

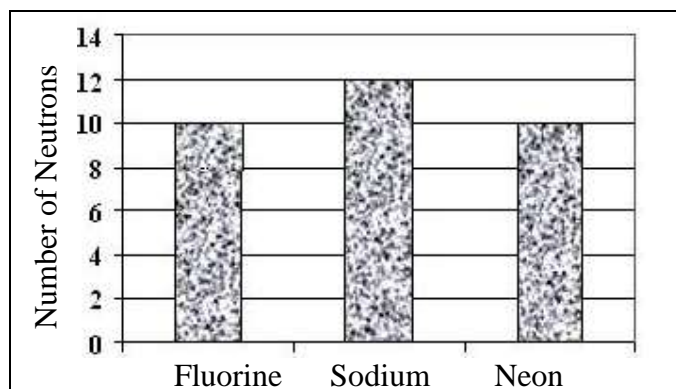
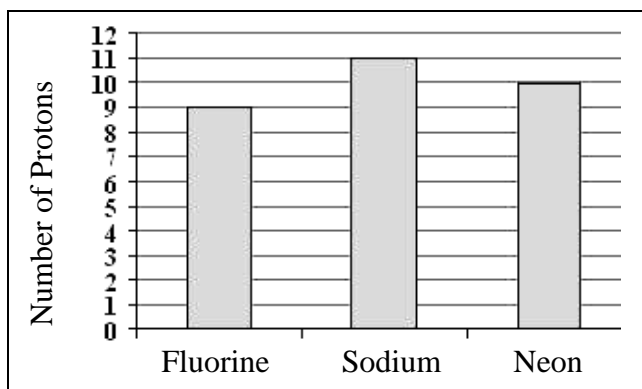
الدورة العادية للعام 2011	الشهادة المتوسطة	وزارة التربية والتعليم العالي المديرية العامة للتربية دائرة الامتحانات
الاسم: الرقم:	مسابقة في مادة الكيمياء المدة ساعة	

**This Exam Is Composed of Three Exercises. It Is Inscribed on 2 Pages.  
Answer the Three Following Exercises:**

**First Exercise (7 points)  
Sodium Fluoride**

The fluoride ion helps to protect the teeth against dental decay. Studies have shown that when sodium fluoride, (an ionic compound containing fluoride ion) is added to drinking water, tooth decay decreases by 65 %. On the other hand, the element fluorine is a very reactive element; it reacts with a large number of substances.

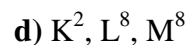
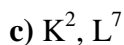
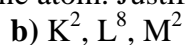
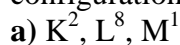
1 - The bar graphs given below show the components of the nucleus of each of the atoms: fluorine, sodium and neon.



1.1 - Copy and complete the table given below:

	<i>Atomic Number</i>	<i>Mass Number</i>	<i>Number of Electrons</i>
Fluorine (F)			
Sodium (Na)			

1.2 - Choose, among the following electron configurations, the one which corresponds to the electron configuration of sodium atom and that which corresponds to the electron configuration of fluorine atom. Justify.



2 -

2.1- Explain the formation of a stable sodium ion from a sodium atom.

2.2- Calculate the charge of the sodium ion.

3-Write the Lewis electron-dot symbol for each of fluorine and sodium atoms.

4 - Give the advantage of using toothpaste containing sodium fluoride instead of another toothpaste which does not contain sodium fluoride.

5 - The sodium fluoride used to produce a toothpaste contains 4.6 g of sodium.

Calculate the number of moles of sodium used.

**Given:**  $M(\text{Na}) = 23 \text{ g.mol}^{-1}$ ; Relative charge of a proton =  $1+$ ; Relative charge of an electron =  $1-$ .

## Second Exercise (6 points) Crude Oil and Plastic Materials

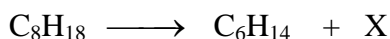
Crude oil is treated in the refinery. The figure on the right shows the schema of the fractionating tower. Each fraction consists of a mixture of hydrocarbons.

Pentane  $C_5H_{12}$  is one of the components of refinery gas.

Decane  $C_{10}H_{22}$  is one of the components of naphtha.

A hydrocarbon (H) of molecular formula  $C_{25}H_{52}$  is one of the components of fuel oil.

- 1 - Give the name of the separation technique used to separate the crude oil into different fractions.
- 2 - Given the following boiling point temperatures:  $260\text{ }^\circ\text{C}$ ,  $40\text{ }^\circ\text{C}$  and  $120\text{ }^\circ\text{C}$ .
  - Attribute to each of the different fractions of the crude oil indicated by the numbers 1, 2 and 3 shown on the adjacent figure the convenient boiling point temperature.
- 3 - The equation given below corresponds to the cracking of octane.



