المادة: الكيمياء	الهيئة الأكاديميّة المشتركة	
الشهادة: المتوسطة	قسم : العلوم	
نموذج رقم -٢-		
المدّة : ساعة واحدة		

نموذج مسابقة (يراعي تعليق الدروس والتوصيف المعدّل للعام الدراسي ٢٠١٦-٢٠١٧ وحتى صدور المناهج المطوّرة)

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

 Answer the two following questions.

## 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:

$$2 \ Mg_{(s)} + O_{2 \ (g)} \rightarrow 2MgO_{(s)} \quad \text{(Reaction-1)}$$

The intense light produced during this combustion leads magnesium to be widely metal used in photographic flashes.

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

Document -1
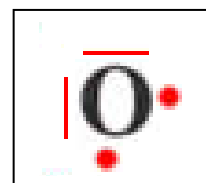
Document-2

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 configuration the one that represents to Magnesium atom.
      i- $K^2L^8M^2$ ii- K^2L^3 iii-$K^2L^8M^8N^2$
   2.2 Deduce to which column and row in the periodic table belongs the element Magnesium.
   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 magnesium atom.
   Knowing that the relative charge of a proton = 1+
4- Document-2 represents the Lewis dot symbol of oxygen atom.
   4.1 Give the number of valence electrons for oxygen atom then deduce its valency.
   4.2 Write the Lewis structural formula of oxygen molecule O_2.
   4.3 Indicate the nature of bond in the oxygen molecule O_2.
5- Magnesium oxide MgO, produced by the reaction 1, is ionic compound.
   5.1 Explain the formation of ionic bond between Mg and O.
   5.2 Specify the nature of the bond in CaO. Knowing that the calcium element is located just below Mg element in the periodic table.

## Exercise 2: (7 points)

Propene : Product of the day

Propene , 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 prepared by cracking of the hydrocarbon heptane (C_7H_{16}). The equation of the reaction is shown below (reaction 1):

$$C_7H_{16} \rightarrow \ C_3H_6 \ + \text{Compound (A)} \quad \text{reaction (1)}$$

Propene is used to manufactured polypropene which is represented in the following document (1):

Polypropene is mainly used in food packaging, technical parts for cars, carpets and ropes. This polymer is described as being a thermoplastic, so it can be recycled.
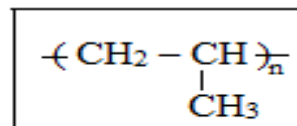
$$\left(\!CH_2 - CH\!\right)_{\!n}$$
$$\qquad\qquad | $$
$$\qquad\qquad CH_3$$
Document-1

1. **Pick out from the text:**
   1.1. Two properties and two uses of propene.
   1.2. Two uses of polypropene.
2. 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. Show that propene is an unsaturated hydrocarbon.
5. Referring to document-1:
   5.1 Write the condensed structural formula of the repeated unit.
   5.2 Deduce the condensed structural formula of a portion of polypropene containing three repeated units.
6. For the following statements, indicate the right answer. Justify
   6.1 Upon the action of heat, polypropene becomes:
       i- Soft   ii- Solid   iii- Gaseous
   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).
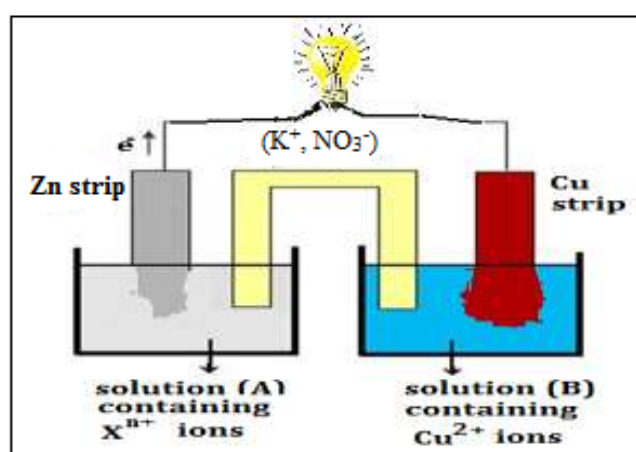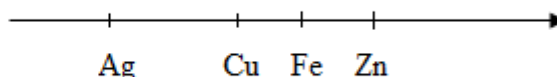

