

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

*This Exam Is Composed of Three Exercises. It Is Incribed on 2 Pages.
The Use of Non-programmable Calculator Is Allowed.
Answer the Following Three Exercises.*

First Exercise (7 points)

Use of Magnesium and Copper Metals in Galvanic Cell

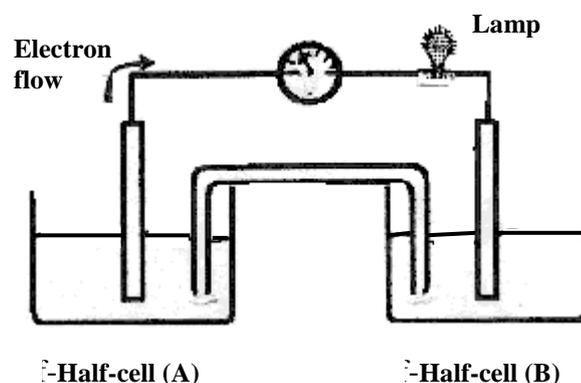
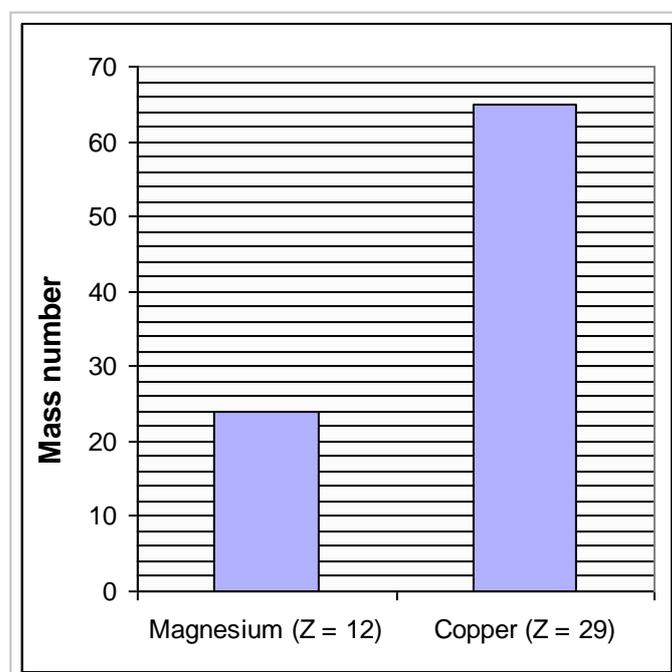
The bar graph shows the atomic number and the mass number for the atoms of the elements magnesium and copper.

- 1- Deduce from the bar graph the number of neutrons for each of magnesium and copper atoms.
- 2- Write the electron configuration for the magnesium atom.
- 3- The element magnesium is very reactive compared to the element copper. It has more tendency to lose electrons than copper. These metals are used to construct, Magnesium-Copper, Galvanic cell (G). The Galvanic cell (G) is represented as:



The given schema shows the Galvanic cell (G).

- a- Copy, on your answer sheet, the schema of the Galvanic cell (G) and indicate on it the anode, the cathode and the cation in each half-cell.
- b- Write the reduction half-reaction, the oxidation half-reaction and deduce the overall (cell) reaction that takes place when the Galvanic cell (G) is set to function.
- c- When the salt bridge is removed, the lamp does not light. Justify.



(G)

Second Exercise (6 points)
Inert Gases

Elements of column 18 (Group VIII) are called inert gases; they have various uses. Helium (He, Z = 2) is non-flammable; it is used to fill balloons. Neon (Ne, Z = 10) and argon (Ar, Z = 18) are used in lighting tubes. Sometimes, scuba divers use breathing - mixture composed of oxygen and helium. The table given below shows the percentage relative abundance of the neon isotopes.

% Relative abundance	Neon isotopes
0.13	^{22}Ne
7.82	^{21}Ne
92.05	^{20}Ne

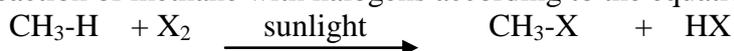
- 1- The three isotopes of neon have the same electron configuration. Justify.
- 2- Identify, based on the **Remark**, the heaviest isotope of neon mentioned in the table and give its percentage relative abundance.
- 3- State why the inert gases exist in nature as mono-atomic gases.
- 4- The mass of a sample (S) of neon gas is equal to 4 g. Calculate the number of moles of neon gas in sample (S).
- 5- Extract from the passage the uses of helium.

Remark: *The heaviest isotope is the isotope which contains the greatest number of neutrons in its nucleus.*

Given : Molar mass of neon, $M(\text{Ne}) = 20 \text{ g}\cdot\text{mol}^{-1}$

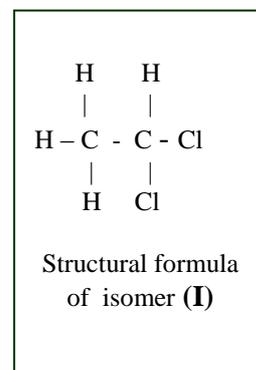
Third Exercise (7 points)
Haloalkanes

Halomethanes are compounds used as refrigerants, solvents, anesthetics... They are obtained from the reaction of methane with halogens according to the equation:



Where X_2 is the formula of a halogen molecule such as Cl_2 or Br_2 .

