

Chemical Periodicity

A-Level Chemistry ■ Topic 9

A-Level Chemistry



Chemical Periodicity

What we will cover

- 1 Atomic radius
- 2 Melting point & structure
- 3 Oxidation numbers
- 4 Oxides: acid-base
- 5 Amphoteric Al_2O_3
- 6 Chlorides with water



properties repeat in periods

1 Physical properties

Chemical Periodicity

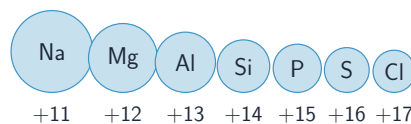
Physical properties

Atomic radius across Period 3

Periodicity 周期性: properties repeat across each **period** 周期.

Atomic radius 原子半径 *decreases* across Period 3 – the rising **nuclear charge** 核电荷 pulls the same outer shell inwards.

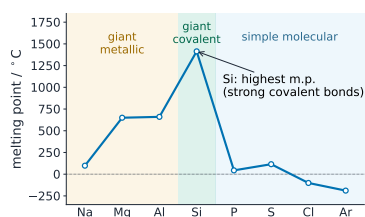
atomic radius decreases as nuclear charge increases



Chemical Periodicity

Physical properties

Melting point and structure

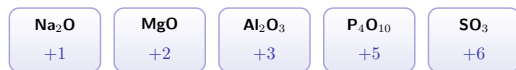


Melting point peaks at silicon:

- Na, Mg, Al – **giant metallic** 金属晶体, conduct
- Si – **giant covalent** 原子晶体, highest m.p.
- P, S, Cl, Ar – **simple molecular** 分子晶体, low m.p.

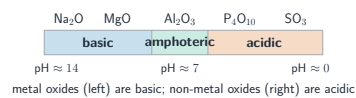
2 Chemical properties

Oxidation numbers



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

Oxides: acid–base behaviour

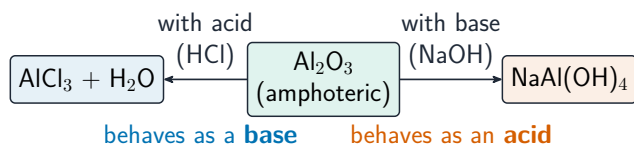


The oxides change across the period:

- metal oxides (Na, Mg) – **basic**
- Al_2O_3 – **amphoteric** 两性
- non-metal oxides (P, S) – **acidic**

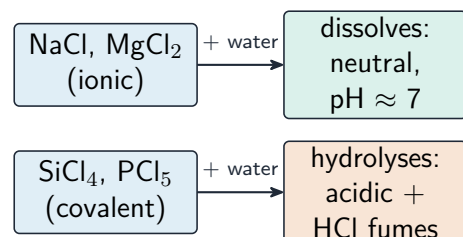
Amphoteric aluminium oxide

Aluminium oxide 氧化铝 is **amphoteric** 两性 – it reacts with **both** acids and bases. With acid it behaves as a base; with base it behaves as an acid.



Chlorides with water

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



3 Recap

Worked example – melting points across Period 3

Explain why the melting point rises Na → Al, peaks at Si, then falls sharply at P.

- Na, Mg, Al: **giant metallic**. Charge goes +1 → +3 and more electrons delocalise, so attraction grows.
- Si: **giant covalent**. Many strong covalent bonds must break ⇒ the peak.
- P: **simple molecular** (P_4). Only weak **induced-dipole forces** 诱导偶极力 break.
- So the drop is **giant** → **simple**, not a change in bond strength.

Melting point follows the **structure**, not the atom. Giant (metallic or covalent) ⇒ high; simple molecular ⇒ low.

Topic 9 – key takeaways

1 Radius

decreases across the period

2 Melting point

peaks at silicon (giant covalent)

3 Oxides

basic → amphoteric → acidic

4 Chlorides

ionic dissolve; covalent hydrolyse

Check yourself

- 1 Which Period 3 element has the highest melting point?
- 2 Which oxide is amphoteric?
- 3 Is Na_2O acidic or basic?
- 4 What do covalent chlorides do in water?



Answers 1. silicon 2. Al_2O_3 3. basic 4. hydrolyse to an acidic solution