

Instructions

- ✓ **Include all phases of substances**
- ✓ **Do not leave any spaces between the substance and the phase**
- ✓ **Write charges as normal numbers eg Na+1 with no spaces**
- ✓ **Always write the sign first and then the charge eg Na+1 not Na1+**

Question 1

Give **one word/term** for the following:

- 1.1 The electrode where oxidation takes place in electrochemical cells
- 1.2 The part of a galvanic cell that prevents the build up of charge in the reaction vessels
- 1.3 A substance whose oxidation number increases during a chemical reaction

Question 2: Multiple choice questions

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Only write the correct letter (**A - D**) of the answer next to the question number.

- 2.1 The oxidation number of an oxidizing agent

- A. Decreases
- B. Remain constant
- C. Is always zero
- D. Increases

- 2.2 Consider the reaction:



In this reaction, electrons are transferred from:

- A. Al to Al^{3+}
- B. Cu to Cu^{2+}
- C. Al to Cu^{2+}
- D. Cu to Al^{3+}

- 2.3 Make use of oxidation numbers to determine which one of the following reactions is a redox reaction.
- A. $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{NaNO}_3 + \text{AgCl}$
 - B. $\text{Mn} + \text{CuCl}_2 \rightarrow \text{Cu} + \text{MnCl}_2$
 - C. $\text{H}_2\text{SO}_4 + 2\text{KNO}_3 \rightarrow \text{K}_2\text{SO}_4 + 2\text{HNO}_3$
 - D. $\text{HCl} + \text{H}_2\text{O} \rightarrow \text{Cl}^- + \text{H}_3\text{O}^+$
- 2.4 Considering the following simplified cell notations. Which one of the following reactions does not occur spontaneously?
- A. $\text{Zn} / \text{Zn}^{+2} // \text{Cu}^{+2} / \text{Cu}$
 - B. $\text{Mg} / \text{Mg}^{+2} // \text{Cu}^{+2} / \text{Cu}$
 - C. $\text{Cu} / \text{Cu}^{+2} // \text{Fe}^{+2} / \text{Fe}$
 - D. $\text{Cu} / \text{Cu}^{+2} // \text{Ag}^{+1} / \text{Ag}$
- 2.5 Which of the following is **NOT** the function of the salt bridge
- A. Keep two half-cells neutral
 - B. Complete the circuit
 - C. Allow ionic exchange
 - D. Make one electrode an anode and the other the cathode.
- 2.7 The stronger the reducing agent, the greater its ability to....
- A. donate protons
 - B. donate electrons
 - C. combine with protons
 - D. combine with electrons
- 2.8 The oxidation number of phosphorus in H_3PO_4 is....
- A. +3
 - B. -2
 - C. +2
 - D. +5

- 2.9 During the processing of gold ore, zinc is added to the gold cyanide solution to produce gold according to the balanced equation below:



The reducing agent in this reaction is:

- A. Na^+
- B. Au^+
- C. Zn
- D. CN^-

Question 3

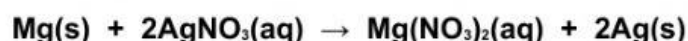
- 3.1 Give the oxidation number of the sulfur in the following compounds (include the sign):

