

# Chemistry Worksheet: Redox Reactions

## GCE O Level & Integrated Programme (Singapore)

### Instructions

- Answer all questions carefully and show all working where appropriate.
- For structured questions, clearly label your answers and present your reasoning.
- Use a pencil for diagrams and ensure all labels are clearly written.

### Section 1: Multiple-Choice Questions (15 Marks)

1. In the reaction:  $Mg + 2HCl \rightarrow MgCl_2 + H_2$

Which species is oxidised?

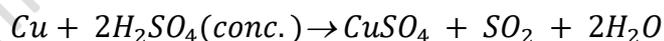
- (A) Mg
  - (B)  $H^+$
  - (C)  $Cl^-$
  - (D)  $MgCl_2$
- 

2. In the redox reaction:  $2KMnO_4 + 16HCl \rightarrow 2KCl + 2MnCl_2 + 5Cl_2 + 8H_2O$

What is the oxidation state of Mn in  $KMnO_4$ ?

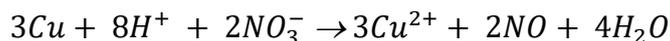
- (A) +2
  - (B) +5
  - (C) +7
  - (D) +4
- 

3. Which of the following is the reducing agent in the reaction:



- (A) Cu
  - (B)  $H_2SO_4$
  - (C)  $CuSO_4$
  - (D)  $SO_2$
-

4. The ionic equation for the reaction between dilute nitric acid and copper is:



In this equation, which species is the oxidising agent?

- (A) Cu
  - (B)  $\text{H}^+$
  - (C)  $\text{NO}_3^-$
  - (D) NO
- 

5. When the equation:  $\text{Fe}^{2+} + \text{MnO}_4^- + \text{H}^+ \rightarrow \text{Fe}^{3+} + \text{Mn}^{2+} + \text{H}_2\text{O}$  is balanced, the coefficient of  $\text{Fe}^{2+}$  is:

- (A) 3
  - (B) 4
  - (C) 5
  - (D) 6
- 

6. In the electrolysis of molten NaCl, which product is formed at the cathode?

- (A)  $\text{Cl}_2$
  - (B) Na
  - (C) NaOH
  - (D)  $\text{H}_2$
- 

7. In the electrolysis of dilute NaCl solution, which gas is produced at the anode?

- (A)  $\text{Cl}_2$
  - (B)  $\text{O}_2$
  - (C) Na
  - (D)  $\text{H}_2$
- 

8. During the electrolysis of concentrated NaCl solution, what is the product at the cathode?

- (A) Na
  - (B)  $\text{H}_2$
  - (C)  $\text{Cl}_2$
  - (D) NaOH
- 

9. In the electrolysis of aqueous copper sulfate using copper electrodes, what occurs at the anode?

- (A)  $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$
  - (B)  $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$
  - (C)  $2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4\text{e}^-$
  - (D)  $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$
-

10. The direction of electron flow in an electrolytic cell is:

- (A) From anode to cathode through the external circuit
  - (B) From cathode to anode through the external circuit
  - (C) From anode to cathode through the electrolyte
  - (D) From the power source to the anode
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11. In the electrolysis of aqueous  $\text{CuSO}_4$  using inert electrodes, which product forms at the cathode?

- (A) Cu
  - (B)  $\text{O}_2$
  - (C)  $\text{H}_2$
  - (D)  $\text{SO}_2$
- 

12. In a redox reaction, if an element increases its oxidation state, it is:

- (A) Reduced and acts as an oxidising agent
  - (B) Oxidised and acts as a reducing agent
  - (C) Oxidised and acts as an oxidising agent
  - (D) Reduced and acts as a reducing agent
- 

13. How many moles of electrons are transferred in the reaction:



- (A) 1 mol
  - (B) 2 mol
  - (C) 3 mol
  - (D) 4 mol
- 

14. In the electrolysis of molten NaCl, the equation at the cathode is:

- (A)  $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$
  - (B)  $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$
  - (C)  $2\text{Na}^+ + 2\text{e}^- \rightarrow 2\text{Na}$
  - (D)  $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$
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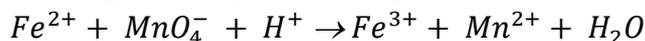
15. In the electrolysis of concentrated NaCl solution, the overall reaction is:

- (A)  $2\text{NaCl} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2 + \text{Cl}_2$
  - (B)  $\text{NaCl} \rightarrow \text{Na} + \text{Cl}_2$
  - (C)  $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$
  - (D)  $\text{Na}^+ + \text{H}_2\text{O} \rightarrow \text{NaOH} + \text{H}_2$
-

## Section 2: Structured Questions

### Question 1: Balancing Redox Reactions and Identifying Oxidising/Reducing Agents (8 Marks)

**Part (a):** Balance the following redox equation using the oxidation state method:



**(4 marks)**

**Part (b):** In the balanced equation above:

- Identify the oxidising agent and explain your choice. **(2 marks)**
- Identify the reducing agent and explain your choice. **(2 marks)**

### Question 2: Stoichiometric Calculations Based on Redox Reactions (8 Marks)

**Part (a):** The reaction between zinc and copper(II) sulfate is:



Calculate the mass of copper produced when 6.5 g of zinc reacts completely with excess copper(II) sulfate solution.

**(Relative atomic masses: Zn = 65, Cu = 64) (4 marks)**

**Part (b):** In another reaction, 0.4 mol of  $KMnO_4$  reacts with excess iron(II) sulfate in acidic solution according to:



Calculate the number of moles of  $Fe^{2+}$  oxidised. **(4 marks)**

### Question 3: Electrolysis and Electrolytic Cells (8 Marks)

**Part (a):** Sketch and label a simple electrolytic cell for the electrolysis of **molten NaCl**.

Your diagram should include:

- The anode and cathode
- The direction of electron flow (with arrows)
- The electrolyte
- The products formed at each electrode

**(4 marks)**

**Part (b):** For the electrolysis of **dilute NaCl solution** using inert electrodes:

- Write the equation for the reaction at the cathode. **(1 mark)**
- Write the equation for the reaction at the anode. **(1 mark)**
- Explain why  $Cl_2$  is not produced at the anode in dilute NaCl solution, even though  $Cl^-$  ions are present. **(2 marks)**