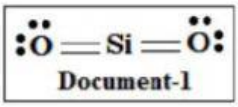
Exercise 1 (6 points) **Manufacture of Glass**

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.



Document-1

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.
   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. Quick lime 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.

a) ....

b) ....

c) ....

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

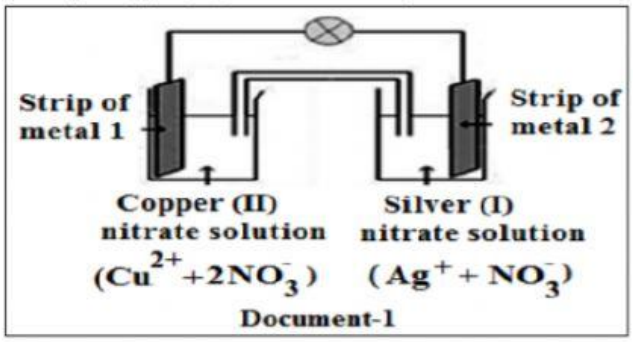
Exercise 2 (7 points) **Electrochemical Cells**

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.

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).



Document-1

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

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

1.2.1. Show, using oxidation numbers, that the above equation corresponds to an oxidation-reduction reaction.

1.2.2. Write the half-reactions that take place at the anode and the cathode of the cell 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