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GCSE Chemistry: revision notes

# Reactivity and extracting metals

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## Start here: some metals react more than others

- Some metals react very quickly (potassium fizzes and melts on water); others hardly at all (gold stays shiny for thousands of years).
- Putting metals in order of how readily they react gives the **reactivity series**. A more reactive metal loses its outer electrons more easily, to form positive ions.
- A more reactive metal can push a less reactive metal out of its compound. This is a **displacement reaction**.

## Metals and oxygen

- Metals react with oxygen to form metal oxides, for example $2Mg + O_2 \rightarrow 2MgO$.
- **Oxidation** is the gain of oxygen. **Reduction** is the loss of oxygen.

## The reactivity series

- When metals react, their atoms form positive ions. The more easily a metal forms positive ions, the more reactive it is.
- Order, most reactive first: potassium, sodium, lithium, calcium, magnesium, aluminium, (carbon), zinc, iron, (hydrogen), copper, silver, gold.
- Potassium, sodium and lithium react with cold water; calcium reacts steadily; magnesium reacts very slowly with cold water.
- Metals above hydrogen react with dilute acids to make a salt and hydrogen; copper, silver and gold do not.

## Displacement reactions

- A more reactive metal displaces a less reactive metal from a compound.
- Example: magnesium + copper sulfate → magnesium sulfate + copper. The blue colour fades and brown copper forms.
- No reaction happens if the metal is less reactive than the metal in the compound, for example copper + zinc sulfate.

## Extracting metals

- Unreactive metals such as gold are found in the Earth as the metal itself. Most metals are found as compounds in ores, and must be extracted by chemical reactions.
- Metals less reactive than carbon, such as iron and zinc, can be extracted from their oxides by **reduction** with carbon: $2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$.
- Metals more reactive than carbon, such as aluminium, are extracted by electrolysis, which uses much more energy.

## Oxidation and reduction in terms of electrons (Higher)

- **Oxidation** is the loss of electrons; **reduction** is the gain of electrons (OIL RIG).
- In $Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$, magnesium is oxidised ($Mg \rightarrow Mg^{2+} + 2e^-$) and copper ions are reduced ($Cu^{2+} + 2e^- \rightarrow Cu$).
- Ionic equations leave out **spectator ions**, such as the sulfate ions, which don't change.

### Exam tip

- Link it to **extraction**: metals below carbon are reduced with carbon, and metals above it need electrolysis.
- Use OIL RIG: **oxidation** is loss of electrons, and **reduction** is gain of electrons.

### Common mistakes

- Saying a less reactive metal displaces a more reactive one.
- Mixing up **oxidation** and **reduction**.

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## Worked examples

**Does zinc react with copper sulfate solution? If it does, write the word equation.**

Compare their places in the reactivity series: zinc is above copper. **zinc is more reactive**

So zinc displaces copper from its compound. **zinc takes copper's place**

**Answer: Yes: zinc + copper sulfate → zinc sulfate + copper**

## Key terms

| | |
|---|---|
| **Reactivity series** | A list of metals in order of how readily they react. |
| **Oxidation** | The gain of oxygen, or (Higher) the loss of electrons. |
| **Reduction** | The loss of oxygen, or (Higher) the gain of electrons. |
| **Displacement reaction** | A reaction in which a more reactive metal takes the place of a less reactive metal in a compound. |
| **Ore** | A rock containing enough of a metal compound to make extraction worthwhile. |
| **Extraction** | Removing a metal from its ore. |
| **Redox reaction** | A reaction in which both oxidation and reduction happen. |
| **Spectator ion** | An ion that does not change during a reaction. |

## Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. Which metal is the most reactive?
2. What is oxidation, in terms of oxygen?
3. Which reaction happens?
4. How is iron extracted from iron oxide?
5. How is aluminium extracted?
6. Why is gold found as the metal itself?
7. What is seen when zinc is placed in copper sulfate solution?
8. What is oxidation, in terms of electrons? (Higher)

### Answers

1. Potassium
2. Gain of oxygen
3. Magnesium + copper sulfate
4. Reduction with carbon
5. Electrolysis
6. It is very unreactive
7. Brown copper forms and the blue colour fades

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8. Loss of electrons

## What to do next

**Practise 11 questions on this topic**

**Try 7 exam questions, with mark schemes**

**Read the lesson, one step at a time**

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