

**First Exercise (7 pts)****Lewis-Dot Structure**

Gilbert Newton Lewis was an American physical chemist known for the discovery of the covalent bond and his concept of electron pairs; his Lewis dot structures and other contributions to valence bond theory have shaped modern theories of chemical bonding.

**1- The percentage natural abundance of some isotopes is given in the table below.**

Isotopes	Oxygen isotopes			Hydrogen isotopes		Copper isotopes	
Elements	O-16	O-17	O-18	H-1	H-2	Cu-63	Cu-65
Percentage	99.77	0.04	0.2	99.985	<b>X</b>	69.2	30.8

1.1- Represent the percentage natural abundance of copper isotopes on a circle graph.

1.2- The percentage natural abundance of H-2 is **X**. Determine **X**.

1.3- Define isotopes.

1.4- Write the electron configuration and lewis electron-dot symbol of C, H, and O.

1.5- Determine the valence for each of these atoms.

1.6- Write one lewis dot structure of **C<sub>3</sub>H<sub>8</sub>O molecule**.

**2-Usage of the periodic Table**

Use the given periodic table to answer the following:

	I	II		III	IV	V	VI	VII	VIII
1	H								<sup>4</sup> He
2	Li	Be		B	C	N	O	F	
3	Na	Mg			Si				
4		Ca							

2.1- Determine in which group and period calcium (Ca) is found.

2.2- Determine the atomic number of the second element of halogen.

2.3- Write the symbol of two elements belong to the alkaline earth metal group and one noble gas.

**Second Exercise (7 pts)****Galvanic Cell**

Billions of electrochemical cells are used all over the world every year. These cells which are intended for general public use count ~ 95% of the market. The rest are related to the use in different professional and military fields. A galvanic cell is constructed from Al and Cu. Al has a more tendency to lose electrons from Cu. We have two solutions in two beakers, one containing (Al<sup>3+</sup>, SO<sub>4</sub><sup>2-</sup>), and another containing (Cu<sup>2+</sup>, SO<sub>4</sub><sup>2-</sup>).

**1- Al and Cu Galvanic cell**

1.1- Sketch and label the above Galvanic cell.

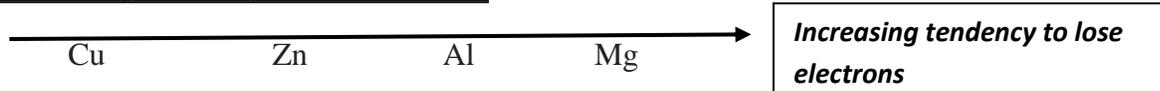
1.2- Indicate the oxidation half reaction and reduction half reaction. Justify.

- 1.3- Deduce the overall reaction and write the cell representation.  
 1.4- Identify which species is the oxidant and which species is the reductant.  
 1.5- When the salt bridge is removed, the voltmeter read zero volt. Justify.

## 2-Oxidation number

- 2.1- Define the oxidation number.  
 2.2- Assign the oxidation number of Sulfur (S) in the following:  
 $\text{SO}_4^{2-}$ ,  $\text{SO}_3^{2-}$ , and  $\text{H}_2\text{S}$ .

## 3- Increasing tendency to lose electrons



- 3.1- A galvanic cell [Mg-Zn] is constructed. The teacher proposes the following equations for the overall reaction: **a)**  $\text{Mg}^{2+} + \text{Zn} \rightarrow \text{Mg} + \text{Zn}^{2+}$  (**R<sub>1</sub>**) and **b)**  $\text{Mg} + \text{Zn}^{2+} \rightarrow \text{Mg}^{2+} + \text{Zn}$  (**R<sub>2</sub>**)  
 Explain which equation (**R<sub>1</sub>**) or (**R<sub>2</sub>**) can be associated to this galvanic cell.

## **Third Exercise (6 pts)**

## **Fluoride and Tooth Decay**

The fluoride ion helps protect teeth against decay. Studies have shown that when sodium fluoride is added to drinking water, tooth decay decreases by 65%. Research has also shown that fluoride not only reduces cavities in children and adults, but it also helps repair the early stages of tooth decay, even before the decay is visible.

### 1- Sodium Fluoride

- 1.1- Name the two chemical elements present in sodium fluoride.  
 1.2- Give the Lewis electron dot symbol for each atom. (  $_{11}\text{Na}$  ,  $_{9}\text{F}$  )  
 1.3- Indicate, using the octet rule, the ions of these elements.  
 1.4- Deduce the formula of sodium fluoride.  
 1.5- Identify the type of bond in sodium fluoride molecule.

