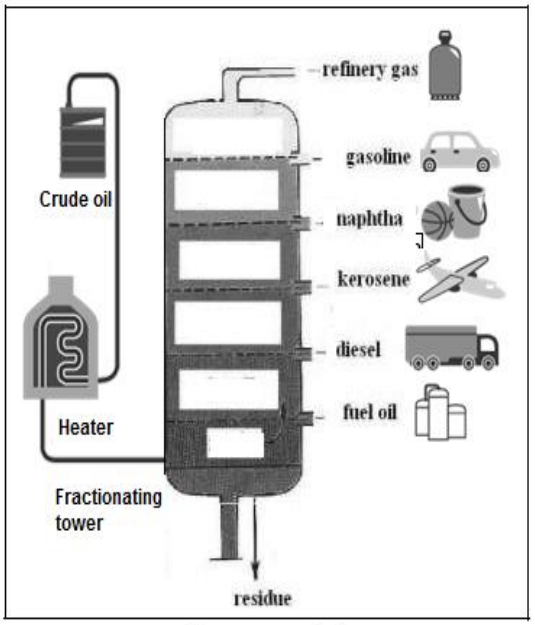
4- The cracking of heptane (C_7H_{16}) produces ethene and a hydrocarbon (A) of formula C_xH_y according to the following equation:

$$C_7H_{16} \longrightarrow C_2H_4 + C_xH_y$$

4.1. Show that the molecular formula of compound (A) is C_5H_{12}.

4.2. Write the possible condensed structural formulas of compound (A) and give the name of each.

4.3 Specify the nature of the relationship that exists between the different possible structures of compound (A).



Document-1

Exercise 3 (6 points)

Sulfur Dioxide Pollution

Sulfur dioxide (SO_2) is emitted mainly by the combustion of sulfur-containing fossil fuels (coal, oil, gas oil) and by certain industrial processes. This gas is irritating, especially to the respiratory system. Furthermore, SO_2 turns into sulfuric acid which contributes to the acid rain. The harmful effects produced by acid rain are: the impoverishment of the natural environment as well as the deterioration of the buildings.

Document-1 shows the variation of the amounts of SO_2 in Gegagram (Gg) between the years 1850 and 2000.

1- **Pick out from the passage**:

1.1 A harmful effect that can be caused by acid rain.

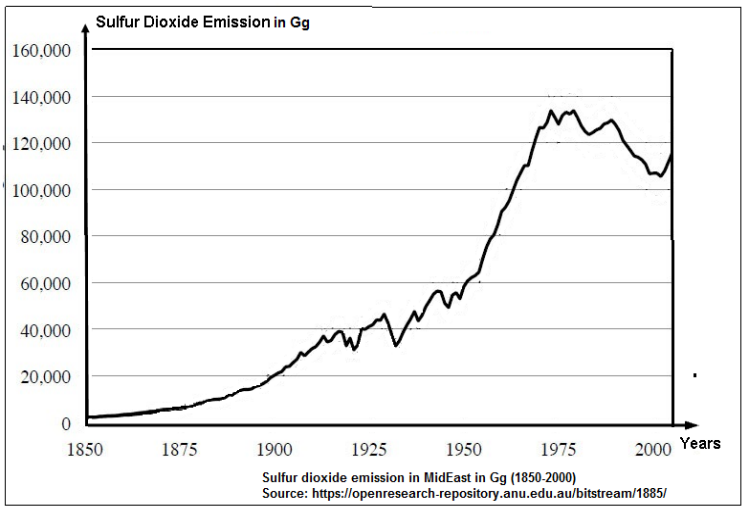
1.2 The major source of sulfur dioxide production.

1.3 A harmful effect of sulfur dioxide on human health.

2- Referring to document-1:

2.1. Give the value of the amount of sulfur dioxide released into the air in the year 1975 and that released in the year 2000.

2.2 Specify how the air pollution by sulfur dioxide (SO_2) evolves during this period.



Document-1

3- Sulfur burns with oxygen gas of the air according to the following equation:

$$S_{(s)} + O_{2\,(g)} \longrightarrow SO_{2\,(g)}$$

3.1 Calculate the oxidation number of S in SO_2.

3.2 Show that the above reaction is an oxidation-reduction reaction.

3.3 Specify the oxidizing species.

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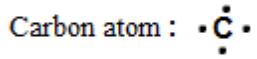
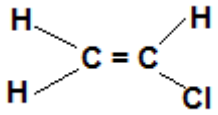
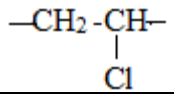
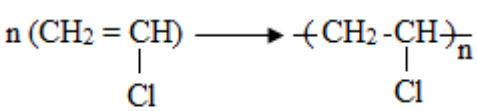
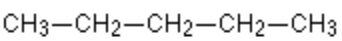
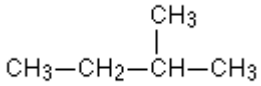
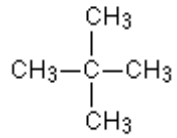
أسس التصحيح (تراعي تعليق الدروس والتوصيف المعدّل للعام الدراسي 2016-2017 وحتى صدور المناهج المطوّرة)

