This Exam Is Composed of Three Exercises. It Is Inscribed on 2 Pages.
Answer the Three Following Exercises:

First Exercise (7 points)
Chlorine and Chloroalkanes

Chlorine gas is a disinfectant* chemical, it reacts with water to produce nascent oxygen which kills bacteria. It is added in limited amounts to swimming pools.
Chlorine gas is used in the synthesis of many chemical products such as: antifreeze fluids (chloroalkanes) synthetic fibers,…

1- The representation of chlorine atom is given as: $_{17}^{35}Cl$

  1.1- Give the name and the symbol of each of the two numbers 35 and 17 associated to Cl atom.
  1.2- Deduce the number of neutrons of the given chlorine atom.
  1.3- Write the electron configuration of the given chlorine atom.

2- The representation of an atom X is: $_{17}^{37}X$.

  2.1- Justify whether X and Cl are atoms of the same element or are atoms of two different elements.
  2.2- Compare the relative nuclear charge of the atoms X and Cl.
     Given: Relative charge of a proton = +1
3- Give the reason why chlorine gas is added to swimming pools.
4- Synthesis of a chloroalkane.
  4.1- The chloroalkane C_2H_5Cl can be obtained by the reaction of HCl with an **alkene**.
     Write the condensed structural formula of this alkene and give its IUPAC name.
  4.2- One molecule of ethene reacts with one molecule of water to produce an alcohol.
     Write, using condensed structural formulas for the organic compounds, the equation of this
     reaction and give the IUPAC name of the alcohol produced.
Remark: *Disinfectant chemical : Any chemical agent that destroys bacteria.

Second Exercise (6 points)
Galvanic Cell: Mg –Cu

A device that converts chemical energy into electrical energy is called galvanic cell. In a galvanic cell, the metals serving as electrodes differ in their tendency to lose electrons. A spontaneous electron transfer reaction takes place.
Given : - The written representation of the galvanic cell Mg - Cu is :
$$Mg \mid Mg^{2+} \text{ - salt bridge - } Cu^{2+} \mid Cu$$
     - The electrode Mg is the anode.
 Available Materials:

- Solutions : Copper (II) nitrate ($Cu^{2+} + 2NO_3^-$), zinc nitrate ($Zn^{2+} + 2NO_3^-$) and
        magnesium nitrate ($Mg^{2+} + 2NO_3^-$).
- Connecting wires and alligator clips.
- U tube, filled with an ionic solution ($Na^+ + NO_3^-$).
- U shape iron wire. Iron is a good conductor of electricity.
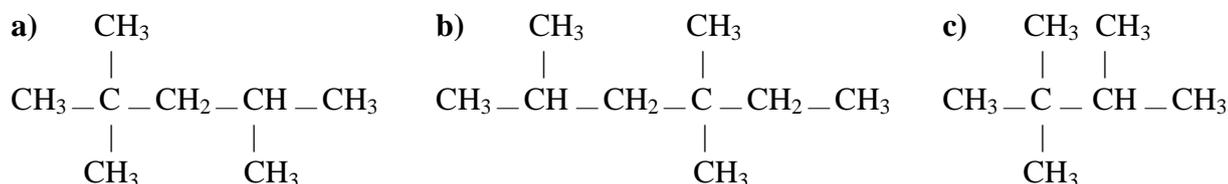- Strips of: Magnesium, zinc and copper.
- Light bulb.
- Voltmeter.
- Beakers.

1 - Indicate the steps necessary to construct the operating galvanic cell Mg - Cu.

2 - Draw and label the half-cell where oxidation takes place.

3 -The half-reaction at the cathode is: $Cu^{2+} + 2e^- \rightarrow Cu$.
Write the half- reaction that takes place at the anode. Deduce the overall reaction of the galvanic cell Mg-Cu.

4 - Specify whether the amount of copper (II) Cu^{2+} ions in the cathode half-cell increases or decreases for the operating galvanic cell.

