

الاسم:
الرقم:مسابقة في مادة الكيمياء
المدّة: ساعة واحدة

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

**First Exercise (6 points)
Gaseous Pollutants**

Pollution occurs when harmful materials are released into the environment in amounts exceeding their tolerable level. Gaseous air pollutants such as carbon dioxide CO₂, sulfur dioxide SO₂ and nitric oxide NO are released into air from combustion of fossil fuels (heavy fuel, charcoal, gasoline). In the presence of humidity in air, these gases form compounds H₂SO₄, H₂CO₃, HNO₃ that cause acid rain.

Given: Electron configuration of:

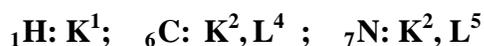


Table of Gaseous Pollutants of Air	
Pollutants	Tolerable level of some gaseous pollutants in air (µg / m ³).
Carbon monoxide	10000
Carbon dioxide	7500
Nitrogen dioxide	120
Ozone	100
Sulfur dioxide	75

- 1- Identify among the given atoms (H, C, N, O, and S) those that belong to the same period (row) and those that belong to the same column(group).
- 2- Write the Lewis electron-dot symbol of the atoms composing carbon dioxide molecule.
- 3- Explain the bond formation in carbon dioxide molecule.
- 4- In an industrial region (**R**) the amount of carbon dioxide in air is 7000 µg / m³ and that of sulfur dioxide is 95 µg / m³.

The air in the industrial region (**R**) is polluted .Justify.

**Second Exercise (7 Points)
Petroleum and Natural Gas**

Petroleum and natural gas are fossil fuels; they are made of compounds called hydrocarbons. Compound (**H**) is a hydrocarbon. A molecule of compound (**H**) contains 4 carbon atoms and 10 hydrogen atoms.

- 1- Give the significance of the term hydrocarbon.
- 2- Write the condensed structural formulas of all possible isomers of hydrocarbon (**H**) and give the (IUPAC) systematic name of each isomer.
- 3- Open chain hydrocarbons can be alkanes, alkenes and alkynes. Show that compound (**H**) is an alkane.

petroleum is separated into several kinds of products in the refineries.
The cracking of an alkane (A) gives hexane (C₆H₁₄) and an alkene (P). The number of carbon atoms in a molecule of alkene (P) is 3. The equation of the cracking of (A) is:



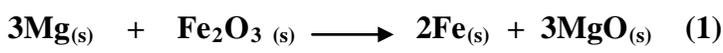
- a) Determine the number of the carbon atoms and the number of hydrogen atoms in a molecule of alkane (A).
- b) Write the structural formula of (P) and indicate the type of bonds between its carbon atoms.

**Third Exercise (7 points)
Redox Reaction: Corrosion of Iron**

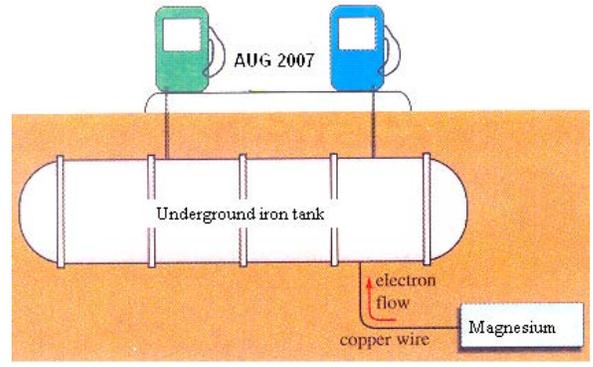
Corrosion of underground metallic iron pipes and tanks can be greatly prevented by connecting the pipes or the tanks to an active metal such as zinc or magnesium.

Given:

-Consider the reaction represented by the following equation:



- The oxidation number of oxygen is (-2).

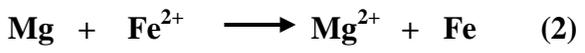


- 1- Show, using oxidation numbers, that the reaction represented by equation (1) is an oxidation reduction reaction.
- 2- Identify the oxidant in the given reaction.
- 3- Choose from the following half-reactions, those that can be associated to the above reaction as oxidation half-reaction and reduction half-reaction. Justify.

