

9.1 Periodicity of physical properties of Period 3

Name: _____ Class: _____ Date: _____ **Total: 22 marks**

KEY WORDS melting point 熔点 • ionic radius 离子半径 • atomic radius 原子半径
• electrical conductivity 导电性 • period 周期

Objective

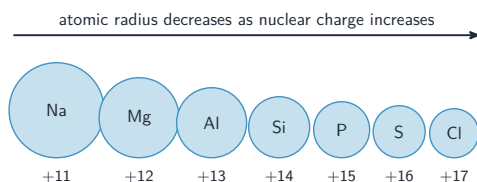
Build the skills to answer exam questions on the **physical properties of Period 3** — the trends in **atomic radius** 原子半径, **melting point** 熔点 and **electrical conductivity** 导电性, explained by structure and bonding.

You must be able to:

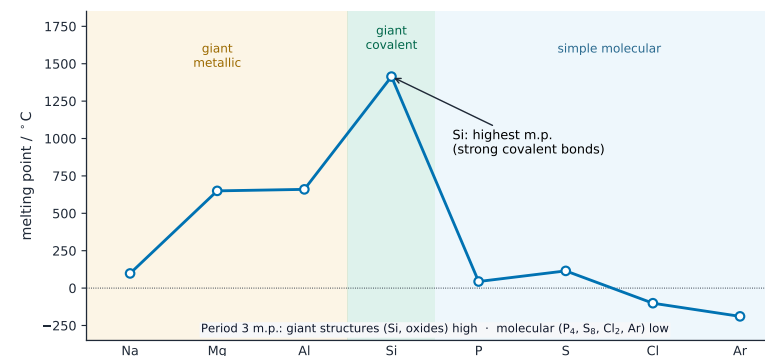
- describe the trends in atomic/ionic radius, melting point and conductivity across Period 3
- explain the melting point and conductivity trends in terms of structure and bonding

1 Worked examples

■ Trends across Period 3



Atomic radius decreases across the period: rising nuclear charge pulls the same outer shell inwards



Melting point peaks at silicon (giant covalent); high for the metals, low for the simple molecular elements

- 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.

2 Practice

2.1 Describe the trend in atomic radius across Period 3. [1]

2.2 State which Period 3 element has the highest melting point and what type of structure it has. [2]

3 Exam-style questions

3.1 Why do Na, Mg and Al conduct electricity well? [1]

- | | |
|---|---|
| A | B |
| C | D |
- A they are simple molecular
 - B they have delocalised electrons (giant metallic)
 - C they have covalent networks
 - D they have low melting points

3.2 Why does silicon have the highest melting point in Period 3? [1]

- | | |
|---|---|
| A | B |
| C | D |
- 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

3.3 Explain why the melting point increases from sodium to aluminium. [3]

3.4 Explain why the melting point of sulfur (S_8) is higher than that of phosphorus (P_4). [2]

3.5 The table gives the melting points of four Period 3 elements.

Element	Na	Al	Si	S
Melting point / K	371	933	1687	392

(a) Explain, in terms of structure and bonding, why the melting point rises from Na to Al. [3]

(b) Explain why silicon's melting point is far higher than any of the others. [3]

(c) Sulfur exists as S_8 molecules and phosphorus as P_4 . Explain why sulfur's melting point is low, yet higher than that of phosphorus (317 K). [3]

(d) State and explain the trend in atomic radius across Period 3. [3]