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Third Exercise (7 points)
Combustion of Fuels

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Carbon dioxide gas, CO_2, produced from the combustion of fuels has a harmful effect on the environment when it exists in large amount in the air. It contributes to the increase of the average temperature of Earth's atmosphere. The presence of green areas on Earth helps to diminish the amount of CO_2 in the atmosphere. In fact, green plants through the process of photosynthesis absorb CO_2 gas.

1 - An isomer of octane C_8H_{18}, used as car fuel is 2,2,4-trimethylpentane.

   **1.1 -** Choose among the following condensed structural formulas, the condensed structural formula of 2,2,4-trimethylpentane. Justify.

a)
$$CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2 - \underset{\underset{CH_3}{|}}{CH} - CH_3$$

b)
$$CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{CH}} - CH_2 - \underset{\underset{CH_3}{|}}{C} - CH_2 - CH_3$$

c)
$$CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - \overset{\overset{CH_3}{|}}{CH} - CH_3$$

    1.2 - Write the equation for the complete combustion reaction of octane.

2 - Through the years 1950 to 2000 green areas have been decreased due to deforestation* and more fuels have been used for transportation.
The graph given below shows the percentage concentration of CO_2 in the atmosphere and the expected percentage concentration in the year 2050.
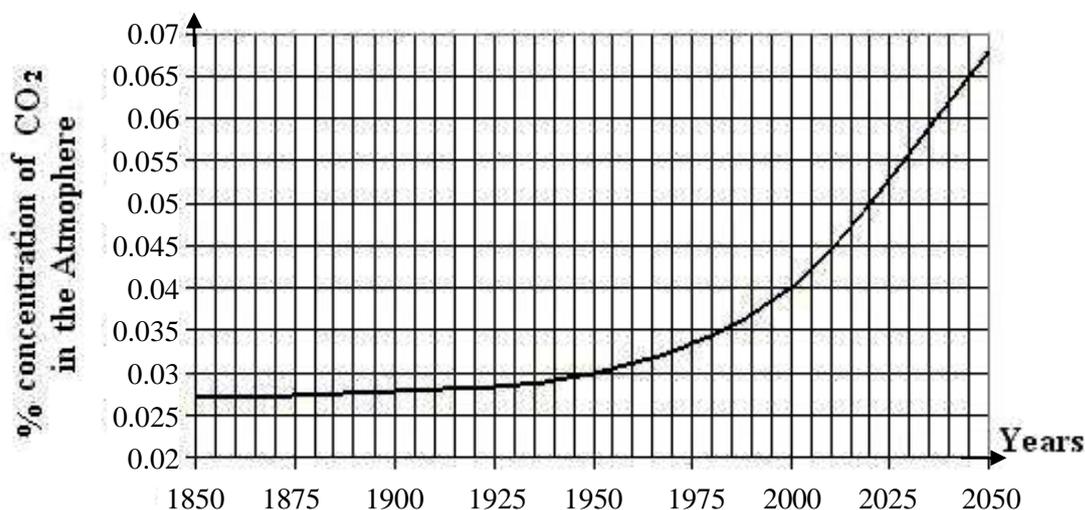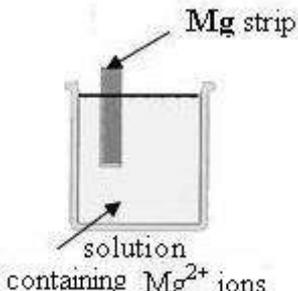

    Refer to the graph:

    2.1 - Calculate the change of the percentage concentration of CO_2 (ΔC_1) between the years 1950 and 2000.

    2.2 - Calculate the expected change of the percentage concentration of CO_2 (ΔC_2) between the years 2000 and 2045.

    2.3 - Compare the values (ΔC_1) and (ΔC_2). Draw a conclusion.

3 - Indicate the effect of increasing green areas on Earth by planting trees on the average temperature of Earth's atmosphere. Justify.

Remark: *Deforestation: Destruction of the forests by human activities.