3.1 - Determine the molecular formula X.

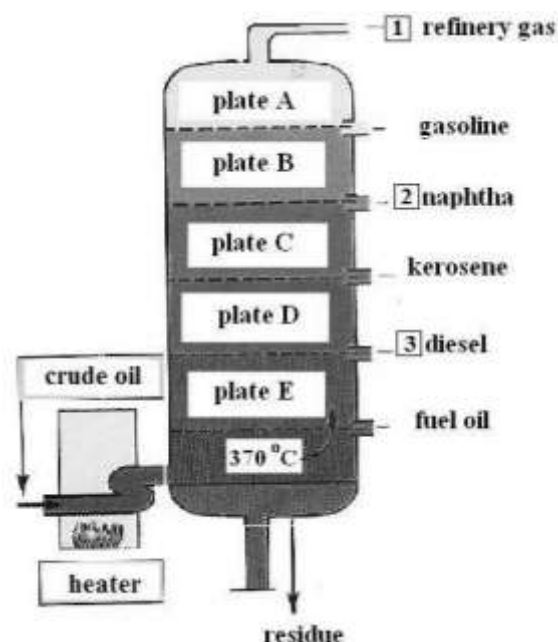
3.2 - Specify which of the two techniques (a) or (b) is a chemical change:

(a) - Cracking. (b) - Separation of the crude oil into different fractions.

4 - Ethene,  $C_2H_4$  undergoes polymerization, it is used for making synthetic polymer.

4.1 - Write, using condensed structural formulas, the equation of the polymerization of ethene.

4.2 - Give the name of the synthetic polymer obtained.



## Third Exercise (7 points)

### Electrical Energy from Redox Reaction

To study spontaneous oxidation-reduction reaction during a laboratory session, the teacher distributes to the students the schema of the galvanic cell (G) and the data given below:

#### Given Data:

- Copper (II) nitrate solution ( $Cu^{2+} + 2NO_3^-$ )
- Iron (II) nitrate solution ( $Fe^{2+} + 2NO_3^-$ )
- Silver nitrate solution ( $Ag^+ + NO_3^-$ )
- Copper **Cu** strip, - Iron **Fe** strip, - Silver **Ag** strip
- Copper has more tendency to lose electrons than silver but it has less tendency to lose electrons than iron.

1- In a half-cell, a strip of a metal is dipped in a solution containing the ions of the same metal.

1.1- Arrange the three metals **Cu**, **Fe** and **Ag** on a horizontal axis in an increasing order of their tendency to lose electrons.

1.2- Specify, based on the given schema, the anode of the galvanic cell (G).

1.3- Identify the strip **X**, **solution 1** and **solution 2**.

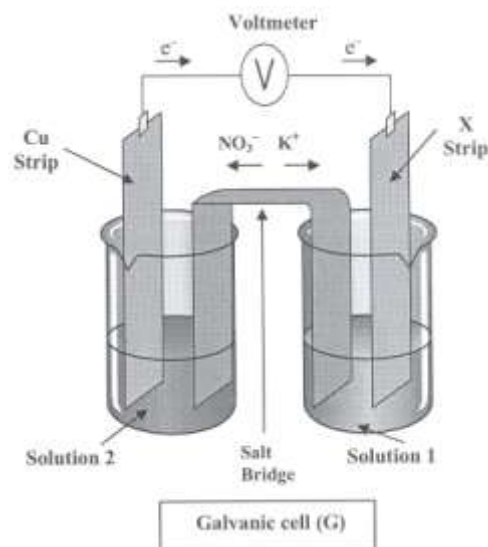
2-

2.1- Write the half-reaction that takes place at each of the two electrodes when the cell is functioning.

2.2- Deduce the equation of the overall reaction of the galvanic cell (G).

3- Justify why potassium ions  $K^+$  migrate, in the salt bridge, towards the half-cell containing the strip **X**.

4- Indicate whether the overall reaction of galvanic cell (G) is spontaneous or non spontaneous reaction.





