This is a Class 1 exam

Lebanon Evangelical School
for Boys and Girls
Loueizeh - Baabda

Stage Exam 05

12MAY2023

Do NOT write in this box. Your MARK will be placed here.

Subject :	Chemistry
Class :	9B and 9C
Teacher :	Mrs. Mirella Freige
Duration :	1 hour

Your name :		*Time taken to complete exam*
Your Class :		
Exam Room :		
How many sheets, including cover sheet :		

- Do not open this paper until the teacher in charge instructs you to do so.
- The most important thing to remember in taking an exam is NEVER PANIC.
- If you are caught cheating in this exam, you will be awarded zero for ALL exams that are taken on this day.

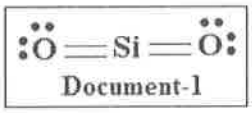
Exercise 1 (7 points) **Manufacture of Glass**

The principle of manufacturing glass and the raw materials used had almost been the same since thousands of years.

The constituents of glass vary according to the type of glass manufactured. The most common raw materials of glass are mainly silicon dioxide (silica) SiO_2, calcium oxide CaO and sodium oxide Na_2O.

1. Pick out from the text, the names of the raw materials used in the manufacture of glass.

2. **Document-1** shows the Lewis structure of the silica molecule SiO_2.



Document-1

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

2.1. Specify the column (group) to which silicon (Si) belongs in the periodic table.

2.2. Choose the valence of oxygen atom (O) in silica. Justify.

a) Valence = 6 **b)** Valence = 4 **c)** Valence = 2

3. Quicklime is the name given to the ionic compound calcium oxide CaO.
Document-2 represents the equation of formation of calcium ion Ca^{2+} and the electron configuration of this ion.

- Equation of formation of calcium ion: $Ca \rightarrow Ca^{2+} + 2e^-$
- Electron configuration of calcium ion: $K^2 L^8 M^8$

Document-2

Answer by true or false. Justify.

a) The nucleus of calcium atom (Ca) and its corresponding ion have the same composition.

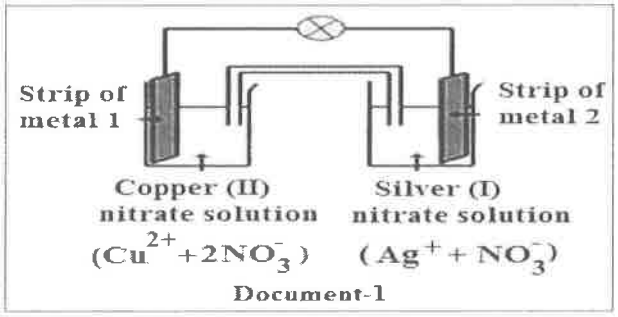
b) The number of electrons in calcium ion Ca^{2+} is equal to 20.

c) The atomic number of calcium element is Z = 20.

4. Explain how oxygen atom attains stability in each of the compounds calcium oxide CaO and silicon dioxide SiO_2.

Exercise 2 (7 points) **Electrochemical Cells**

An electrochemical cell converts chemical energy into electric energy. Several metals can be used to construct cells. Metals differ in their tendencies to lose electrons; for example copper (Cu) has more tendency to lose electrons than silver (Ag) and it has less tendency to lose electrons than magnesium (Mg). The greater the difference between the tendencies of metals to lose electrons, the higher the voltage of the cell.



Document-1

1. An electrochemical cell G_1 is constructed. **Document-1** shows the schema of the functioning cell G_1.

1.1. Identify the metal (1).

1.2. The overall equation of the cell reaction G_1 is given below:

$$2Ag^{+}_{(aq)} + Cu_{(s)} \rightarrow 2Ag_{(s)} + Cu^{2+}_{(aq)}$$

1.2.1. Write the half equations of the reactions that take place at the anode and the cathode of the cell G_1.

1.2.2. Identify the oxidant (oxidizing agent) and the reductant (reducing agent) in the cell reaction G_1.

1.3. Justify the following statements:

a) The mass of the copper strip decreases after a certain time of the functioning of the cell G_1.

b) When the salt bridge is removed, the lamp of the cell G_1 doesn't glow.

2. Referring to the text, answer the following questions:

2.1. Arrange the metals copper (Cu), silver (Ag) and magnesium (Mg) on an axis according to their increasing tendencies to lose electrons.

2.2. A cell G_2 is constructed by connecting the two half-cells:

- A magnesium strip (Mg) dipped in a solution containing magnesium ions Mg^{2+}.
- A silver strip (Ag) dipped in a solution containing silver ions Ag^+.

- Give the symbolic representation of the cell G_2.

2.3. Under standard conditions, the voltage of the cell G_1 is $U_1 = 0.46V$.

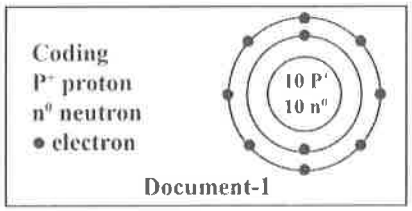
- Choose from the following values, the one that corresponds to the voltage (U_2) of the cell G_2 under the same conditions. Justify.

a) $U_2 = 0.46$ V **b)** $U_2 = 0.16$ V **c)** $U_2 = 3.17$ V

Exercise 3 (6 points) **Aluminum: A Common Metal**

Aluminum is a silvery white metal. It is the most abundant metal on Earth's crust. It has been widely used in industry in recent years replacing iron due to its low density and longer durability, because unlike iron it resists corrosion in humid air.