**2- Given:** Mass number (**A**) of **Na** is 23, and mass number (**A**) of **F** is 19.

2.1- Recopy the following table and complete it.

Element	Number of protons	Number of neutrons	Number of electrons	Location in the periodic table
Sodium				
Fluoride				

### 3- H<sub>2</sub>O molecule:

- 3.1- Water molecule  $\text{H}_2\text{O}$  contains two single covalent bonds.  
 Explain this statement then draw the Lewis dot structure for  $\text{H}_2\text{O}$ .  
 3.2- What is the advantage of adding sodium fluoride to water?

**Good Work!!!**

# Answer key of Chemistry (midterm Exam)

## Grade 9

### First Exercise (7pts)

#### Lewis Dot Structure

Expected Answers	Mark	Comment
1-	0.75	
1.1- circle graph	0.25	
1.2- $X=100-99.985=0.015\%$	0.25	
1.3- isotope definition	0.75	
1.4- electron configuration of C,H,O	0.75	
Lewis dot symbol of C,H,O	0.75	
1.5- define valence	0.75	
Valance of C:4, H:1 , O:2		
1.6- one lewis structure of <b>C<sub>3</sub>H<sub>8</sub>O</b> molecule		
2-		
2.1- define group and period	. 0.5	
calcium belongs to group II and period 4	0.75	
2.2-elements of group VII are halogens. Then it will have 7 electrons on last shell..second halogen has 3 energy levels Electron configuration of element is : $K^2 L^8 M^7$ Therefore its atomic number (Z) is 17.. in a neutral atom number of protons(Z) equal number of electrons	1.25	
2.3- alkaline earth metals are group II. So Be and Ca are two elements in this group.	0.75	
Noble gas belongs to group VIII: Helium (He)	0.25	

### Second Exercise (7 pts)

#### Galvanic cell

Expected Answers	Mark	Comment
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<b><u>1- Al and Cu Galvanic cell</u></b> 1.1 – schema of galvanic cell and label	1.5	
1.2 – ox ½ rxn: $\text{Al} \rightarrow \text{Al}^{3+} + 3\text{e}$ Red ½ rxn: $\text{Cu}^{2+} + 2\text{e} \rightarrow \text{Cu}$  Oxidation loses electrons and reduction gains electrons.	0.5 0.5 0.25	
1.3 – overall: $2\text{Al} + 3\text{Cu}^{2+} \rightarrow 2\text{Al}^{3+} + 3\text{Cu}$ Cell representation: $\text{Al} \text{Al}^{3+}  \text{Cu}^{2+} \text{Cu}$  1.4- oxidant: $\text{Cu}^{2+}$ gained 2 e Reductant: Al lost 3e  1.5- salt bridge is removed so zero volt; open circuit, no flow of electrons.	0.5 0.5 0.5 0.25	
<b><u>2-Oxidation number</u></b> 2.1- Oxidation number is the number assigned to an element that indicates the number of electrons the atom gain loose or share in a chemical bonding. 2.2-ON of S in : $\text{SO}_4^{2-}$ is +6 $\text{SO}_3^{2-}$ is +4 $\text{H}_2\text{S}$ is -2	0.5  0.5 0.5 0.5	
<b><u>3- Increasing tendency to lose electrons</u></b> 3.1-b Mg has more tendency than Zn to lose electron and become oxidized.	0.5	

### Third Exercise (6 pts)

#### Fluoride and tooth decay

Expected Answers	Mark	Comment
<b><u>1- Sodium Fluoride</u></b> 1.1- sodium and fluorine	0.25	
1.2- lewis dot symbol for Na and F	0.5	
1.3- sodium atom satisfies octet rule by losing one electron in order to be stable. Ion is $\text{Na}^+$ while fluorine atom satisfies octet rule by gaining one electron in order to be stable. Ion is $\text{F}^-$ 1.4- NaF 1.5- as mentioned above, sodium atom loses 1 electron while fluorine atom gains one electron. Therefore sodium gives one electron to fluorine atom to form an ionic bond. (bond between metal and	1  0.25  1	

nonmetal)

2-

Element	Number of protons	Number of neutrons	Number of electrons	Location in the periodic table
Sodium	11	12	11	group I, period 3
Fluoride	9	10	9	group VII, period 2

**3- H<sub>2</sub>O molecule:**

3.1- lewis dot symbol of H and O

Bond between two non metals; covalent bond

Lewis dot structure of H<sub>2</sub>O

3.2- to decrease tooth decay by 65 %

2

0.75

0.25