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

This Exam Includes Three Exercises. It Is Inscribed on Two Pages.
Answer the Following Three Exercises .Use of Non – Programmable Calculator Is Allowed.

First Exercise (7 points)
Hazards of Burning Magnesium

Magnesium is a chemical element with the symbol (Mg) and atomic number 12. When working with burning magnesium, protective eye goggles are worn because the brilliant white light produced by burning magnesium can permanently damage the retinas of the eyes.

1- Water reacts violently with burning magnesium producing magnesium hydroxide and hydrogen gas according to the equation **(E)** given below:

$$Mg + 2\,H_2O \rightarrow Mg(OH)_2 + H_2 \qquad \textbf{(E)}$$

As a result, water cannot extinguish burning magnesium. The hydrogen gas produced intensifies the fire. Dry sand is an effective extinguisher for burning magnesium.

1.1- Pick out from what has preceded the reason why water cannot be used to extinguish burning magnesium.

1.2- Justify why we should protect our eyes when working with burning magnesium.

2-Magnesium has three stable isotopes: ^{24}Mg, ^{25}Mg and ^{26}Mg

- Compare the composition of the nuclei of the three stable isotopes of magnesium.

3- The atom of chlorine has seven valence electrons and has three occupied energy levels.

3.1- Write the Lewis electron dot symbol of chlorine atom.

3.2- Determine the relative charge of the electron cloud of chlorine atom.
(Relative charge of an electron = **-1**)

4- Magnesium ($_{12}Mg$) belongs to column 2 (group II) of the periodic table and has three occupied energy levels. Magnesium reacts with chlorine to produce the compound magnesium chloride ($MgCl_2$)

- Explain the bond formation in the compound magnesium chloride.

5-A mass of 5.28g of magnesium reacts with water according to the equation **(E).**

- Calculate the number of moles of magnesium that reacts with water.

Given: $M_{(Mg)} = 24\ g.mol^{-1}$

Second Exercise (6 points)
Ethene and Its Uses

Ethene, C_2H_4, can be obtained from petroleum refining, it is the most important hydrocarbon used to manufacture plastics, to produce ethanol and other compounds. Also, it is used in cultivating plants to ripen some fruits such as tomato, banana…

1-To obtain ethene, the hydrocarbon of molecular formula C_7H_{16} is subjected to cracking.
The equation given below represents the reaction that takes place during cracking.

$$C_7H_{16} \rightarrow C_2H_4 + (B)$$

1.1- Show that the molecular formula (B) is C_5H_{12}.

1.2- Write the condensed structural formula of the hydrocarbon of molecular formula (B) having two branches.

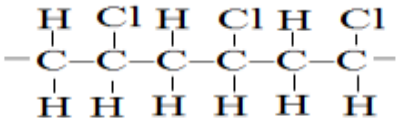
1.3- Give the IUPAC name of the hydrocarbon of molecular formula (B) having two branches.

2-One molecule of ethene reacts, in the presence of sulfuric acid as catalyst, with one molecule of water to produce one molecule of ethanol.

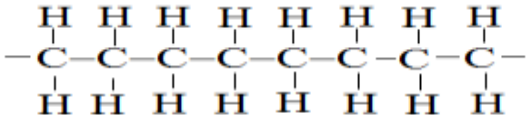
2.1- Give the name of the functional group of ethanol molecule.

2.2- Specify whether the reaction of ethene with water is addition or substitution reaction.

3- Polyethene and polyvinyl chloride (polychloroethene) are two polymers much used in making plastics. A portion of the polymeric chain of each of these two polymers is given below:



(I)



(II)

3.1- Choose from the list of names **(L)** given below, the name of the monomer of each of the two polymers represented by the portions of the polymeric chains **(I)** and **(II)**.

(L): [vinyl chloride ; ethane ; ethene ; chloroethane **]**

3.2- Indicate the number of repeated units in the corresponding portion of the polymeric chain of the polymer **(I)**.