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الاسم: الرقم:	مسابقة في مادة الكيمياء المدة ساعة	مشروع معيار التصحيح

### First Exercise (7 points)

Part of the Q	Expected Answer	Mark		
1.1	Atomic number	<b>0.50</b> <b>(6x0.25)</b>		
	Mass number			
	Number of Electrons			
	Fluorine (F)	9	19	9
	Sodium (Na)	11	23	11
1.2	Electron configuration of Na atom: (a) because it has 11 electrons. <b>(0.25x2)</b> Electron configuration of F atom: (c) because it has 9 electrons. <b>(0.25x2)</b>	<b>1</b>		
2.1	Sodium atom loses the single electron on its valence energy level. The ion formed will satisfy the octet rule.	<b>0.50</b>		
2.2	Charge of an ion = total positive charge + total negative charge. <b>(0.25)</b>	<b>1</b>		
	Number of protons for sodium ion = 11 $\Rightarrow$ total positive charge = 11+. <b>(0.25)</b>			
	Number of electrons for sodium ion = 10 $\Rightarrow$ total negative charge = 10-. <b>(0.25)</b>			
	Charge of sodium ion = (11+) + (10-) = 1+. <b>(0.25)</b>			
3	The Lewis electron dot symbol for Na and F atoms respectively are:  Na ·                                  ·· ·F· ·· <b>(0.50x2)</b>	<b>1</b>		
4	The advantage of using toothpaste containing sodium fluoride is that it helps to protect the teeth against dental decay.	<b>0.5</b>		
5	$n = \frac{m}{M}$ <b>(0.25)</b> $\Rightarrow n = \frac{4.6g}{23g \cdot mol^{-1}}$ <b>(0.25)</b> $\Rightarrow n = 0.2 mol.$ <b>(0.25x2)</b>	<b>1</b>		

### Second Exercise (6 points)

Part of the Q	Expected Answer	Mark
1	The separation technique: Fractional distillation.	<b>0.75</b>
2	Fraction 1 - 40 °C, Fraction 2- 120 °C, Fraction 3- 260 °C. <b>(3x0.25)</b>	<b>0.75</b>
3.1	$C_8H_{18} \longrightarrow C_6H_{14} + X$	<b>2</b>
	Law of conservation of mass (atoms): Number of atoms of each element is conserved in the reaction. <b>(0.50)</b>	
	$\Rightarrow X$ should contain (8 - 6) = 2 carbon atoms <b>(0.50)</b> and (18 - 14) = 4 hydrogen atoms. <b>(0.50)</b>	
	$\Rightarrow$ The molecular formula X is $C_2H_4$ . <b>(0.50)</b>	
3.2	(a) Cracking is a chemical process. It involves a chemical change. New substances are formed.	<b>1</b>
4.1	The equation of the polymerization of ethene is :	<b>1</b>
	$n(CH_2 = CH_2) \longrightarrow \left[ CH_2 - CH_2 \right]_n$	
4.2	The name of the polymer is polyethene.	<b>0.50</b>

### Third Exercise (7 points)

Part of the Q	Expected Answer	Mark
1.1	<p>Based on the given, Ag has less tendency to lose electrons than Cu, and Cu has less tendency to lose electrons than Fe.</p> $\begin{array}{c} \text{--- Ag} \quad \text{--- Cu} \quad \text{--- Fe} \quad \text{---} \\ \text{Increasing order of tendency} \\ \text{to lose electrons} \end{array}$	1
1.2	Referring to the schema of the galvanic cell (G), The anode of this cell is the copper strip because the electrons flow from the copper strip towards the X strip.	0.50
1.3	<p>Cu strip is the anode. Therefore, X strip is the cathode of galvanic cell (G), it should have less tendency to lose electrons. Among the three given metals, silver has less tendency to lose electrons than copper. Therefore, X is silver. (1)</p> <p>A half-cell consists of a metal dipped in a solution of its ions. Therefore,  <b>Solution-1</b> is: <math>(\text{Ag}^+ + \text{NO}_3^-)</math> (0.50)  <b>Solution-2</b> is: <math>(\text{Cu}^{2+} + 2\text{NO}_3^-)</math> (0.50)</p>	2
2.1	<p>Anode half-reaction: <math>\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-</math> (0.50)            Cathode half-reaction: <math>\text{Ag}^+ + 1\text{e}^- \rightarrow \text{Ag}</math> (0.50)</p>	1
2.2	$\begin{array}{l} \text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^- \\ \underline{2\text{x}(\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag})} \quad (0.50) \\ \text{Cu} + 2\text{Ag}^+ \rightarrow \text{Cu}^{2+} + 2\text{Ag} \end{array}$ <p>Is the equation of the overall reaction (0.50)</p>	1
3	At the cathode, $\text{Ag}^+$ ( $\text{X}^+$ ) ions are reduced and changed to Ag ( $\text{X}_{(s)}$ ) atoms. This leads to a decrease in the quantity of positive charge in <b>solution -1</b> . To keep charge balance (electro-neutrality) of <b>solution-1</b> , $\text{K}^+$ ions migrate towards it.	1
4	The overall reaction is a spontaneous reaction.	0.50