This Is a Class 1 exam

Lebanon Evangelical School for Boys and Girls

Lebanon Evangelical School
for Boys and Girls Loueizeh - Baabda

Stage Exam 03

16MAY2025

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

Subject :	Chemistry
Class :	9B, 9C and 9E
Teacher :	Mrs. Mirella Freige
Duration :	1 hour
You are to answer the questions to this exam on : Lined paper	

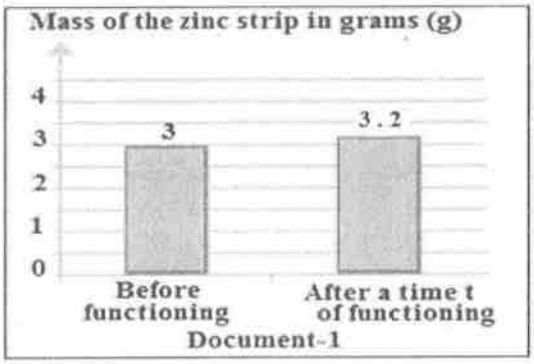
Your name :		*Time taken to complete exam*
Your Class :		
Exam Room :		
How many sheets, including cover sheet :		

- 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 I (6 points) Aluminum – Zinc Cell

Redox reactions involve the transfer of electrons from one chemical species to another.
In the laboratory, a group of students construct an aluminum-zinc electrochemical cell (G), in order to study the variation in mass of the zinc strip during the functioning of this cell.

Document -1 is a bar graph that represents the obtained result.



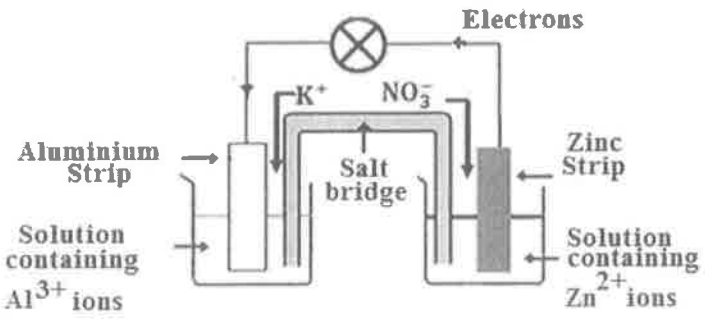
Document-1

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

   1.1 Show that the zinc strip is the cathode of the cell (G).

   1.2 Identify, among the metals zinc and aluminum, the one that has the greater tendency to lose electrons.

2. A grade 9 student, schematizes the cell (G) constructed by his classmates.



Pick out from the schema above the two errors committed by this student. Justify.

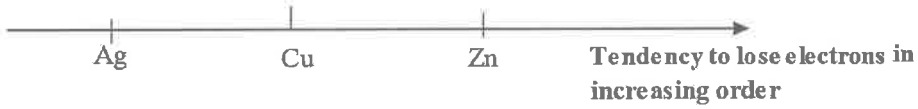
3. Write the oxidation and the reduction half-reactions of the cell (G).

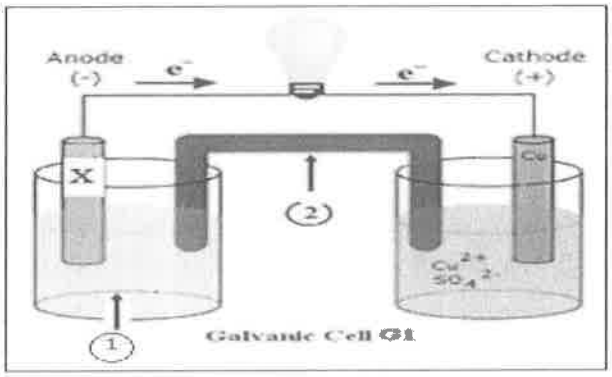
4. Deduce the overall equation of the reaction of this cell.

5. Describe the steps to build this cell.

Exercise II (7 points) **Galvanic Cell**

To know whether a metal is the anode or the cathode in a galvanic cell, its tendency to lose electrons is compared to the tendency to lose electrons of another metal.
The tendency to lose electrons of three metals silver, copper, and zinc is arranged in increasing order on a horizontal axis:





The ionic forms of the three metals are: (Zn^{2+}, Cu^{2+} and Ag^{+})

1. Show that metal X in the galvanic cell is Zn.

2. Specify the direction of the electric current flow.

3. Indicate the role of the material numbered 2.

4. List the names of the materials numbered on the schema of the galvanic cell.

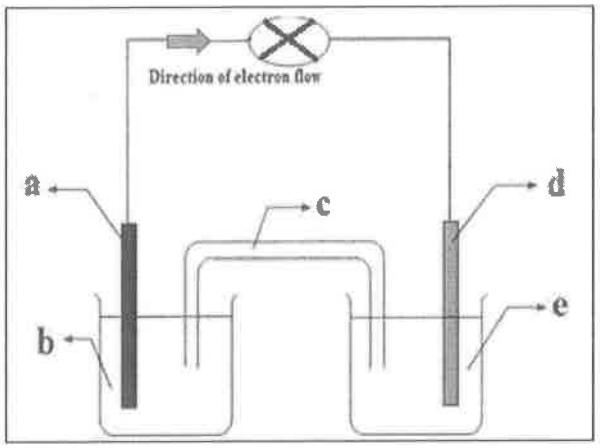
5. Write the equation of the half-reaction that takes place at each of the two electrodes in the galvanic cell. Deduce the overall equation.