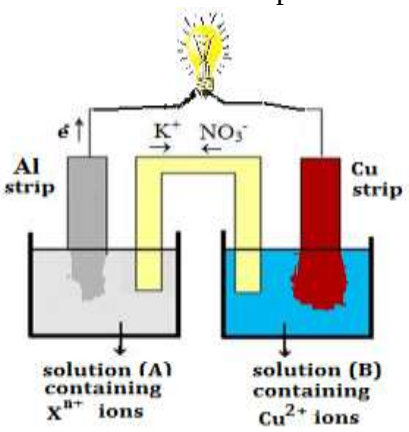
4- Pick out from the text two uses of ethene**.**

Third Exercise (7 points)

Galvanic Cell: Al - Cu

The principles of electrochemistry are used to make electrical batteries and for electroplating. Batteries have many uses including in torches, electrical appliances, digital cameras…Electroplating is the process of coating the surface of a conducting object with a layer of metal using electrical current. The importance of electroplating is that it is used to give a metal particular property such as corrosion protection, as well as it is used for decorative reasons.

The metals aluminum (Al) and copper (Cu) are used as electrodes in certain galvanic cells.



1- Atoms of metals lose electrons to become ions:

"Aluminum atom loses 3 electrons, it becomes aluminum ion; whereas, copper atom loses 2 electrons, it becomes copper (II) Cu^{2+} ion".

-Translate the preceding statement in the form of two equations.

2-The schema of Al-Cu galvanic cell is given on the right.

-Indicate the identity of the cation X^{n+} of the solution **(A).**

3- The half-reaction that takes place at the cathode is:

$$Cu^{2+} + 2e^- \rightarrow Cu$$

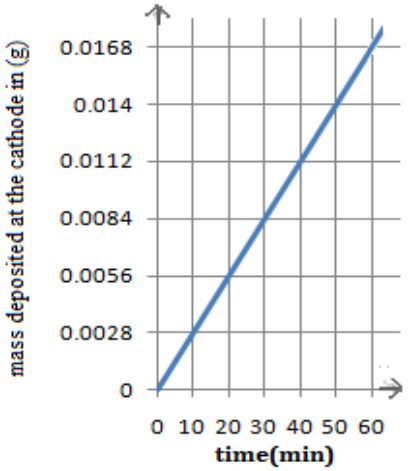
3.1- Write the half-reaction that takes place at the anode.

3.2- Deduce the equation of the overall reaction.

3.3- Justify that the cathode of this galvanic cell becomes thicker after operating for an interval of time.

4- The graph given on the right shows the estimated mass of copper deposited on the surface of the cathode as a function of time.

- Compare the value of the mass deposited at the surface of the cathode at 10 min. to the value of the mass deposited at the surface of the cathode at 50 min.



5- Pick out from the text:

5.1- The definition and the importance of electroplating.

5.2- Two uses of batteries.

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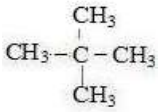
	اسس التصحيح في مادة الكيمياء	