	Answer	**Mark**
	First Exercise (7 points)	
1.1	35 stands for mass number ; A. 17 stands for atomic number ; Z. **(4×0.25pt)**	**1**
1.2	The number of neutrons is given by : N = A-Z N = 35-17 = 18 neutrons. **(2×0.25pt)**	**0.50**
1.3	An atom is electrically neutral, it consists of equal number of protons and electrons. Z = number of protons = number of electrons = 17 Electron configuration , $_{17}Cl$: K^2, L^8, M^7 **(2×0.50pt)**	**1**
2.1	An element is identified by its atomic number Z. The two atoms have the same atomic number (17), therefore they are atoms of the same element**.** **(2×0.50pt)**	**1**

2.2	Because X and Cl are atoms of the same element => they have the same nuclear charge.
	* The nuclear charge is given by the equation:
	  Q = Z x relative charge of a proton
	  Q = 17 x (+1) = + 17
		0.50

3	Chlorine reacts with water to produce nascent oxygen which kills bacteria.	**0.50**
4.1	The condensed structural formula of the alkene is : $CH_2 = CH_2$ > The IUPAC name of the alkene is**:** Ethene.	**1**
4.2	The equation of the reaction is : $CH_2=CH_2$ $+ H_2O$ $\rightarrow CH_3\text{-}CH_2OH$ **(1pt)** The name of the alcohol is : ethanol . **(0.5pt)**	**1.50**
	Second Exercise (6 points)	

1	Construction of the operating galvanic cell**:**
	  - Dip a magnesium strip in beaker (A) containing magnesium nitrate solution.
	  - Dip a copper strip in beaker (B) containing copper (II) nitrate solution.
	  - Associate the two half-cells by the salt bridge, which is an inverted U tube containing
	   sodium nitrate solution.
	  - Connect the two metal strips to each other through a voltmeter using wires.
	  4 x (0.5pt)
		2

2	Oxidation takes place at the anode. The anode half-cell	**1**

3	The half-reaction at the anode: $\quad$ $Mg \longrightarrow Mg^{2+} + 2\bar{e}$ $\quad$ **(1 pt)** The half-reaction at the cathode: $\quad$ $Cu^{2+} + 2\bar{e} \longrightarrow Cu$ The overall reaction is : $\quad$ $Mg + Cu^{2+} \longrightarrow Mg^{2+} + Cu$ $\quad$ **(1 pt)**	**2**
4	Cu^{2+} ions are found in the cathode half-cell. At the cathode reduction takes place, Cu^{2+} ions are reduced to Cu atoms $\Rightarrow$ the amount of Cu^{2+} ions in the cathode half-cell decreases.	**1**
	Third Exercise (7 points)	
1.1	The condensed structural formula of 2,2,4-trimethylpentane is: **a)** $\quad$ CH_3 $\qquad\quad$ | $CH_3 - C - CH_2 - CH - CH_3$ $\qquad\quad$ | $\qquad\qquad$ | $\qquad\quad CH_3 \qquad\quad CH_3$ **(0.5pt)** The longest chain consist of 5 carbon atoms and it has two methyl groups on the second carbon atom and a third methyl group on the fourth carbon atom of the carbon chain. **(1pt)** *Because it has 8 carbon atoms.	**1.50**
1.2	The equation for the complete combustion reaction of octane is : $2\,C_8H_{18} + 25\,O_2 \longrightarrow 16CO_2 + 18H_2O$ - If the equation is not balanced. **(0.5 pt)**	**1**
2.1	The change of the percentage concentration of CO_2 between the years 1950 and 2000: $(\Delta C_1) = 0.04 - 0.03 = 0.01.$ **3 x(0.5pt)**	**1.50**
2.2	The expected change of the percentage concentration of CO_2 between the years 2000 and 2045: $(\Delta C_2) = 0.065 - 0.04 = 0.025.$ **2x(0.5pt)**	**1**
2.3	$0.025 > 0.01\ (\Delta C_2 > \Delta C_1)$. It is expected that the average temperature of the Earth's atmosphere will be increased. **2x(0.5pt)**	**1**
3	The average temperature of the Earth's atmosphere will be less. **(0.5pt)** Planting trees increases the green areas. Trees through photosynthesis absorb $CO_2 \Rightarrow$ the amount of CO_2 in the atmosphere decreases. Hence, the contribution of CO_2 to the increase of the average temperature of the Earth's atmosphere will be less. **(0.5pt)**	**1**