Exercise 1 (7 points)
Polyvinyl Chloride (PVC)

Part of questions	Expected answers	Mark
1.1	<table><tr><td>**Atoms**</td><td>H</td><td>C</td><td>Cl</td></tr><tr><td>Number of neutrons</td><td>A-Z=1-1=0</td><td>12-6=6</td><td>35-17=18</td></tr><tr><td>Electron configuration</td><td>K^1</td><td>K^2L^4</td><td>$K^2L^8M^7$</td></tr></table> The values of A and Z are derived from document-1. Where the number of neutrons N=Mass number (A) - number of protons and the number of protons =number of electrons in an atom.	¾ ¾ ½
1.2	Carbon atom : 	½
1.3.1	i -6 The relative electric charge of carbon atom = relative charge of one electron x its number of electrons. the number of electrons = number of protons =6 in carbon atom therefore the electric charge of carbon atom= 6x(1-)= -6	¼ ½
1.3.2	ii. valence = 4 Referring to the electron configuration of carbon atom (K^2L^4), carbon atom belongs to column 14 then it has 4 unpaired electrons in its outermost shell.	¼ ½
2.1	The structural formula of vinyl chloride compound: 	½
2.2	The molecular formula of vinyl chloride compound is C_2H_3Cl.	½
2.3	The type of bond between two carbon atoms in this molecule is double covalent bond since these atoms shared two pairs of electrons.	¼ ¼
3.1	The condensed structural formula of the repeated unit is: 	½
3.2	The polymerization equation is: 	1

	Exercise 2 (7 points) **Crude oil Refining**	
Part of questions	**Expected answers**	**Mark**
1.1	Fractional distillation used to separate the crude oil into different fractions.	½
1.2	The refinery gas is the first separated constituent and the residue is the last one.	½
2.1	False, the boiling point of straight chain alkane increases as the number of carbon (n) increases. Therefore the boiling point of propane (n = 3) and pentane (n = 5) are respectively -42°C and 36°C.	1
2.2	True; at boiling point 98°C, heptane (n = 7) changes from the liquid state to the gaseous state. At an ambient temperature of 25°C < 98°C, heptane is in the liquid state.	1
3	The complete combustion of propane is: $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$	½
4.1	The cracking equation of heptane is : $C_7H_{16} \rightarrow C_2H_4 + C_xH_y$ According to the law of conservation, the number of atoms of each element in the reaction is conserved: The number of carbon of compound (A) is x = 7 – 2 = 5 and its number of hydrogen y = 16 – 4 = 12. So, the molecular formula of (A) is C_5H_{12}.	1 ¼
4.2	 Pentane (or n-pentane).  2-methylbutane  2,2- dimethylpropane	3x(½)
5	These compounds having the same molecular formula and different structural formulas are called isomers	¾

	Exercise 3 (6 points) **Sulfur Dioxide Pollution**	
Part of questions	**Expected answers**	**Mark**
1.1	To choose one of the harmful effects caused by acid rain: - The impoverishment of the natural environment. or - The deterioration of the buildings.	½
1.2	The major source of sulfur dioxide production is (coal, oil, gas oil)	½
1.3	This gas is irritating to the respiratory system.	½
2.1	The amount of sulfur dioxide, released into the air on 1975 is:130,000 Gg The amount of sulfur dioxide, released into the air on 2000 is: 105,000 Gg.	½ ½
2.2	The quantity of sulfur dioxide released decreases from 1975 to 2000, so, the air pollution caused by the release of SO_2 decreased during that period.	**1**
3.1	Let x be the o.n of S in SO_2 therefore x-4 = 0 Therefore the o.n of sulfur in SO_2 is +IV	½
3.2	o.n: $\overset{0}{S_{(s)}} + \overset{0}{O_{2(g)}} \longrightarrow \overset{+IV\ -II}{SO_{2(g)}}$ The oxidation number of sulfur increases from 0 in (S) to + IV in SO_2. It's an oxidation. On the other hand, the oxidation number of oxygen decreases from 0 in O_2 to -II in SO_2. It's a reduction. Since there is a change in oxidation number: Then this reaction is redox.	**1** ½
3.3	The oxidizing agent is O_2 since its oxidation number decreases.	½