Exercise walk-through

Periodicity of physical properties of the elements in Period 3 ▪ 9.1

eXercise

You must be able to

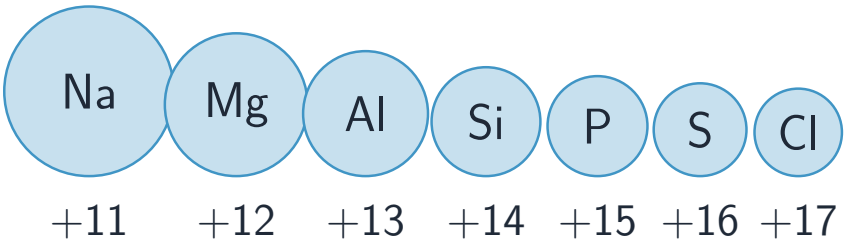
- describe the trends in atomic/ionic radius, melting point and conductivity across Period 3
- explain the melting point and conductivity trends in terms of structure and bonding

Method — Trends across Period 3

- **Na, Mg, Al — giant metallic**: m.p. rises (more delocalised electrons, smaller ions); conduct well.
- **Si — giant covalent**: highest m.p. (strong covalent bonds); barely conducts.
- **P, S, Cl, Ar — simple molecular**: low m.p. (weak forces); do not conduct.

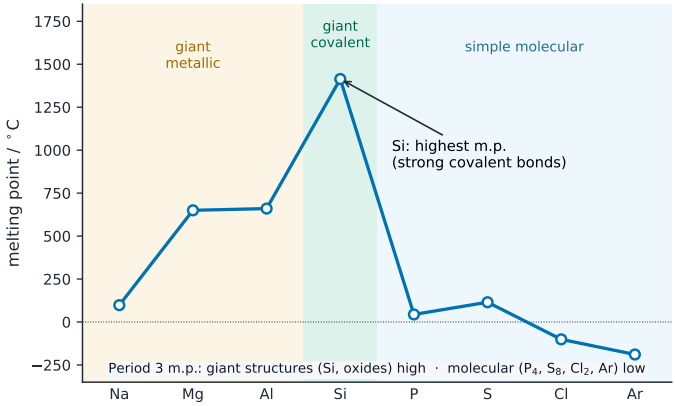
Method — Trends across Period 3

atomic radius decreases as nuclear charge increases



A row of atoms from Na to Cl shrinking left to right as nuclear charge rises

Method — Trends across Period 3



A graph of melting point across Period 3 peaking sharply at silicon

Practice 2.1 ▪ 1 mark

Describe the trend in atomic radius across Period 3.

Solution 2.1

Method: Trends across Period 3

Worked steps

it decreases across the period B1.

Practice 2.2 ▪ 2 marks

State which Period 3 element has the highest melting point and what type of structure it has.

Solution 2.2

Method: Trends across Period 3

Worked steps

silicon **B1**; giant covalent / giant molecular **B1**.

Exam-style 3.1 ▪ 1 mark

Why do Na, Mg and Al conduct electricity well?

A they are simple molecular

B they have delocalised electrons (giant metallic)

C they have covalent networks

D they have low melting points

Solution 3.1

Method: Trends across Period 3

A they are simple molecular

B they have delocalised electrons (giant metallic) ✓

C they have covalent networks

D they have low melting points

Worked steps

B. Giant metallic structures have delocalised electrons that conduct.

Exam-style 3.2 ▪ 1 mark

Why does silicon have the highest melting point in Period 3?

A it is a metal

B strong covalent bonds throughout a giant structure must be broken

C it has the most delocalised electrons

D only weak forces hold it together

Solution 3.2

Method: Trends across Period 3

A it is a metal

B strong covalent bonds throughout a giant structure must be broken ✓

C it has the most delocalised electrons

D only weak forces hold it together

Worked steps

B. Silicon is a giant covalent structure with strong bonds throughout.

Exam-style 3.3 ▪ 3 marks

Explain why the melting point increases from sodium to aluminium.

Solution 3.3

Method: Trends across Period 3

Worked steps

from Na to Al each atom releases more delocalised electrons ($1 \rightarrow 3$) **M1**; and the metal ions get smaller with higher charge **M1**; so the metallic bonding is stronger, needing more energy to melt **A1**.

Exam-style 3.4 ▪ 2 marks

Explain why the melting point of sulfur (S) is higher than that of phosphorus (P).

Solution 3.4

Method: Trends across Period 3

Worked steps

sulfur exists as larger S_8 molecules with more electrons than P_4 (M1); so it has stronger London (van der Waals) forces, giving a higher melting point (A1).