

Exercise walk-through

Periodicity of chemical properties of the elements in Period 3 ■ 9.2

eXercise

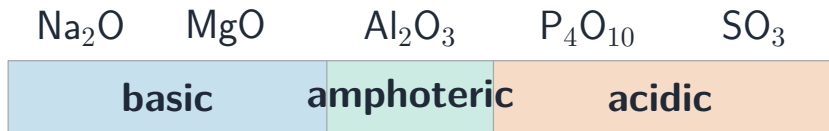
You must be able to

- write equations for the reactions with oxygen, chlorine and water
- explain the acid–base behaviour of the oxides (including amphoteric Al_2O_3)
- explain the reactions of the chlorides with water and the pH obtained

Method — Oxides: acid–base trend

Na O, MgO are **basic** ($\text{Na O} + \text{H O} \rightarrow 2\text{NaOH}$, pH 13–14). P O , SO are **acidic** ($\text{SO} + \text{H O} \rightarrow \text{H SO}$, pH 0–1). The oxidation number rises across (Na O +1 ... SO +6) = the outer-shell electrons used.

Method — Oxides: acid–base trend



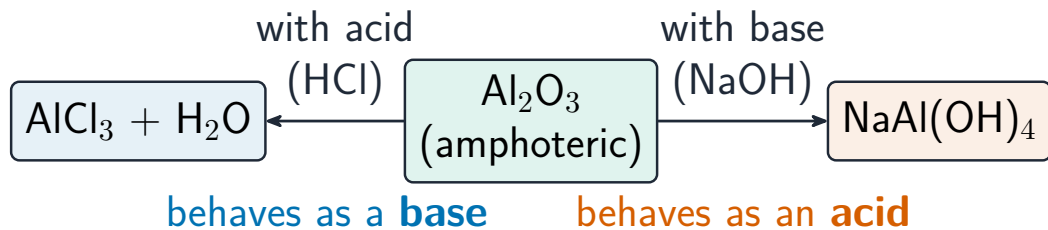
pH $\approx$ 14

pH $\approx$ 7

pH $\approx$ 0

metal oxides (left) are basic; non-metal oxides (right) are acidic

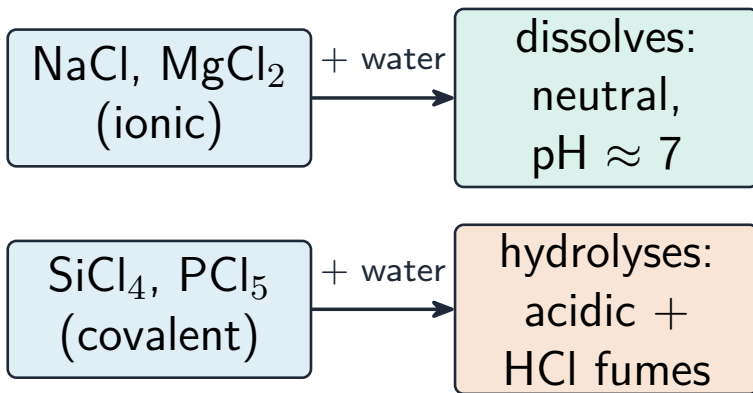
Method — Oxides: acid–base trend



Aluminium oxide reacting with acid on one side and base on the other

Method — Chlorides with water

E.g. $\text{SiCl}_4 + 2\text{H}_2\text{O} \rightarrow \text{SiO}_2 + 4\text{HCl}$.

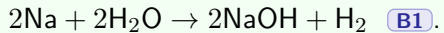


Practice 2.1 ■ 1 mark

Write the equation for the reaction of sodium with water.

Solution 2.1

Worked steps



Practice 2.2 ■ 2 marks

State the acid–base nature of (a) MgO and (b) SO_2 .

Solution 2.2

Method: Oxides: acid–base trend

Worked steps

(a) basic; (b) (strongly) acidic **B1** *each*.

Exam-style 3.1 ■ 1 mark

Which Period 3 oxide is amphoteric?

A Na O

B MgO

C Al O

D SO

Solution 3.1

Method: Oxides: acid–base trend

A Na O

B MgO

C Al O



D SO

Worked steps

C. Al O is amphoteric.

Exam-style 3.2 ■ 1 mark

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

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

Solution 3.2

Method: Chlorides with water

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

Worked steps

C. PCl_5 hydrolyses to an acidic solution and HCl fumes.

Exam-style 3.3 ■ 2 marks

- (a) Write an equation for the reaction of sulfur trioxide, SO_3 , with water, and state the approximate pH.
- (b) Explain what is meant by Al_2O_3 being **amphoteric**, and write an equation for its reaction with hydrochloric acid.

Solution 3.3

Method: Oxides: acid–base trend

Worked steps

(a) $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$ **B1**; pH 0–1 **B1**.

(b) amphoteric = reacts with both acids and bases **M1**; $\text{Al}_2\text{O}_3 + 6\text{HCl} \rightarrow 2\text{AlCl}_3 + 3\text{H}_2\text{O}$ **M1** **A1**.

Exam-style 3.4 ■ 3 marks

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

Solution 3.4

Method: Chlorides with water

Worked steps

NaCl is ionic, so it just dissolves to give ions and a neutral solution **M1**; SiCl₄ is covalent and is hydrolysed by water **M1**, releasing HCl which makes the solution acidic **A1**.