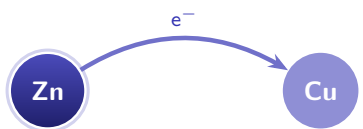
Electrochemistry

A-Level Chemistry ▪ Topic 6

A-Level Chemistry



What we will cover

1. Oxidation number
2. Redox & OIL RIG
3. Balancing redox equations
4. Disproportionation
5. Oxidising & reducing agents



redox pushes electrons round

1 Oxidation number and redox

Oxidation number

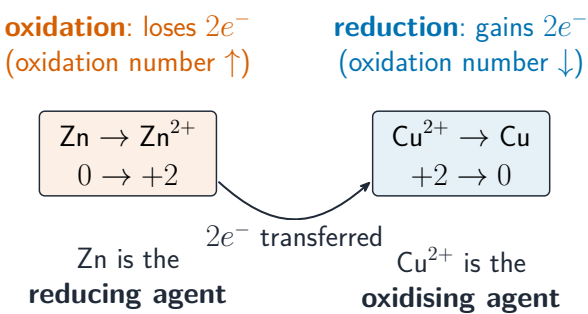
The **oxidation number** 氧化数 shows electrons lost or gained vs the free element.

- element $= 0$; simple ion $=$ its charge
- H $= +1$, O $= -2$, F $= -1$
- they sum to 0 (or the ion's charge)

known	unknown	known
K	Mn	O_4
$+1$	$+7$	$4 \times (-2)$

they sum to 0: $(+1) + \text{Mn} + (-8) = 0$, so $\text{Mn} = +7$

Redox and OIL RIG



A **redox** 氧化还原 reaction transfers electrons:

- **oxidation** 氧化 is loss (number up)
- **reduction** 还原 is gain (number down)

Remember **OIL RIG**; they always happen together.

Balancing redox equations

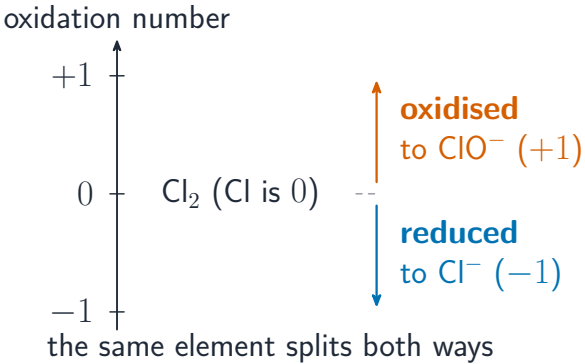
$Fe^{2+} \rightarrow Fe^{3+}$ $(+2 \rightarrow +3)$	oxidised: rises 1 $(\times 5)$
$MnO_4^- \rightarrow Mn^{2+}$ $(+7 \rightarrow +2)$	reduced: falls 5 $(\times 1)$

5 electrons lost $=$ 5 gained $\Rightarrow$ ratio **5 Fe^{2+} : 1 MnO_4^-**

Use oxidation-number changes:

> The total rise in oxidation number must equal the total fall (every electron lost is gained) – this fixes the ratio.

Disproportionation



Disproportionation 歧化 is when the same element is both oxidised and reduced at once. Chlorine $(0) \rightarrow \mathrm{ClO}^-\ (+1)$ *and* $\mathrm{Cl}^-\ (-1)$ in cold water.

Oxidising and reducing agents



- an **oxidising agent** 氧化剂 takes electrons – it is itself reduced
- a **reducing agent** 还原剂 gives electrons – it is itself oxidised

Rusting is the oxidation of iron by oxygen.

Exam tips

- Apply the oxidation-number rules in order: O is -2 **except** in peroxides (-1); H is $+1$ **except** in metal hydrides (-1).
- In a redox equation the **total increase equals the total decrease** in oxidation number – use this to fix the ratio, then balance O with H_2O and H with H^+.
- An **oxidising agent is itself reduced**; name both what is oxidised/reduced *and* the agent for full marks.
- **Disproportionation** is the same element both oxidised and reduced – show both oxidation-number changes.

2 Recap

Worked example – oxidation number

Find the oxidation number of sulfur in SO_4^{2-}.

- Let the oxidation number of S be x. Each O is -2.
- The numbers must add up to the ion's charge, -2:
- $x + 4(-2) = -2$
- $x = -2 + 8 = +6$.

Oxidation numbers sum to the charge (0 for a neutral compound). O is -2 and H is $+1$ – except in peroxides and metal hydrides.

Topic 6 – key takeaways

1 Oxidation number

electrons lost/gained vs the element

2 OIL RIG

oxidation is loss; reduction is gain

3 Balancing

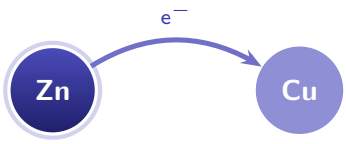
total rise = total fall

4 Agents

oxidising agent is reduced; reducing agent oxidised

Check yourself

1. Oxidation number of Mn in $KMnO_4$?
2. Does oxidation lose or gain electrons?
3. What is it called when one element is both oxidised and reduced?
4. An oxidising agent is itself what?



Answers **1.** $+7$ **2.** loses electrons **3.** disproportionation **4.** reduced