

Exercise walk-through

Oxidation-Reduction (Redox) Reactions ■ 4.9

eXercise

You must be able to

- assign **oxidation numbers** 氧化数
- identify what is **oxidized** (loses electrons) and **reduced** (gains electrons)
- name the **oxidizing** and **reducing agents**

Method — Oxidation numbers

Assign each atom an oxidation number: free element = 0; a monatomic ion = its charge; O usually -2 ; H usually $+1$; the sum equals the overall charge.

Method — OIL RIG

Oxidation **I**s **L**oss of electrons; **R**eduction **I**s **G**ain. Oxidation raises the oxidation number; reduction lowers it.

Method — A worked redox

$\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Zn}^{2+} + \text{Cu}$: Zn goes $0 \rightarrow +2$ (**oxidized**, loses e^-); Cu goes $+2 \rightarrow 0$ (**reduced**, gains e^-).

Method — Agents

The **reducing agent** is the species that is oxidized (it gives electrons away); the **oxidizing agent** is the species that is reduced (it takes electrons). Here Zn is the reducing agent, Cu^{2+} the oxidizing agent.

Practice 2.1 ■ 1 mark

State the oxidation number of an element in its free (uncombined) form.

Solution 2.1

Method: Oxidation numbers

Worked steps

0 **B1**.

Practice 2.2 ■ 2 marks

Find the oxidation number of S in SO_4^{2-} (O is -2).

Solution 2.2

Worked steps

$$S + 4(-2) = -2 \Rightarrow S = +6 \quad \text{M1} \quad \text{A1}.$$

Practice 2.3 ■ 1 mark

In $\text{Mg} \rightarrow \text{Mg}^{2+} + 2e^{-}$, is Mg oxidized or reduced?

Solution 2.3

Method: A worked redox

Worked steps

Oxidized (loses electrons) **B1**.

Exam-style 3.1 ■ 1 mark

Oxidation is defined as the

A gain of electrons

B loss of electrons

C gain of protons

D loss of protons

Solution 3.1

A gain of electrons

B loss of electrons



C gain of protons

D loss of protons

Worked steps

B — loss of electrons.

Exam-style 3.2 ■ 2 marks

Consider $\text{Fe} + \text{Cu}^{2+} \rightarrow \text{Fe}^{2+} + \text{Cu}$.

- (a) State the oxidation number change for Fe and for Cu.
- (b) Identify which is oxidized and which is reduced.

Solution 3.2

Method: A worked redox

Worked steps

(a) Fe: $0 \rightarrow +2$; Cu: $+2 \rightarrow 0$ **M1** **A1**. (b) Fe is oxidized; Cu^{2+} is reduced **M1** **A1**.

Exam-style 3.3 ■ 3 marks

For $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$, identify the oxidizing agent and the reducing agent.

Solution 3.3

Method: Agents

Worked steps

Zn is oxidized ($0 \rightarrow +2$), so Zn is the reducing agent **M1**; H^+ is reduced ($+1 \rightarrow 0$), so HCl is the oxidizing agent **M1 A1**.