

# 4.9 Oxidation-Reduction (Redox) Reactions

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Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 12 marks

## Objective

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Build the skills to answer exam questions on **oxidation-reduction (redox) reactions**.

**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**

## 1 Worked examples

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Study these first. Each one shows the method for a question type used later—follow the steps and you can do the Practice and Exam-style questions yourself.

### ■ 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.

### ■ OIL RIG

**Oxidation Is Loss** of electrons; **Reduction Is Gain**. Oxidation raises the oxidation number; reduction lowers it.

### ■ 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  $e^-$ ).

### ■ 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,  $\text{Cu}^{2+}$  the oxidizing agent.

## 2 Practice

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Now apply the methods above.

**2.1** State the oxidation number of an element in its free (uncombined) form. [1]

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**2.2** Find the oxidation number of S in  $\text{SO}_4^{2-}$  (O is  $-2$ ). [2]

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**2.3** In  $\text{Mg} \rightarrow \text{Mg}^{2+} + 2e^-$ , is Mg oxidized or reduced? [1]

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### 3 Exam-style questions

**3.1** Oxidation is defined as the [1]

- **A** gain of electrons
- **B** loss of electrons
- **C** gain of protons
- **D** loss of protons

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

(a) State the oxidation number change for Fe and for Cu. [2]

(b) Identify which is oxidized and which is reduced. [2]

**3.3** For  $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$ , identify the oxidizing agent and the reducing agent. [3]

## 4 Go further

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You are now ready for the real exam questions on this subtopic:

- work through the **4.9 Oxidation-Reduction (Redox) Reactions** lesson on the **Learn** page;
- read the **Oxidation-Reduction (Redox) Reactions** section of the AP Chemistry handout on the **Know** page.

## Solutions

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**2.1** 0.

**2.2**  $S + 4(-2) = -2 \Rightarrow S = +6$ .

**2.3** Oxidized (loses electrons).

**3.1 B** —loss of electrons.

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

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