	Expected Answers	*Marks*
	First Exercise (7 Points)	
1.1	The hydrogen gas produced by the reaction of burning magnesium with water intensifies the fire.	**0.5**
1.2	The brilliant white light produced by burning magnesium can permanently damage the retinas of the eyes.	**1**
2	The nucleus of an atom (isotope) is composed of protons and neutrons. The nucleus of each atom (isotope) of magnesium contains 12 protons**.(0.75)** The nucleus of the isotope ^{24}Mg contains 24-12 = 12 neutrons **(0.25)**, the nucleus of the isotope ^{25}Mg contains 25-12=13 neutrons **(0.25)** and the nucleus of the isotope ^{26}Mg contains 26-12 = 14 neutrons**.(0.25)**	**1.5**
3.1	The Lewis electron dot symbol of chlorine atom is: :$\ddot{\underset{\ddot{}}{\text{Cl}}}$:	**0.5**
3.2	The electron configuration of the chlorine atom is: K^2 L^8 M^7 => total number of electrons in the electron cloud of Cl atom = 17**(0.25)** The relative charge of the electron cloud = **(0.25)** number of electrons in the electron cloud x relative charge of an electron: **(0.25)** $Q_{\text{electron cloud}} = 17 \times (-1) = -17$**(0.25)**	**1**
4	Mg atom loses two valence electrons to become stable magnesium ion Mg^{2+}.**(0.5)** Cl atom has 7 valence electrons. It needs one electron to have octet of electrons. Each of the two chlorine atoms gains one electron from magnesium atom to become stable chloride ion Cl^-.**(0.5)** The oppositely charged Mg^{2+} and Cl^- ions attract each other mutually by an electrostatic force to form the ionic compound magnesium chloride $MgCl_2$. **(0.5)**	**1.5**
5	The number of moles is : => n = 5.28 g / 24 $g.mol^{-1}$**(0.5)** => n = 0.22**(0.25)**mol**(0.25)**	**1**
	Expected Answers	
	Second Exercise (6 Points)	
1.1	According to the law of conservation of mass (atoms), the number of atoms of each element in the reaction is conserved.**(0.5)** Let X be the number of C atoms and Y the number of hydrogen atoms in the molecular formula (B). For C atoms: 7 = 2+X => X = 5 **(0.5)** =>For H atoms: 16 = 4 + Y =>Y=12**(0.5)** The molecular formula (B) is C_5H_{12}	**1.5**

1.2	The condensed structural formula of the hydrocarbon of molecular formula (B) having two branches is: 	**0.5**
1.3	The IUPAC name is : 2,2-dimethylpropane	**0.5**
2.1	The functional group of ethanol molecule is: hydroxyl group.	**0.5**
2.2	The reaction of ethene with water is an addition reaction. One of the bonds of the double covalent bond of the molecule C_2H_4 breaks and changes into single covalent bond.	**1**
3.1	The name of the monomer of the polymer **(I)** is vinylchloride (chloroethene).**(0.5)** The name of the monomer of the polymer **(II)** is ethane.**(0.5)**	**1**
3.2	The number of repeated units in polymeric chain **(I)** is 3.	**0.5**
4	Two uses: manufacture of plastics; ripen some fruits.	**0.5**

	Expected Answers	***Marks***
	Third Exercise (7 Points)	
1	$Al \rightarrow Al^{3+} + 3e^-$ **(0.5)** and $Cu \rightarrow Cu^{2+} + 2e^-$ **(0.5)**	**1**
2	The cation X^{n+} is Al^{3+}	**0.5**
3.1	The half-reaction that takes place at the anode is: $Al \rightarrow Al^{3+} + 3e^-$	**0.5**
3.2	The half-reaction at the anode is: $Al \rightarrow Al^{3+} + 3e^-$ The half-reaction at the cathode is: $Cu^{2+} + 2e^- \rightarrow Cu$ In a redox reaction electrons are conserved. Multiply anode reaction by 2 **(0.25)**and cathode reaction by 3 **(0.25)** and add the two obtained half-reactions**.(0.25)** $2[Al \rightarrow Al^{3+} + 3e^-]$ $3[Cu^{2+} + 2e^- \rightarrow Cu]$ **The equation of the overall reaction** $2Al + 3Cu^{2+} \rightarrow 2Al^{3+} + 3Cu$ **(0.25)**	**1**
3.3	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.	**1**
4	Mass of copper metal deposited at the cathode at 10 min = 0.0028g **(0.25)** Mass of copper metal deposited at the cathode at 50 min = 0.014g **(0.25)** Mass of copper metal deposited at 50 min > Mass of copper metal deposited at 10 min (0.014 > 0.0028) **(0.5)**	**1**
5.1	Electroplating is the process of coating the surface of a conducting object with a layer of metal using electrical current.**(0.5)** The importance of electroplating is that it is used to give a metal particular property such as corrosion protection and for decorative reasons.**(0.5)**	**1**
5.2	Two uses of batteries: digital cameras, torches. **(0.5) x2**	**1**