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المادة: الكيمياء الشهادة: المتوسطة نموذج: رقم ـ ٢ـ المدّة : ساعة واحدة	الهيئة الأكاديميّة المشتركة قسم : العلوم	المركز التربوي للبحوث والإنماء

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

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

Exercise 1: (7 points)

Magnesium and Photographic Flash

Magnesium ($_{12}$Mg) is a lightweight and relatively soft metal that strongly reacts with oxygen gas found in the air when it is heated. The chemical reaction is represented by the following equation:

$$2\ Mg_{(s)} + O_{2\ (g)} \rightarrow 2MgO_{(s)} \qquad \text{(Reaction 1)}$$
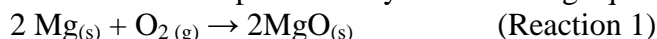
The intense light produced during this combustion leads magnesium to be widely metal used in photographic flashes.

Magnesium element	- The atomic number of the Mg element is equal to 12
	- Magnesium has three stable isotopes: ^{24}Mg, ^{25}Mg and ^{26}Mg

Document -1
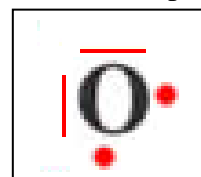
Document-2

1- Pick out from the text the reason why magnesium is used in photographic flashes.

2- **Referring to document-1**:

   2.1 Specify, among the following electron configurations, the one that refers to magnesium atom

     i- $K^2L^8M^2$ ii- K^2L^3 iii-$K^2L^8M^8N^2$

   2.2 Deduce the column and the row to which magnesium element belongs in the periodic table.

   2.3 Recopy and complete the following table

| Isotopes Identity Card	^{24}Mg	^{25}Mg	^{26}Mg
Atomic number (Z)			
Mass number (A)			
Number of neutrons (N)			

3- Determine the relative nuclear charge of the magnesium atom.
   Knowing that the relative charge of a proton = 1+

4- **Document-2** represents the Lewis dot symbol of the oxygen atom.

   4.1 Give the number of valence electrons for oxygen atom then deduce its valency.

   4.2 Write the Lewis structure of oxygen molecule O_2.

   4.3 Indicate the type of chemical bonding that exists between the oxygen atoms.

5- Magnesium oxide MgO, produced by reaction (1), is an ionic compound.

   5.1 Explain the formation of ionic bond between Mg and O.

   5.2 Specify the type of chemical bonding in CaO, knowing that the element calcium is located just below Mg in the periodic table.

Exercise 2: (7 points)

Propene: Product of the Day

Propene, of condensed structural formula CH_3-$CH=CH_2$, is a colorless, odorless and highly flammable gas. In cold countries, propene is used for heating as an alternative of butane.

Propene (C_3H_6) can be obtained by cracking of the hydrocarbon heptane (C_7H_{16}). The equation of the reaction is shown below (reaction 1):

$$C_7H_{16} \rightarrow \quad C_3H_6 \ + \text{Compound (A)} \quad \text{(Reaction 1)}$$
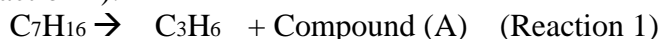
Propene is used in the manufacture of polypropene which is represented in the **document -1**:

This Polypropene is mainly used in food packaging, technical parts for cars, carpets and ropes. This type of polymer is described as being a thermoplastic (softens upon heat), so it can be recycled.

$$\left(CH_2 - CH\right)_{n}$$
$$|$$
$$CH_3$$
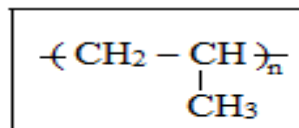
Document-1