Document-1

1. Indicate the nature of the cation X^{n+} in solution (A).
2. The half cathodic equation of this cell is:
   $Cu^{2+} + 2e^- \rightarrow Cu$
   2.1. Write the equation of the half- reaction 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 During the functionating of the cell, nitrate ions (NO_3^-) move towards the solution (A).
   5.2 The lamp still shins if the salt bridge is removed.
   5.3 The spontaneous transfer of electrons occurs in the external circuit.
6. The document-2 shows the four metals Ag, Cu, Fe and Zn arranged in increasing order of their tendency to lose electrons:

Document-2

Note: As the difference between the tendency to lose electrons increases, the voltage of the cell increases

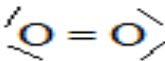Specify the metal that produces with zinc metal a galvanic cell having the highest voltage.

أسس التصحيح (تراعي تعليق الدروس والتوصيف المعدّل للعام الدراسي ٢٠١٦-٢٠١٧ وحتى صدور المناهج المطوّرة)
Suggested marking Scheme

Exercise 1 (7 points)
Magnesium and photographic flash

Part of the question	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 the element Magnesium contains 2 electrons on its valence shell, it 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	<table><tr><td></td><td>^{24}Mg</td><td>^{25}Mg</td><td>^{26}Mg</td></tr><tr><td>Atomic number (Z)</td><td>12</td><td>12</td><td>12</td></tr><tr><td>Mass number (A)</td><td>24</td><td>25</td><td>26</td></tr><tr><td>Number of neutrons (N)</td><td>12</td><td>13</td><td>14</td></tr></table>	1 ½
3-	The relative charge of nucleus= relative charge of protons+ relative charge of neutrons The relative charge of neutrons = 0 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 valence of an element indicates the number of unpaired electrons on its valence shell. The valence of oxygen atom is 2.	¼ ½
4.2		½
4.3	Double covalent bond.	¼
5.1	Mg atom belongs to column 2; it tends to lose two valence electrons to become a stable magnesium ion Mg^{2+} (octet rule). O atom has 6 valence electrons. It needs two electrons to complete its octet . The oxygen atom gains the two electrons from magnesium atom to become stable oxygen ion O^{2-} . The oppositely charged Mg^{2+} and O^{2-} ions 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 (A) is located just below magnesium in the periodic table, that is Ca and Mg belong to the same column 2. Therefore they have the same chemical properties; so calcium makes an ionic bond with oxygen.	¼ ¼

Exercise 2 (7 points)
Propene: Product of the day

Part of questions	Suggested Answers	Mark

1.1	- Two from the following three properties:
	  Colorless\ odorless\ highly flammable gas.
	- Two uses for propene:
	   • In cold countries, propene is used for heating instead of butane.
	   • Propene 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	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	$$CH_3 - \underset{\underset{CH_3}{\mid}}{CH} - CH_3$$ 2-methylpropane	½ ¼
4	Propene, $CH_3\text{-}CH=CH_2$, is a hydrocarbon since it's formed of C and H atoms only. It contains one double covalent bond then it is an unsaturated hydrocarbon.	¼ ½
5.1	$$-CH_2 - \underset{\underset{CH_3}{\mid}}{CH} -$$	½
5.2	$$-CH_2 - \underset{\underset{CH_3}{\mid}}{CH} - CH_2 - \underset{\underset{CH_3}{\mid}}{CH} - CH_2 - \underset{\underset{CH_3}{\mid}}{CH} -$$	1
6.1	i- Soft since polypropene is a thermoplastic	¼ ¼
6.2	iii- Recovered and reused. Polypropene can be recycled	¼ ¼

Exercise 3 (6 points)
Galvanic Cell

Part of question	Suggested Answers	Mark
1-	The cation X^{n+} is Zn^{2+}	½
2.1	The equation of half reaction 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. $$\frac{(Zn \rightarrow Zn^{2+} + 2e^-)}{(Cu^{2+} + 2e^- \rightarrow Cu)}$$ 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 cathodic half reaction, the copper (II) Cu^{2+} ions in solution capture electrons at the surface of the cathode (copper strip) and are deposited as copper metal on the surface of the cathode, then the mass of the cathode increases.	½

5.1	True: to keep electrical neutrality in both half - cells, the nitrate ions move tawords the anodic half-cell (Solution A).	¼ ½
5.2	False: the circuit becomes open.	¼ ½
5.3	True: the zinc strip 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 increases between the two metals (Zn and Ag) is the highest, then the voltage of the cell will be bigger.	¼ ½