3.1.1 SO_2 (1)

3.1.2 H_2SO_4 (1)

3.1.3 H_2S (1)

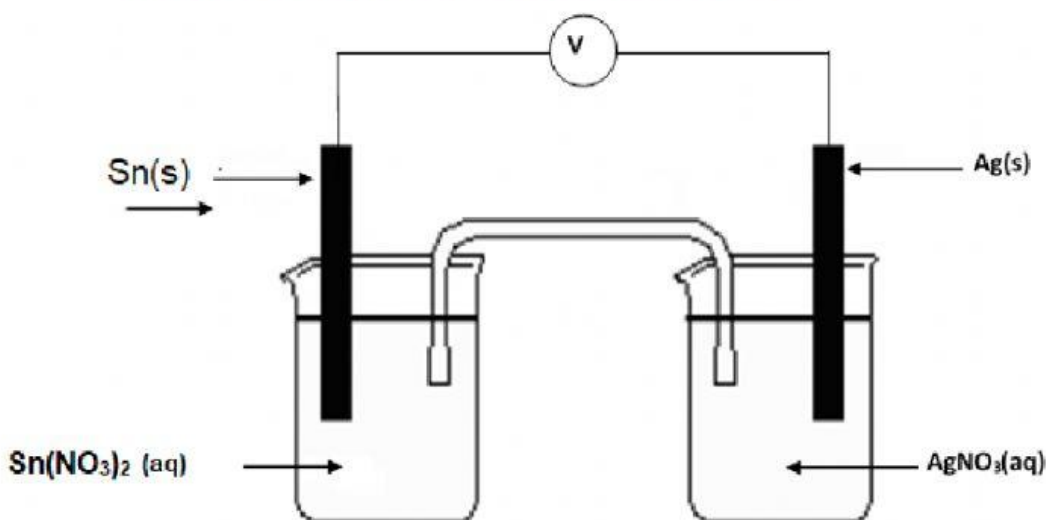
- 3.2 A standard electrochemical cell is constructed based on the following chemical reaction:



Give the oxidation number of the silver in the solution:

Question 4

The diagram below represents a galvanic (voltaic) cell functioning under standard conditions with Tin and silver as electrodes. A voltmeter is connected across the electrodes. **Include all the phases in these answers.**



Instructions:

✓ Include the phases

4.1 State the energy conversion that takes place in this cell.

energy → energy

4.2 Write the oxidation half-reaction for the above cell

→ +

4.3 Write the reduction half-reaction for the above cell

+ →

4.4 Write down the balanced equation for the net (overall) cell reaction that takes place in this cell. **Omit the spectator ions but include phase symbols.**

+ → +

4.5 Write the **symbol** of the element that represents the anode of this cell.

4.6 Write down the cell notation / (symbolic notation of this cell. (do not include the electrolytes concentration of 1 mol.dm⁻³), but ensure to **include the phases**

/ // /

4.7 State in which direction the cations move in the above cell.

From the Sn Ag to the Sn Ag

4.8 Calculate the reading on the voltmeter.

$E^{\ominus}_{\text{Cell}}$ =

4.9 What will happen to the EMF of the cell if:

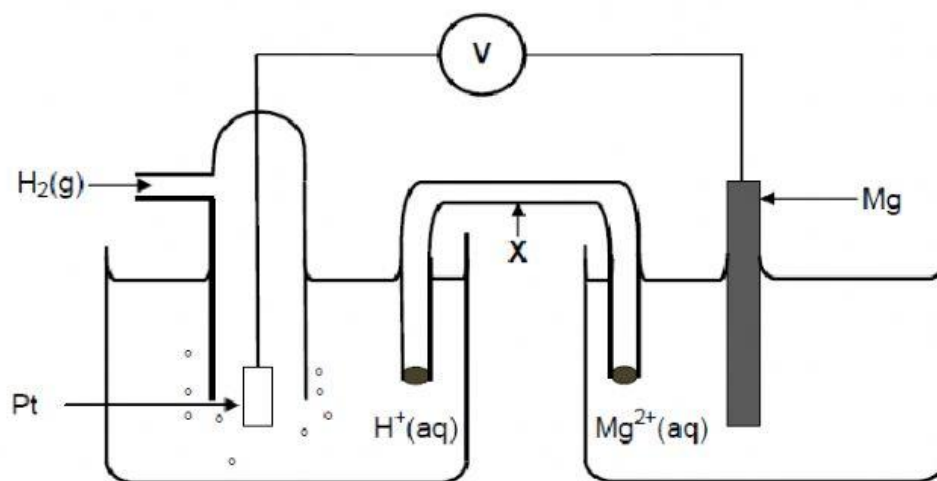
4.9.1 $\text{Sn}^{2+}(\text{aq})$ concentration is increased Increased Decreased Remain constant

4.9.2 $\text{Ag}^{+1}(\text{aq})$ concentration is increased Increased Decreased Remain constant

4.9.3 The size of the Ag electrode is increased Increased Decreased Remain constant

Question 5

The electrochemical cell represented below consists of a hydrogen half-cell and a magnesium half-cell at standard conditions.



