

6.1 Redox processes: electron transfer and oxidation number

Name: _____ Class: _____ Date: _____

Total: 25 marks

KEY WORDS oxidation 氧化 • oxidation number 氧化数 • oxidising agent 氧化剂
 • redox 氧化还原 • reducing agent 还原剂

Objective

Build the skills to answer exam questions on **redox processes** 氧化还原过程 — **oxidation numbers** 氧化数, electron transfer, **disproportionation** 歧化, and **oxidising/reducing agents** 氧化剂/还原剂.

You must be able to:

- calculate oxidation numbers in compounds and ions
- use changes in oxidation number to balance redox equations
- explain redox, oxidation, reduction, disproportionation, and oxidising/reducing agents

1 Worked examples

■ Oxidation number

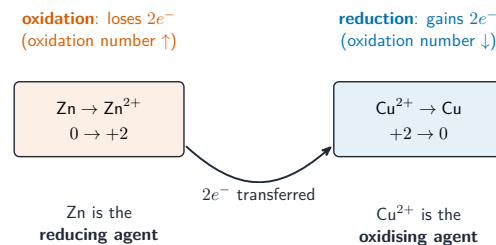
Rules: element = 0; simple ion = its charge; Group 1 = +1, Group 2 = +2; H = +1 (−1 in hydrides); O = −2 (−1 in peroxides); F = −1; sum to 0 (compound) or the charge (ion).



they sum to 0: (+1) + Mn + (−8) = 0, so Mn = +7

Fix the known atoms, then use “they sum to zero” to find the unknown (Mn = +7)

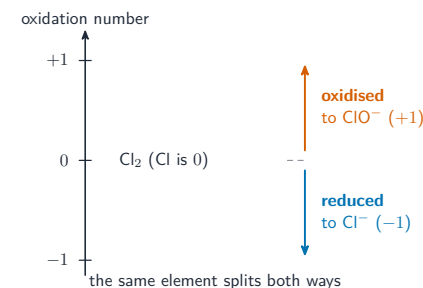
■ Redox — OIL RIG



Oxidation Is Loss, Reduction Is Gain. The reducing agent is oxidised; the oxidising agent is reduced

Oxidation = loss of electrons (number up); **reduction** = gain (number down). An **oxidising agent** takes electrons (is itself reduced); a **reducing agent** gives electrons (is itself oxidised).

■ Disproportionation



The same element is both oxidised and reduced: $Cl(0) \rightarrow ClO^- (+1)$ and $Cl^- (-1)$

2 Practice

2.1 Calculate the oxidation number of (a) S in SO_4^{2-} and (b) N in NO_3^- . [2]

2.2 Complete: "Oxidation is the ____ of electrons; the oxidation number goes ____." [2]

3 Exam-style questions

3.1 What is the oxidation number of chromium in $\text{Cr}_2\text{O}_7^{2-}$? [1]

- | | |
|---|---|
| A | B |
| C | D |
- A +3
B +6
C +7
D +12

3.2 In the reaction $\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Zn}^{2+} + \text{Cu}$, the reducing agent is: [1]

- | | |
|---|---|
| A | B |
| C | D |
- A Zn
B Cu^{2+}
C Zn^{2+}
D Cu

3.3 When chlorine reacts with cold water it forms Cl^- and ClO^- .

(a) State the oxidation number of chlorine in Cl_2 , in Cl^- and in ClO^- . [3]

(b) Explain why this is a disproportionation reaction. [2]

3.4 In acidic solution, MnO_4^- ($\text{Mn} = +7 \rightarrow +2$) oxidises Fe^{2+} ($\rightarrow \text{Fe}^{3+}$). Use oxidation-number changes to deduce the ratio of MnO_4^- to Fe^{2+} . [2]

3.5 Chlorine reacts with **cold dilute** sodium hydroxide:



(a) Give the oxidation number of chlorine in Cl_2 , in NaCl and in NaClO . [3]

(b) Explain why this reaction is described as disproportionation. [2]

(c) With **hot concentrated** sodium hydroxide the products are NaCl and NaClO_3 . Write the balanced equation and show that this reaction is also disproportionation. [4]

(d) Chlorine also displaces iodine from aqueous potassium iodide. Write the ionic equation, and identify the oxidising agent, explaining your choice. [3]