- 1- Justify whether the reaction represented by the above given equation is an addition or a substitution reaction.
- 2- Give the IUPAC names for the following compounds CH_2Cl_2 and CH_3Br .
- 3- Haloalkanes, like halomethanes are obtained from alkanes by replacing one or more of the hydrogen atoms by halogen atoms. The compound $\text{C}_2\text{H}_4\text{Cl}_2$ has two isomers **(I)** and **(II)**. The structural formula of isomer **(I)** is given.
 - a) Write the structural formula of isomer **(II)** and give its systematic name.
 - b) Identify which of the two isomers **(I)** or **(II)** can be obtained by the reaction of one molecule of ethene with one molecule of chlorine.
- 4- A student named a branched alkane (A) as: 2-ethylbutane.
 - a) Write the condensed structural formula corresponding to this name.
 - b) Show that this name is not correct. Give the correct name of alkane (A).
- 5- Give the molecular formula of (A) and write the equation of the reaction for the



Expected Answers	Marks	Comments
<p>2 – The mass number of an atom is given by: $A = Z + N$ then $N = A - Z$.</p> <p>but the isotopes of an element have the same Z, therefore the isotope having the greatest A has the greatest number of neutrons and hence it is the heaviest isotope, based on the table the heaviest isotope is ^{22}Ne.</p> <p>Its percentage relative abundance is: 0.13%.</p>	<p>1 ½</p> <p>½</p>	<p>$N = A - Z$ $N = 22 - 10 = 12$ $N = 21 - 10 = 11$ $N = 20 - 10 = 10$ Therefore ^{22}Ne has the greatest number of neutrons, hence it is the heaviest isotope. (1½)</p>
<p>3 – The inert gases are mono-atomic because their valence shell is saturated and consequently they are chemically stable.</p>	1	They have, duet or octet of electrons.
<p>4 - $n_{\text{mol}} = \frac{m_{\text{g}}}{M_{\text{g.mol}^{-1}}}$ or $\frac{1\text{mol} \rightarrow 20\text{g}}{x \leftarrow 4\text{g}}$</p> <p>$n = \frac{4}{20} = 0.2 \text{ mol}$ or $x = \frac{4 \times 1}{20} = 0.2 \text{ mol}$</p>	<p>½</p> <p>½</p>	Without unit – ¼
<p>5 - - Fill balloons. - Breathing-mixture.</p>	<p>½</p> <p>½</p>	
Third Exercise (7 pts)		
<p>1 – It is a substitution reaction because one hydrogen atom of methane is replaced by one halogen atom. Or, methane is alkane it is saturated, it does not undergo addition reaction, => it is substitution reaction.</p>	1	The number of atoms connected to the carbon atom is not increased.
<p>2 – CH_2Cl_2 : dichloromethane CH_3Br : monobromomethane</p>	<p>½</p> <p>½</p>	bromomethane is accepted
<p>3 – a – The structural formula of isomer (II) is :</p> $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H} - \text{C} - \text{C} - \text{H} \\ \quad \\ \text{Cl} \quad \text{Cl} \end{array}$ <p>its name is: 1,2 - dichloroethane</p> <p>b – The isomer (II) can be obtained from the addition of one chlorine molecule to one ethene molecule. The double bond breaks and one chlorine atom will be connected to each carbon atom.</p>	<p>½</p> <p>½</p> <p>1</p>	The following equation: $\text{CH}_2 = \text{CH}_2 + \text{Cl} \rightarrow \text{CH}_2\text{Cl} - \text{CH}_2\text{Cl}$ is accepted.
<p>4 – a - $\text{CH}_2 - \text{CH} - \text{CH}_2 - \text{CH}_3$</p> $\begin{array}{c} \\ \text{CH}_2 \\ \\ \text{CH}_3 \end{array}$ <p>b – This name is not correct because the main chain must be the longest chain: 5 atoms of carbon and not 4. Its correct name is: 3- methylpentane</p>	<p>½</p> <p>½</p> <p>½</p>	The longest chain is not respected.
<p>5 – The molecular formula of A is: C_6H_{14} The equation of the complete combustion is: $2\text{C}_6\text{H}_{14} + 19\text{O}_2 \rightarrow 12\text{CO}_2 + 14 \text{H}_2\text{O}$</p>	<p>½</p> <p>1</p>	$\text{C}_6\text{H}_{14} + \frac{19}{2} \text{O}_2 \rightarrow 6\text{CO}_2 + 7 \text{H}_2\text{O}$ is accepted.