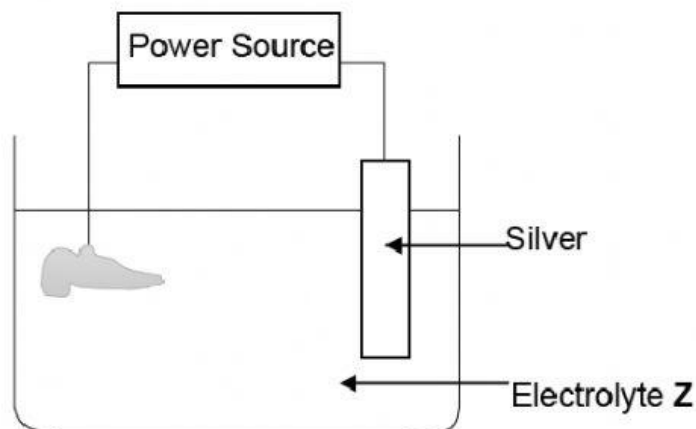
The Voltmeter reading is 2,36V.

- 5.1 Write down the name of the item of apparatus labeled **X**.
- 5.2 Is magnesium the ANODE or CATHODE in the half-cell above?
- 5.3 Write down the balanced NET (overall) cell reaction that takes place in this cell. **No spectator ions are required but include phase symbols.**

+ → +

Question 6

The simplified diagram below represents an electrolytic cell used by a grandmother to preserve her grandchild's first leather shoe by electroplating it with silver.



✓ Include the phases

6.1 Will the shoe be the anode or cathode of the cell:

6.2 Write the half reaction that occurs on the surface of the shoe

+ →

6.3 What will happen to the concentration of the electrolyte as the reaction progresses:
Increased Decreased Remain constant

6.4 The reason for the answer in 6.3 is: the rate at which the $\text{Ag(s)} \rightarrow \text{Ag}^+(\text{aq})$
oxidises reduces at the anode equals to the rate at which the $\text{Ag(s)} \rightarrow \text{Ag}^+(\text{aq})$
oxidises reduces at the cathode

6.5 When a constant current flows for 2 mins, 27g of silver is deposited on the shoe

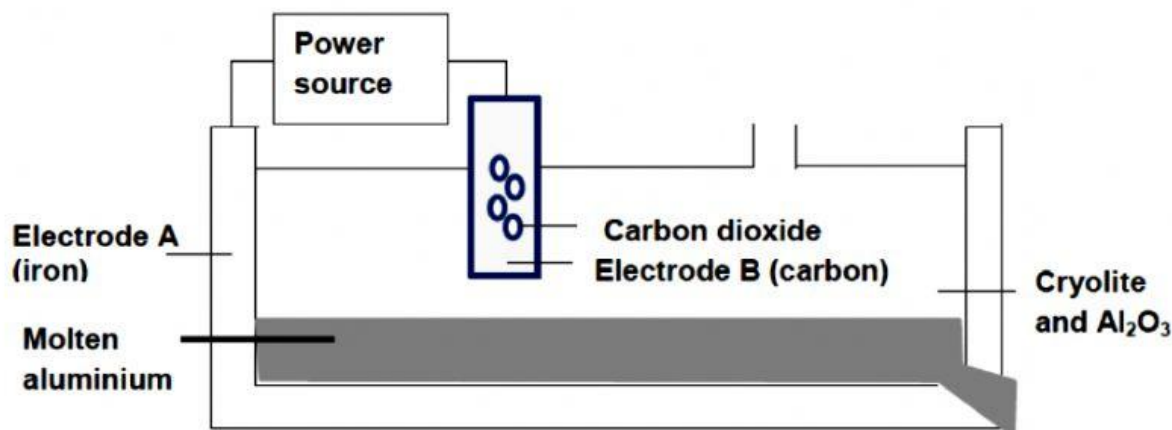
6.5.1 Would the mass loss on the silver electrode be greater than less than or equal to
the 27g mass gain at the shoe

