

6.1 Redox processes: electron transfer and oxidation number

Name: _____ Class: _____ Date: _____

Total: 13 marks

KEY WORDS oxidation 氧化 • oxidising agent 氧化剂 • oxidation number 氧化数 • 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.

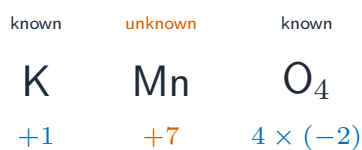
You must be able to:

- 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

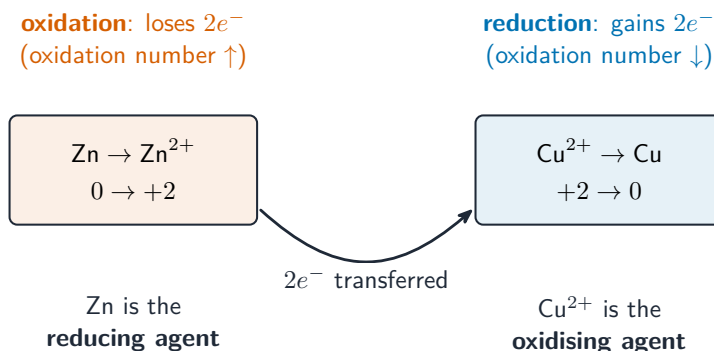
Rules: element = 0; simple ion = its charge; Group 1 = +1, Group 2 = +2; H = +1 (−1 in hydrides); O = −2 (−1 in peroxides); F = −1; sum to 0 (compound) or the charge (ion).



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)

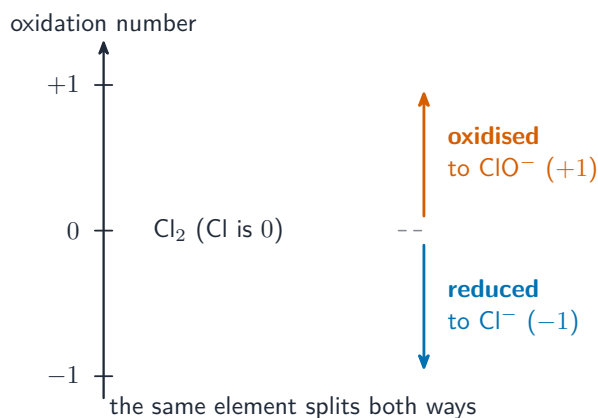
■ Redox — OIL RIG



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: $\text{Cl} (0) \rightarrow \text{ClO}^- (+1)$ and $\text{Cl}^- (-1)$

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** +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** 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]

Solutions

2.1 (a) S: $x + 4(-2) = -2 \Rightarrow x = +6$; (b) N: $x + 3(-2) = -1 \Rightarrow x = +5$.

2.2 loss; up.

3.1 B. $2x + 7(-2) = -2 \Rightarrow 2x = 12 \Rightarrow x = +6$.

3.2 A. Zn loses electrons (is oxidised), so it is the reducing agent.

3.3 (a) $\text{Cl}_2 = 0$; $\text{Cl}^- = -1$; $\text{ClO}^- = +1$.

(b) the same element (chlorine) is both oxidised ($0 \rightarrow +1$) and reduced ($0 \rightarrow -1$) in one reaction.

3.4 Mn falls by 5 ($+7 \rightarrow +2$); Fe rises by 1 ($+2 \rightarrow +3$); so 5 Fe^{2+} are needed per MnO_4^- — ratio 1 : 5.