1. **Pick out from the text:**
     1.1. Two properties and two uses of propene.
     1.2. Two uses of polypropene.
2. **Referring to reaction (1)**, show that the molecular formula of compound (A) is C_4H_{10}.
3. Write the condensed structural formula of compound (A) knowing that it has one branch. Give its name.
4. Specify whether propene is an unsaturated hydrocarbon.
5. **Referring to document-1**:
     5.1 Write the condensed structural formula of the repeating unit of the polymer.
     5.2 Deduce the condensed structural formula of a portion of polypropene containing only three repeating units.
6. For the following statements, indicate the right answer. Justify
     6.1 Upon heating, polypropene becomes:
       i- Soft   ii- Solid   iii- Gas
     6.2 Polypropene is not considered as pollutant since it is:
       i- Biodegradable   ii- Burns in air   iii- Is recovered and reused
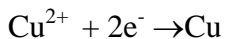
Exercise 3: (6 points)

Galvanic Cell

An electrochemical cell is a device that converts chemical energy into electrical energy through a chemical redox reaction. **Document-1** shows a galvanic cell (electrochemical cell formed of Zn- Cu).

1. Indicate the nature of the cation X^{2+} in solution (A).
2. The half cathodic equation of this cell is:
   $$Cu^{2+} + 2e^- \rightarrow Cu$$
     2.1. Write the half-equation of the reaction occurring at the anode.
     2.2. Deduce the overall equation of the reaction.
3. Write the cell representation.
4. Justify that the cathode of this galvanic cell becomes thicker after operating for an interval of time.
5. Specify whether the following statements are true or false:
     5.1 When the cell is operating, nitrate ions (NO_3^-) move towards solution (A).
     5.2 If the salt bridge is removed, the lamp still shines.
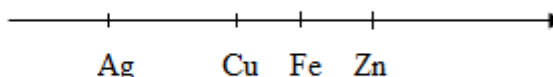   **5.3** The spontaneous transfer of electrons occurs in the external circuit.
6. **Document-2** shows four metals Ag, Cu, Fe and Zn which are arranged in an increasing order of their tendency to lose electrons:
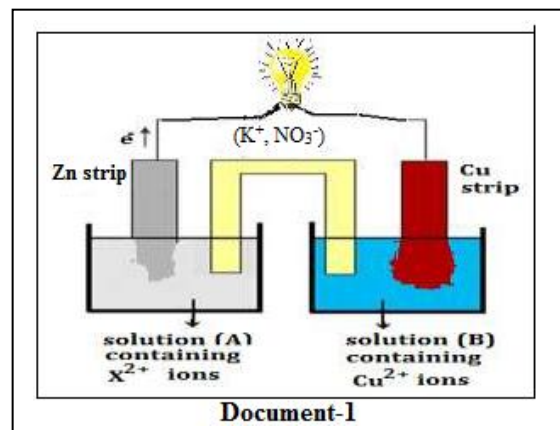
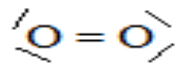**Note:** As the difference between the tendency to lose electrons increases, the voltage of the cell increases

Ag   Cu   Fe   Zn

Document-2

Specify the metal that produces with zinc metal a galvanic cell having the highest voltage.

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

	Exercise 1 (7 points) Magnesium and Photographic Flash	
Part of the Q	**Suggested Answers**	**Mark**
1.1	Magnesium is a widely metal used in photographic flashes because of the intense light produced during its combustion with oxygen found in the air.	¼
2.1	The atomic number of the element Mg is equal to 12. In a neutral atom, number of protons = number of electrons =12 The correct answer is i- $K^2L^8M^2$:	3(¼)
2.2	Since magnesium atom contains 2 electrons on its valence shell, the element Mg belongs to column 2. Since it has 3 occupied energy levels (K, L and M), it belongs to row 3.	¼ ¼ ¼
2.3			^{24}Mg	^{25}Mg	^{26}Mg
---	---	---	---
Atomic number (Z)	12	12	12
Mass number (A)	24	25	26
Number of neutrons (N)	12	13	14		1 ½
3	The relative charge of neutrons is null. Then, the relative charge of nucleus= relative charge of protons= number of protons in the nucleus x relative charge of a proton = 12 x (1+) = +12	¼ ¼ ¼
4.1	The number of valence electrons of oxygen atom is equal to 6. The valency of an element indicates the number of electrons needed by the atom to complete its octet. So, the valency of oxygen atom is 2.	¼ ½
4.2	$\langle \overset{\shortmid}{\underset{\shortmid}{O}} = \overset{}{\underset{}{O}} \rangle$	½
4.3	Double covalent bond.	¼
5.1	Mg atom belongs to column 2; this metal tends to lose two valence electrons to become a stable magnesium ion Mg^{2+} (octet rule). O atom has 6 valence electrons, so, it needs two electrons to complete its octet. The oxygen atom will gain two electrons from magnesium atom to become stable oxygen ion O^{2-} . The oppositely charged ions (Mg^{2+} and O^{2-}) attract each other mutually by an electrostatic force to form the ionic compound magnesium chloride MgO.	¼ ¼ ¼ ¼
5.2	The element calcium (Ca) is located just below magnesium in the periodic table, so, Ca and Mg belong to the same column 2. Therefore, they have the same chemical properties and calcium will make an ionic bond with oxygen.	¼ ¼