6.5.2 Calculate the number of electrons transferred.

= _____ x 10 _____ electrons {3 decimal places}

QUESTION 7

Bauxite ore is dissolved in molten cryolite and purified to Al_2O_3 . From the bauxite, **pure molten aluminium** is obtained. The cell used for the extraction of the aluminium, is shown in the sketch below:



The net cell reaction for this cell is given as:



✓ Include all the phases symbols

7.1 Write down the reduction half reaction for this cell (include phase symbols; NO SPACES):

_____ + _____ $\rightarrow$ _____

7.2 Which one of **electrode A** or **electrode B** should be connected to the positive terminal of the power source?

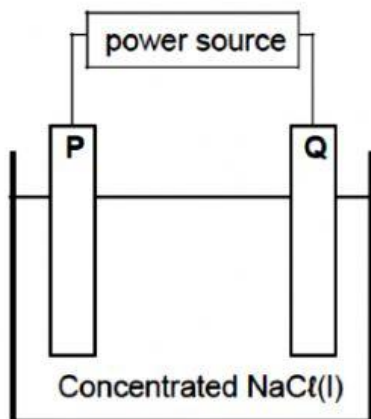
7.3 Write down the formula of the oxidizing agent in this reaction.

- 7.4 The carbon anode needs to be replaced regularly. Write a chemical reaction to explain why this is so (include phase symbols):



QUESTION 8

The simplified diagram below represents an electrochemical cell used for the electrolysis of a molten sodium chloride.



✓ Include all the phases symbols

- 8.1 Is the above cell a GALVANIC or an ELECTROLYTIC cell?

- 8.2 Chlorine gas is released at electrode Q. Write down the:

8.2.1 Electrode (P or Q) at which reduction takes place

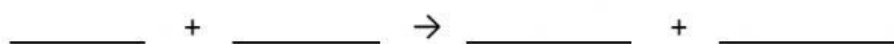
8.2.2 Half reaction that takes place at electrode P.



8.2.3 Direction (P to Q or Q to P) in which electrons flow in the external circuit

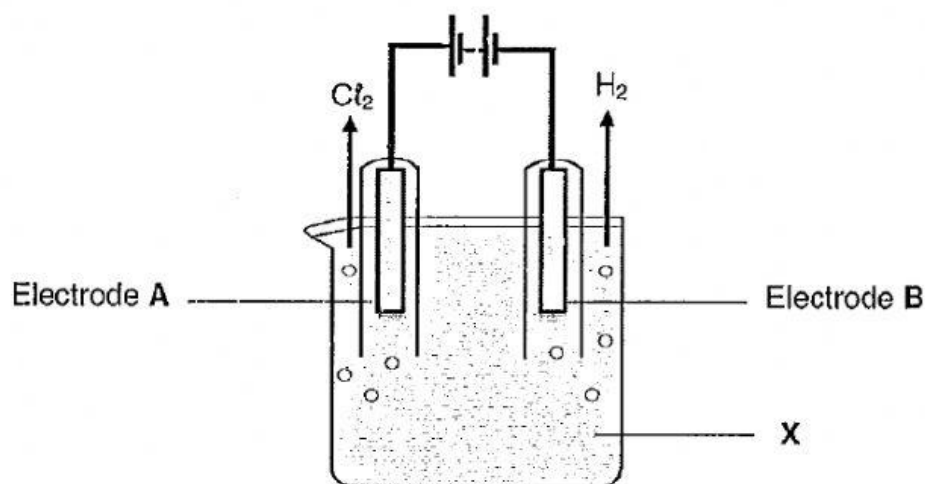
- 8.2.4 NAME of the species that acts as the REDUCING AGENT.

8.3 Write down the balanced net (overall) cell reaction that takes place in this cell.



Question 9

A simplified diagram of an electrochemical cell, used for the production of chlorine gas, is shown below.



✓ Include all the phases symbols

9.1 write down the **name** of electrolyte X

9.2 write down the half reaction that occurs at the positive electrode



9.3 Which electrode, A or B is the cathode

9.4 Litmus added to the electrolyte turns blue around electrode B. Explain this observation with the aid of a relevant balanced half-reaction.

