

Exercise walk-through

9.2

Periodicity of chemical properties of the elements in Period 3

A-Level Chemistry

Oxidation numbers



+1



+2



+3



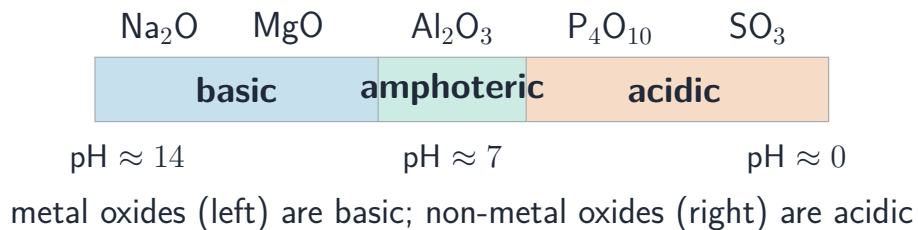
+5



+6

The **oxidation number** rises across the period – it equals the **valence** electrons used in bonding. The chlorides show the same +1 to +5 rise.

Oxides: acid–base behaviour



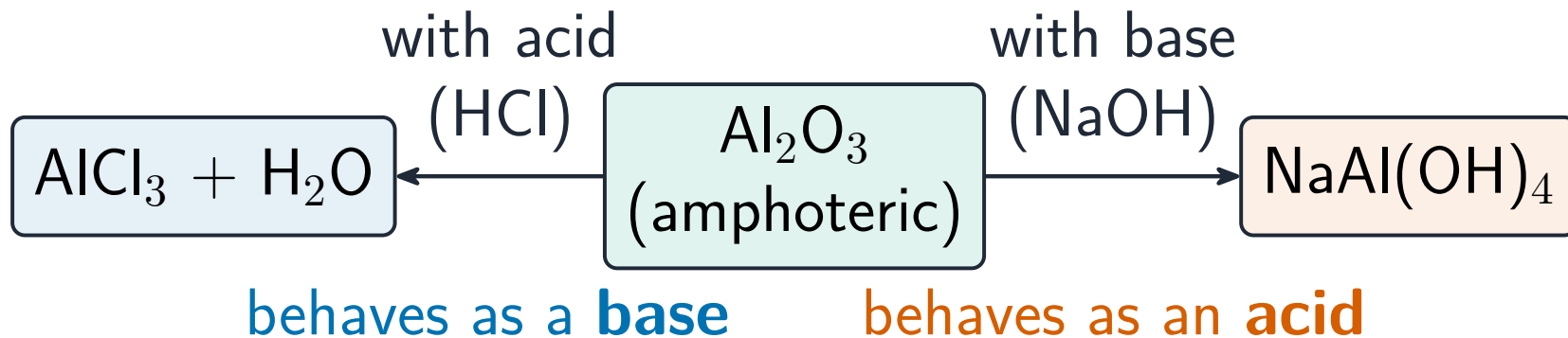
The oxides change across the period:

- metal oxides (Na, Mg) – basic
- Al_2O_3 – amphoteric
- non-metal oxides (P, S) – acidic

Amphoteric aluminium oxide

Al_2O_3 and its **hydroxide oxide** is **amphoteric**

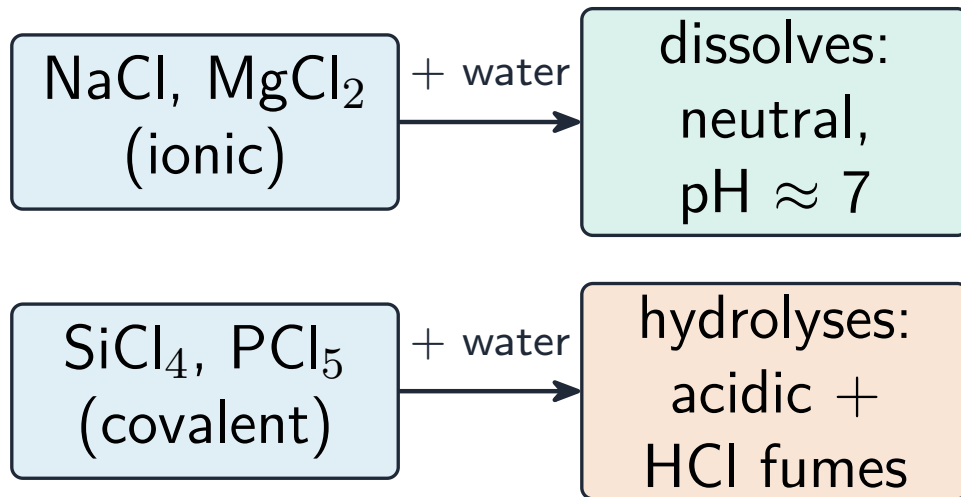
$\text{Al}(\text{OH})_3$ react with **both** acids and bases. **Aluminium** – it reacts with **both** acids and bases. With acid it behaves as a base; with base it behaves as an acid.



Chlorides with water

The chlorides undergo **hydrolysis** – they react with water – giving acidic solutions and fumes of HCl.

- ionic chlorides (NaCl , MgCl_2) just dissolve – near-neutral
- covalent chlorides (SiCl_4 , PCl_5) **hydrolyse** – acidic + HCl fumes



Explaining the trends

These trends follow from the change in bonding and **electronegativity** .

On the left, the elements are metals with low electronegativity, so their oxides and chlorides are ionic and basic (or neutral).

Exercises 2.1·2.2

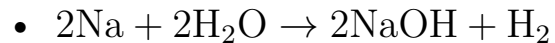
2.1 Write the equation for the reaction of sodium with water. [1]

2.2 State the acid–base nature of (a) MgO and (b) SO_3 . [2]

Exercises 2.1·2.2

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2.1



2.2 State the acid–base nature of (a) MgO and (b) SO₃. [2]

2.2

(a)

- basic

(b)

- (strongly) acidic

Exercises 3.1·3.2

3.1 Which Period 3 oxide is amphoteric?

[1]

☐

A Na_2O

B MgO

C Al_2O_3

D SO_3

3.2 When PCl_5 is added to water, the solution formed is:

[1]

☐

A strongly alkaline

B neutral

C acidic, with HCl fumes

D unchanged (no reaction)

Exercises 3.1-3.2

3.1 Which Period 3 oxide is amphoteric?

[1]

- ☐ **A** Na_2O
B MgO
C Al_2O_3
D SO_3

3.1 C

- Al_2O_3 is amphoteric

3.2 When PCl_5 is added to water, the solution formed is:

[1]

- ☐ **A** strongly alkaline
B neutral
C acidic, with HCl fumes
D unchanged (no reaction)

3.2 C

- PCl_5 hydrolyses to an acidic solution and HCl fumes

Exercise 3.3

3.3 (a) Write an equation for the reaction of sulfur trioxide, SO_3 , with water, and state the approximate pH. [2]

(b) Explain what is meant by Al_2O_3 being **amphoteric**, and write an equation for its reaction with hydrochloric acid. [3]

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3.3

(a)

- $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$; pH 0–1

(b)

- amphoteric = reacts with both acids and bases; $\text{Al}_2\text{O}_3 + 6\text{HCl} \rightarrow 2\text{AlCl}_3 + 3\text{H}_2\text{O}$

Exercise 3.4

3.4 Explain why sodium chloride dissolves to give a neutral solution but silicon(IV) chloride gives an acidic solution. [3]

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- NaCl is ionic, so it just dissolves to give ions and a neutral solution; SiCl₄ is covalent and is hydrolysed by water, releasing HCl which makes the solution acidic