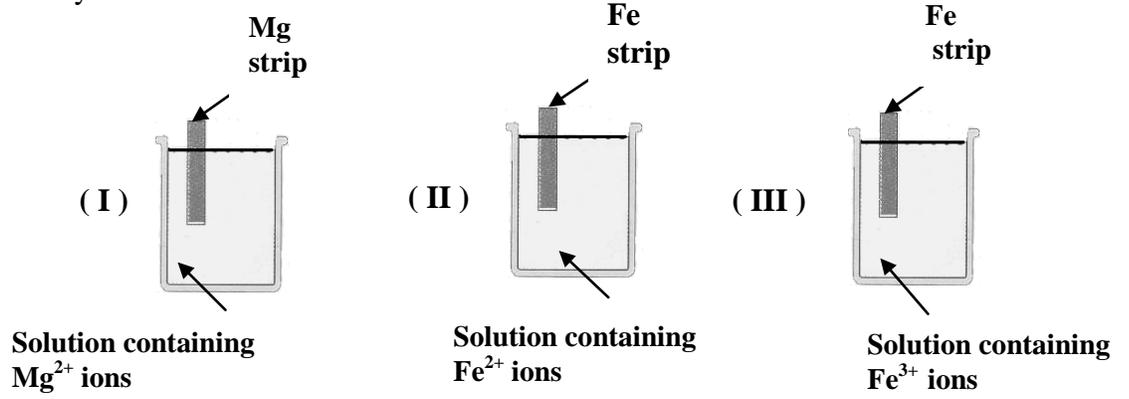


4-State, based on the text, how corrosion of underground iron storage tanks can be prevented.

5-A student makes a galvanic cell (G) based on the following spontaneous redox reaction.



Indicate among the given half-cells (I), (II) and (III) which half-cell **cannot** be associated to galvanic cell (G). Justify.



Marking Scheme

<i>Expected Answers</i>	<i>Marks</i>	<i>Comments</i>
First Exercise (6 Points)		
<p>1- The elements that belong to the same period (row) are C, N, and O because they have the same number of occupied energy levels.</p> <p>- The elements that belong to the same group (column) are O and S because they have the same number of electrons on the outer energy level.</p>	1 1	-Group and period based on electron configuration then deduce. Whole mark. - No deduction(1pt)
<p>2- The Lewis electron-dot symbol of the atoms composing carbon dioxide molecule are:</p> <p style="text-align: center;"> $\begin{array}{ccc} \cdot & & \ddot{ } \\ \cdot & \text{C} & \cdot \\ \cdot & & \cdot \end{array} \quad \begin{array}{ccc} \ddot{ } & & \cdot \\ \cdot & \text{O} & \cdot \\ \cdot & & \cdot \end{array}$ </p>	2 x ½	
<p>3- The carbon atom has 4 valence electrons, it needs four electrons to attain octet.</p> <p>An oxygen atom has 6 valence electrons, it needs two electrons to attain octet.</p> <p>Each oxygen atom shares two pairs of electrons with C atom to have octet of electrons on its valence energy level to form CO₂ molecule.</p>	½ ½ 1	-Explaining based on Lewis dot structure of CO ₂ molecule: acceptable -All other logical reasoning is acceptable
<p>4- In the industrial region (R), the amount of carbon dioxide is 7000 µg.m⁻³ < 75 00 µg.m⁻³. It is not polluted with respect to CO₂ Whereas, the sulfur dioxide level is 95 µg.m⁻³ > 75 µg.m⁻³. It is polluted due to SO₂.</p>	1	-Justification based on SO ₂ only: acceptable
Second Exercise (7 Points)		
<p>1- Hydrocarbon is an organic compound composed only of the elements Carbon and Hydrogen.</p>	½	-Chemical compound of formula C _x H _y : acceptable.
<p>2- The condensed structural formulas of all possible isomers of hydrocarbon (H) are:</p> <p>CH₃-CH₂-CH₂-CH₃ CH₃-CH(CH₃)-CH₃</p> <p style="text-align: center;">Butane 2-methylpropane</p>	2x½ 2x½	Methylpropane:acceptable.
<p>3- Alkanes satisfy the general formula :C_nH_{2n+2}</p> <p>Compound (H) has 4 carbon atoms and 10 hydrogen atoms</p> <p>For C: n = 4 ; For H : 2n+2 = 2x4+2=8+2=10</p> <p>=> (H) is an alkane.</p>	¼ 1	-All bonds C-C in the isomers of (H) are single covalent bond => (H) is an alkane. - C ₄ H ₁₀ is compatible with C _n H _{2n+2} => (H) is an alkane.

