

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

## مسابقة في مادة الكيمياء

المدة: ساعة واحدة

(إنكليزي)

الاسم: .....

الرقم: .....

**This Exam Is Composed of Three Exercises. It Is Inscribed on seven pages, numbered from 1 to 7. Answer the following three exercises:**

**Exercise 1 (7 points)**

**Potassium**

Potassium (**K**) is a chemical element that is oxidized rapidly in contact with air and reacts violently with water. It is often kept immersed in oil.

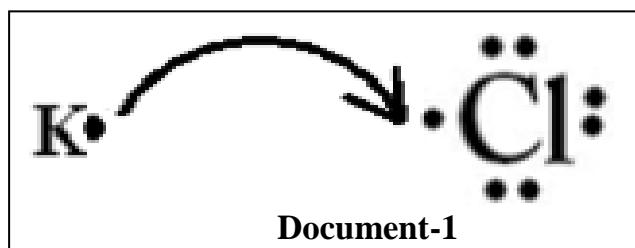
Some chemical fertilizers contain potassium element in the form of many salts such as potassium chloride **KCl**.

1. By referring to the text, justify the storage of potassium in oil.
2. The relative charge of the electron cloud of potassium atom is equal to 19 – :
  - 2.1. Indicate the charge of potassium atom.
  - 2.2. Calculate the relative charge of the nucleus of potassium atom.
  - 2.3. Given:
    - The relative charge of one proton is 1+.
    - Number of protons = atomic number (Z)

Show that the atomic number of potassium is 19.

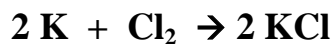
3. **Document -1** represents the schema of the transfer of an electron from the valence energy level of potassium (**K**) atom to that of chlorine atom (**Cl**).

By referring to **Document-1**, answer the following questions:



- 3.1. What is the valence of chlorine atom (**Cl**).
- 3.2. Indicate the column (Group) to which chlorine element belongs.  
Justify.
- 3.3. What is the type of chemical bond in potassium chloride **KCl**.  
Justify.

4. Potassium and chlorine gas react to produce Potassium chloride **KCl** according to the reaction represented by the equation given below:



- 4.1. Give the oxidation number of:

a- Potassium **K**.

b- Chlorine in **Cl<sub>2</sub>**.

c- Chlorine in **KCl**, knowing that the oxidation number of **K** in **KCl** is equal to +I.

- 4.2. Deduce, using oxidation numbers, that that the reaction between potassium and chlorine gas is an oxidation-reduction (Redox) reaction.

Some hydrocarbons with linear carbon chains tend to explode in the cylinder of car engines.

Other hydrocarbons with branched carbon chains burn slowly in the engine which limits detonation.

The octane number is a number that expresses the anti-knock characteristics of a fuel. The higher the octane number, the less explosive is the gasoline.

**1.** In Lebanon, there are two types of gasoline for cars: «95 octane» and «98 octane», having octane numbers of 95 and 98 respectively.

Referring to the text:

**1.1.** Indicate which of these two types of gasoline is more explosive.

**1.2.** Justify.

**2.** Octane can be extracted from crude oil by a physical process.

**2.1.** What is the name of this process?

**2.2.** Choose, from the propositions given below, the one that corresponds to this process.

- a) A process during which the components of a mixture are separated based on the difference in their boiling points.
- b) A process during which large molecules are broken down into smaller molecules.
- c) A process through which addition of identical molecules occurs.

**3.** The complete combustion of octane ( $\text{C}_8\text{H}_{18}$ ) in the presence of oxygen ( $\text{O}_2$ ) is a source of pollution.

**3.1.** Indicate the family of octane.

**3.2.** Write, using molecular formulas, the equation of the complete combustion reaction of octane.

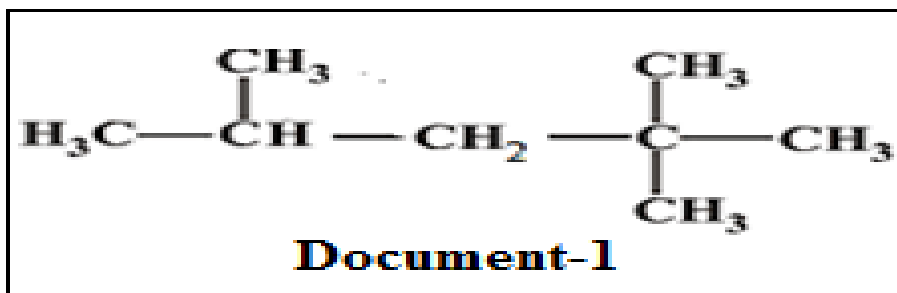
**3.3.** Carbon dioxide ( $\text{CO}_2$ ) obtained is a greenhouse gas, the increase in the level of greenhouse gases in the atmosphere contributes to global warming.

- Give one consequence of global warming.

4. **Document-1** represents the condensed structural formula of hydrocarbon **D**.