	Exercise 2 (7 points) **Propene: Product of the Day**	
Part of the Q	**Suggested Answers**	**Mark**

1.1	- Pick up two from the following three properties:
	Colorless\ odorless\ highly flammable gas.
	- Propene is used:
	   • In cold countries, it is used for heating instead of butane.
	   • In industry, it is used to manufacture polypropene.
		½
		
		½

1.2	Two from the following using of Polypropene:
	   • Food packaging.
	   • Technical parts for cars\ carpets\ropes.
		½

2	Referring to reaction (1) and according to the law of conservation of matter, the number of atoms of each element in the reaction is conserved: The number of carbon atoms for (A) = 7-3 = 4 The number of hydrogen atoms =16-6 =10 then the molecular formula of (A) is C_4H_{10}	½ ½ ½
3	$CH_3 - \underset{\underset{CH_3}{|}}{CH} - CH_3$ 2-methylpropane	½ ¼
4	Propene, $CH_3-CH=CH_2$, is a hydrocarbon since it's only formed of C and H atoms. It also contains one double covalent bond then it is an unsaturated hydrocarbon.	¼ ½
5.1	$-CH_2 - \underset{\underset{CH_3}{|}}{CH}-$	½
5.2	$-CH_2 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - \underset{\underset{CH_3}{|}}{CH}-$	1
6.1	i- Soft. Since polypropene is a thermoplastic	¼ ¼
6.2	iii- Recovered and reused. Since polypropene can be recycled.	¼ ¼

	Exercise 3 (6 points) **Galvanic Cell**	
Part of the Q	**Suggested Answers**	**Mark**
1	The cation X^{2+} is Zn^{2+}	½
2.1	The equation of half reaction occurring at the anode: $Zn \rightarrow Zn^{2+} + 2e^-$	½
2.2	The half-reaction at the anode is: $Zn \rightarrow Zn^{2+} + 2e^-$ The half-reaction at the cathode is: $Cu^{2+} + 2e^- \rightarrow Cu$ In a redox reaction electrons are conserved. Add the two half reactions. $\qquad\qquad (Zn \rightarrow Zn^{2+} + 2e^-)$ $\qquad\qquad \underline{(Cu^{2+} + 2e^- \rightarrow Cu)}$ The equation of the overall reaction is: $Cu^{2+} + Zn \rightarrow Cu + Zn^{2+}$	1
3.	Zn/Zn^{2+} - Salt bridge – Cu^{2+}/Cu	½
4.	Referring to the half reaction at the cathode, the copper (II) ions Cu^{2+} in the solution capture electrons at the surface of the cathode (copper strip) and they are deposited as copper metal on the surface of this cathode, hence the mass of the cathode increases.	½
5.1	True: to keep electrical neutrality in both half - cells, the nitrate ions move towards the anode half-cell (Solution A).	¼ ½
5.2	False: the lamp is switched off because the circuit becomes open.	¼ ½
5.3	True: the zinc loses electrons that flow through the metallic wire to the copper strip.	¼ ½
6	The metal is Ag. Since the difference between the tendency to lose electrons is the highest between the two metals (Zn and Ag), then the voltage of their corresponding cell will have the highest value.	¼ ½