6. Justify the following sentence: the blue color of the copper II sulfate solution $Cu^{2+} + SO_4^{2-}$ fades over time.

Exercise III (7points) **Zn-Sn Galvanic Cell**

Zinc (Zn) has more tendency to lose electrons than tin (Sn). A galvanic cell Zn-Sn is created where the zinc strip serves as the anode. The figure below shows the cell.
The cell representation is:

Zn / Zn^{2+} -Salt bridge- Sn^{2+} / Sn



The ionic forms of zinc and tin are Zn^{2+} and Sn^{2+} respectively.

1. Label the figure above.

2. Write the equations of the reactions taking place at the anode and at the cathode.

3. Deduce the overall equation.

4. Explain how the quantity of Zn^{2+} and Sn^{2+} ions changes in the solutions in the beakers.

5. How does the mass of the Zn and Sn strips change as the reaction takes place?

SE03/2024/2025/9BCE

Exercise I Aluminum – Zinc Cell

1.1. Based on Document-1, the mass of the zinc strip increases from 3g to 3.2g after a time t of functioning because there is formation of $Zinc_{(s)}$ by the reduction of Zn^{2+} ions at the zinc strip, so Zinc strip is the cathode. (1/2)

1.2. Zinc: Cathode and Aluminum: Anode
So Aluminum has the greater tendency to lose electrons. (1/2)

2. The 2 errors are:
- Electron flow direction. (1/4)
- The migration direction of salt bridge ions. (1/4)

. Electrons move from the anode to the cathode (from $Al_{(s)} \longrightarrow Zn_{(s)}$). (1/2)
- K^+ ions of the salt bridge should move toward the solution containing Zn^{2+} ions. (1/2)
- NO_3^- ions of the salt bridge should move toward the solution containing Al^{3+} ions. (1/2)

3. Oxidation half equation: $Al \longrightarrow 3\bar{e} + Al^{3+}$ (x2) (1/2)
Reduction half equation: $Zn^{2+} + 2\bar{e} \longrightarrow Zn$ (x3) (1/2)

4. Number of $\bar{e}$ lost = number of $\bar{e}$ gained. (1/2)
Overall equation: $2Al + 3Zn^{2+} \longrightarrow 2Al^{3+} + 3Zn$. (1/2)

5. In a solution containing Zn^{2+} ions immerse the Zn Strip. (1/4)
In a solution containing Al^{3+} ions immerse the Al Strip. (1/4)
The 2 strips are connected by wires to an ammeter. (1/4)
The 2 solutions are connected by a salt bridge. (1/4)

Exercise II Galvanic Cell

1. Based on the axis, Zn has more tendency to lose electrons than Cu, and in the galvanic cell G, X is the anode (loses electrons) and Cu is the cathode ($\bar{e}$ move from X to Cu(s)), so X is Zn. (1)

2. Electric Current moves from the cathode to the anode, so from $Cu(s) \longrightarrow Zn(s)$. (1)

3. It connects the two solutions and maintains their electroneutrality. (1)

4. ①: Solution containing Zn^{2+} ions. (1/2)
   ②: Salt bridge. (1/2)

5. Anode: $Zn \longrightarrow 2\bar{e} + Zn^{2+}$ (1/4)
   Cathode: $Cu^{2+} + 2\bar{e} \longrightarrow Cu$. (1/4)
   Overall equation: number of $\bar{e}$ lost = number of $\bar{e}$ gained. (1/4)
   $Zn + Cu^{2+} \longrightarrow Zn^{2+} + Cu$. (1/4)

6. The blue color of the solution is due to the presence of Cu^{2+} ions; Cu^{2+} ions undergo a reduction reaction and are transformed into Cu(s), so their quantity decreases over time that's why the blue color fades. (2)

Exercise III Zn - Sn Galvanic Cell

1. a. Zinc Strip. (1/2)
   b. Zn^{2+} ions (1/2)
   c. Salt bridge (1/2)
   d. Sn strip. (1/2)
   e. Sn^{2+} ions. (1/2)

2. At the anode: $Zn \longrightarrow 2\bar{e} + Zn^{2+}$ (1/2)
   At the cathode: $Sn^{2+} + 2\bar{e} \longrightarrow Sn$. (1/2)

3. Overall equation: $Zn + Sn^{2+} \longrightarrow Zn^{2+} + Sn$ (1/2)
   Number of $\bar{e}$ lost = number of $\bar{e}$ gained. (1/2)

4. The quantity of Zn^{2+} ions increases over time because $Zn_{(s)}$ undergoes an oxidation reaction and forms Zn^{2+} ions. (or there is formation of Zn^{2+} ions by the oxidation of $Zn_{(s)}$) (3/4)

   The quantity of Sn^{2+} ions decreases over time because Sn^{2+} ions undergo a reduction reaction and are transformed into $Sn_{(s)}$. (1/2)

5. The mass of the Zn strip decreases as the reaction takes place because $Zn_{(s)}$ is transformed into Zn^{2+} ions. (or because Zn is oxidized to Zn^{2+} ions) (3/4)

   The mass of the Sn strip increases as the reaction takes place because $Sn_{(s)}$ is formed by the reduction of Sn^{2+}. (1/2)