By referring to the text and to **Document-1**:

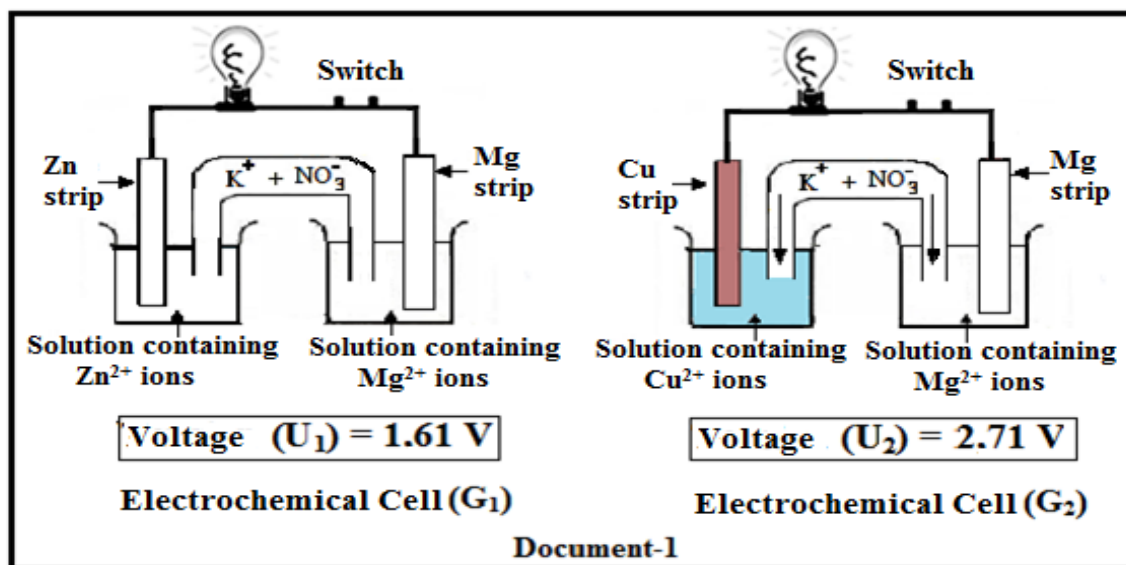
- answer by True or False.
  - correct the false statement(s).
- a) The carbon chain of hydrocarbon **D** is linear.
- b) Hydrocarbon **D** is an isomer of octane.
- c) Hydrocarbon **D** is more explosive than octane.



**Exercise 3 (6 points)****Electrochemical Cells**

Metals differ by their tendencies to lose electrons. A metal ( $M_1$ ) is more active than another metal ( $M_2$ ) if it has greater tendency to lose electrons. The metal ( $M_1$ ) serves as anode in an electrochemical cell  $M_1 - M_2$ .

**Document-1** represents the schemas of two electrochemical cells ( $G_1$ ) and ( $G_2$ ) during their functioning and the voltage ( $U$ ) of each one.



By referring to **Document-1**, answer the following questions:

1. Knowing that magnesium strip is the anode of the cell ( $G_1$ ), indicate the direction of the flow of electrons in this cell.
2. Write the half-reaction that takes place at the anode of the galvanic cell ( $G_1$ ).
3. The half-reaction that takes place at the cathode of the cell ( $G_1$ ) is:  $Zn^{2+} + 2e^- \rightarrow Zn$ .

Knowing that the number of electrons is conserved in a redox reaction,

write the overall equation of the reaction taking place in the electrochemical cell ( $G_1$ ).

4. Referring to the document-1 concerning the cell ( $G_2$ ) answer the following questions:
  - 4.1. Each type of ions in the salt bridge migrates toward one of the half-cells; indicate the direction of movement of nitrate ions  $NO_3^-$  present in the salt bridge of the cell ( $G_2$ ).
  - 4.2. Deduce that magnesium is the anode.

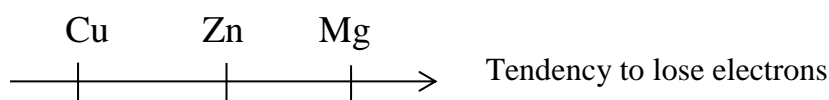
5. Choose, from the proposed representations, the one that corresponds to the electrochemical cell (**G<sub>2</sub>**).

- a)  $\text{Cu} \mid \text{Cu}^{2+}$  - salt bridge -  $\text{Mg}^{2+} \mid \text{Mg}$       b)  $\text{Cu}^{2+} \mid \text{Cu}$  - salt bridge -  $\text{Mg} \mid \text{Mg}^{2+}$   
c)  $\text{Mg} \mid \text{Mg}^{2+}$  - salt bridge -  $\text{Cu}^{2+} \mid \text{Cu}$       d)  $\text{Mg}^{2+} \mid \text{Mg}$  - salt bridge -  $\text{Cu} \mid \text{Cu}^{2+}$

6. In an electrochemical cell, the greater the difference in the tendencies of metals to lose electrons, the higher is the voltage of the cell.

6.1. Referring to the **Document-1**, compare the voltage of the two cells (**G<sub>1</sub>**) and (**G<sub>2</sub>**).

6.2. Given the classification of metals in increasing order of their tendencies to lose electrons:



Justify the classification of these metals.