Document-1 shows the schematic representation of a neon atom (Ne).



Document-1

1. Pick out from the text the reasons, why in recent years, aluminum has been used in industry instead of iron.

2. Referring to **Document-1**, answer the following questions:

   2.1 Calculate the mass number (A) of the neon atom.
   2.2 Write the Lewis electron dot symbol of this atom.
   2.3 Indicate the group (column) and period (row) of the neon element in the periodic table.

3. In certain chemical reactions, each aluminum atom loses 3 electrons to become a stable ion Al^{3+}. Aluminum ion has the same electron configuration as that of the neon atom.

   - Determine the relative charge of the electron cloud of the aluminum ion Al^{3-}, knowing that the relative charge of an electron is 1- .

4. Knowing that the chlorine element belongs to row 3 (period3) and column 17 (group VII) in the periodic table:

   4.1 Write the electron configuration of chlorine atom.
   4.2 Determine the atomic number of chlorine.
   4.3 Write the atomic representation of a chlorine atom with 18 neutrons in its nucleus.

SE05/20222023/Chemistry/9BC

Exercise 1 :

1. Silicon dioxide (1/4) – Calcium dioxide (1/4) and sodium dioxide (1/4).

2.2.1. In doc.-1, silicon shares 4 electron pairs : it has 4 single electrons, so Si belongs to Group IV (col. 14) (1)

2.2. Valence of oxygen : c) valence = 2 since O has shared 2 $\bar{e}$ pairs = it has 2 single $\bar{e}$. (1/2)

3. a) True : the atom and its corresponding ion have the same number of protons and nucleons (1)

b) False : Electron Conf. of Ca^{2+} : $K^2L^8M^8$ (Doc.-2)
Number of $\bar{e}$ = 2+8+8 = 18 $\bar{e}$.
Number of $\bar{e}$ in Ca^{2+} = 18. (1)

c) True : Ca^{2+} : Atom that has lost 2 $\bar{e}$;
Nbr of $\bar{e}$ in Ca atom = 18+2 = 20 $\bar{e}$ and in a neutral atom nbr of $\bar{e}$ = nbr of p^+ = atomic number Z = 20. (1)

4. In CaO : to attain stability, oxygen gains 2 $\bar{e}$ and becomes oxide ion : O^{2-}. (3/4)
In SiO_2 : to attain stability, oxygen needs 2 $\bar{e}$ and shares 2 $\bar{e}$ pairs. (1)

Exercise 2 :

1.1.1. Since the strip of metal 1 is immersed in a solution containing Cu^{2+} ions, Then metal 1 is Copper (1/2)

1.2.1. Anode : $Cu_{(s)} \longrightarrow 2\bar{e} + Cu^{2+}_{(aq)}$ (1/2)
Cathode : $Ag^+ + 1\bar{e} \longrightarrow Ag_{(s)}$ (1/2)

1.2.2. The oxidant is the reactant that undergoes a reduction, so Ag^+ : oxidant. (1/2)
The reductant is the reactant that undergoes an oxidation, so Cu : reductant. (1/2)

1.3 a) Copper: anode is oxidized and is transformed into Cu^{2+} ions. (1)

b) when the salt bridge is removed, the circuit is opened. (1)

2.2.1. Ag Cu Mg → Increasing order of tendency to lose $\bar{e}$. (1)

2.2. Symbolic Representation of G_2: $Mg|Mg^{2+}$ bridge $Ag^{+}|Ag$. (1/2)

2.3. $U_1 = 0.46V$, so $U_2 = 3.17V$. ($U_2 = 3.17V > U_1 = 0.46V$)
The greater difference between the tendencies of metals to lose $\bar{e}$, the higher the voltage of the cell (1)

Exercise 3:

1. Aluminum has been used in industry instead of iron due to its low density and longer durability, because unlike iron it resists corrosion in humid air. (3/4)

2.2.1. Mass number = $A = p^+ + n^\circ = 10 + 10 = 20$. (1/4)

2.2. $|\underline{Ne}|$ (1/4)

2.3. Ne G VIII (col. 18) - Period 2 (row 2). (1)

3. Relative charge of the electron cloud of Al^{3+}
= Charge of electrons = nbr of $\bar{e}$ × relative charge of an $\bar{e}$
$= (2+8) \times (1^-) = 10 \times 1^- = 10^-$ (1)

4.4.1 Cl: G VII = 7 valence $\bar{e}$; r: 3 = 3 occupied shells
So: Cl: Configuration $K^2L^8M^7$ (K, L: saturated) (1)

4.2. Nbr of $\bar{e}$ = 2+8+7 = 17$\bar{e}$; In a neutral atom, nbr of $\bar{e}$ = nbr of p^+ = atomic number Z = 17. (1 1/4)

4.3. $A = Z + N = 17 + 18 = 35$. $^{35}_{17}Cl$ (1/2)