Part of Q	Exercise 1 (7 pts) Potassium Expected Answer	Mark
1.	Potassium is oxidized rapidly in contact with air and reacts violently with water. So it is often kept immersed in oil.	1
2.1	As atom is electrically neutral then its charge is zero.	0.25
2.2	Total charge of atom= Relative charge of nucleus + Relative charge of electron cloud (0.5 pt) Relative charge of nucleus = 0- (19-) =19+ (0.25 pt)	0.75
2.2	charge of nucleus = (number of protons) × (relative charge of a proton) (0.25 pt) 19+ = (number of protons) × (1+) (0.25 pt) Number of protons = $\frac{19+}{1+} = 19$ (0.25 pt) Z = number of protons =19 (0.25 pt)	1
3.1	The valence of chlorine atom is 1.	0.5
3.2	Chlorine belongs to column 17 (group VII) (0.5pt) since chlorine atom has 7 valence electrons (0.5pt),	1
3.3	This bond is ionic.(0.5pt) There is a transfer of electron between potassium atom and chlorine atom. As there is a transfer of electrons, the bond is ionic. (0.5pt)	1
4.1	a- o.n (K) = 0 (0.25 pt) b- o.n (Cl) = 0 (0.25 pt) c- Let $x$ be the oxidation number of Cl in KCl $1 + x = 0$ $x = -1$ (0.5pt)	1
4.2	$2 \text{ K} + \text{Cl}_2 \rightarrow 2 \text{ KCl}$ 0 0 +I -I The oxidation number of chlorine atom decreases from 0 to -I, while the oxidation number of the potassium atom increases from 0 to + I. Since the oxidation numbers vary between reactants and product so the reaction is an oxidation-reduction reaction.	0.5

Part of Q	Exercise 2 (7 points) Petroleum Products Expected Answer	Mark
1.	Gasoline «95 octane» is more explosive than Gasoline «98 octane» (0.5 pt) Since the higher the octane number, the less explosive is the gasoline. (0.5 pt)	1
2.1	Fractional distillation	0.5
2.2	a. A process during which the components of a mixture are separated based on the difference in their boiling points.	0.5
3.1	Octane belongs to the family of Alkanes.	0.5



3.2	The equation of the complete combustion reaction of octane : $2 \text{C}_8\text{H}_{18} + 25 \text{O}_2 \rightarrow 16 \text{CO}_2 + 18 \text{H}_2\text{O}$ .	1
3.3	Melting of polar ice caps. Or change in the distribution of rainfall (precipitations) over various continents.	1
4	<ul style="list-style-type: none"> <li>- The statement (a) is False <b>(0.5 pt)</b> : The carbon chain of 2,2,4-trimethylpentane is branched. <b>(0.5 pt)</b></li> <li>- The statement (b) is correct. <b>(0.5 pt)</b></li> <li>- The statement (c) is False <b>(0.5 pt)</b>: Octane is more explosive than 2,2,4-trimethylpentane <b>(0.5 pt)</b></li> </ul>	2.5

Part of Q	Exercise 3 (6pts) Electrochemical Cells Expected Answer	Mark
1.	In an electrochemical cell, electrons moves from the anode to the cathode then electrons flow from magnesium strip Mg toward the zinc strip Zn.	0.75
2.	The half-reaction that takes place at the anode is: $\text{Mg} \rightarrow \text{Mg}^{2+} + 2\text{e}^-$	0.75
3.	The overall equation of the reaction is: $\text{Mg} + \text{Cu}^{2+} \rightarrow \text{Mg}^{2+} + \text{Cu}$	1
4.1	From the schema of the cell ( $\text{G}_2$ ), $\text{NO}_3^-$ ions move toward the solution containing $\text{Mg}^{2+}$ ions.	0.25
4.	<p>The migration of nitrate ions toward the solution containing <math>\text{Mg}^{2+}</math> ions indicates that the quantity of <math>\text{Mg}^{2+}</math> ions increases in the solution <b>(0.25 pt)</b> then Mg undergoes oxidation <b>(0.5 pt)</b>.</p> <p>Therefore Mg is the anode of this electrochemical cell.</p>	0.75
5.	<p>The written representation of the electrochemical cell (<math>\text{G}_1</math>) is:</p> <p>c) <math>\text{Mg} \mid \text{Mg}^{2+} - \text{Salt bridge} - \text{Cu}^{2+} \mid \text{Cu}</math></p>	1
6.1	The voltage of the cell ( $\text{G}_2$ ) > the voltage of the cell ( $\text{G}_1$ ) ( <b>2.71V &gt; 1.61V</b> )	0.5
6.2	<p>In the cell (<math>\text{G}_1</math>): Mg is the anode then it has more tendency to lose electrons than Zn. <b>(0.25 pt)</b></p> <p>In the cell (<math>\text{G}_2</math>): Mg is the anode then it has more tendency to lose electrons than Cu. <b>(0.25 pt)</b></p> <p>The greater the difference in the tendency of metals to lose electrons, the higher is the voltage of the cell. <b>(0.25 pt)</b></p> <p>then Zn has less tendency to lose electrons than Cu <b>(0.25 pt)</b></p>	1