16 The atomic radii and ionic radii for three elements in Period 3 are shown.

	atomic radius / nm	ionic radius / nm
element X	0.118	0.053
element Y	0.099	0.180
element Z	0.160	0.072

Using this data, which statement is correct?

A Element X has lower electrical conductivity than element Y.

B Element Y has a higher melting point than element X.

C Element Y and element Z react to form an ionic compound.

D Element Z forms ionic compounds by gaining electrons.

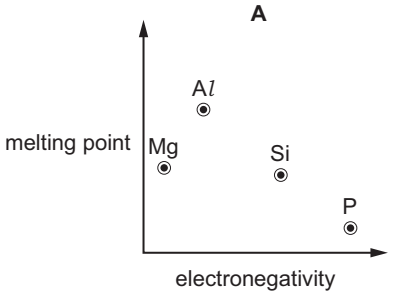
17 Sodium and sulfur react together to form sodium sulfide, Na_2S.

How do the atomic radius and ionic radius of sodium compare with those of sulfur?

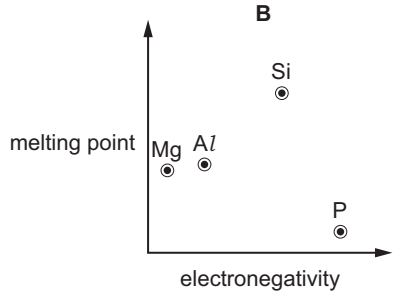
	atomic radius	ionic radius
A	sulfur is greater	sodium is greater
B	sulfur is greater	sulfur is greater
C	sodium is greater	sodium is greater
D	sodium is greater	sulfur is greater

17 Which graph shows the relative melting points of the elements Mg, Al, Si and P plotted against their relative electronegativities?

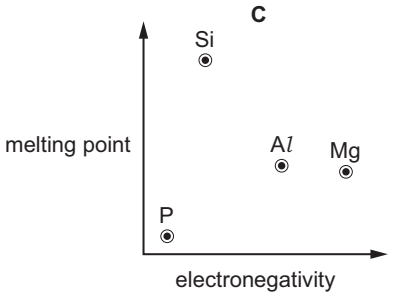
A



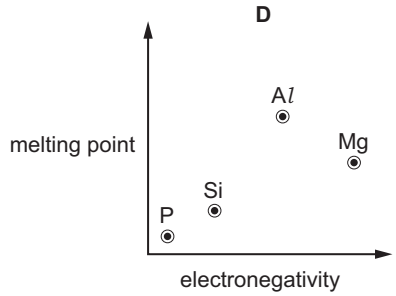
B



C



D



2 The Period 3 elements show trends in physical and chemical properties across the period.

(a) Fig. 2.1 shows the variation in atomic and ionic radii of the Period 3 elements Na to C*l*.

The ionic radius of Si is **not** shown.

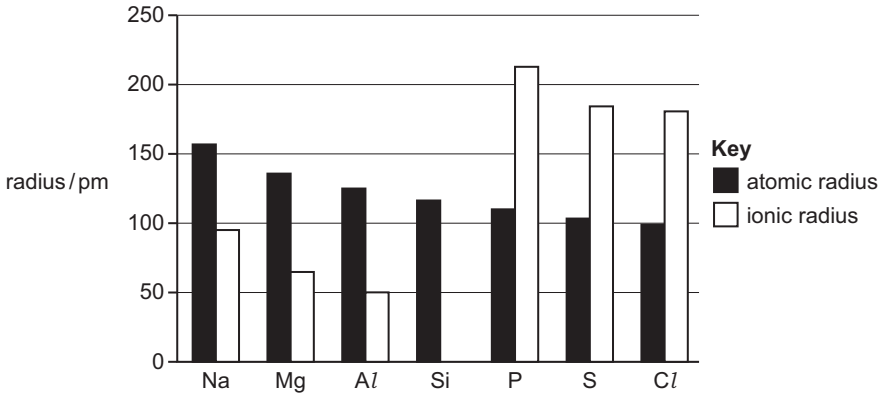


Fig. 2.1

(i) Explain the trend shown in the atomic radii of the Period 3 elements Na to C*l*.

.....

.....

.....

..... [2]

(ii) Explain why there is a large difference in the ionic radii of A*l* and P.

.....

.....

.....

..... [2]

(b) Table 2.1 gives some information about some of the Period 3 oxides.

Row B gives the pH of the solution that forms when the Period 3 oxide is added to water.

Table 2.1

	formula of Period 3 oxide	Na_2O	MgO	Al_2O_3	SiO_2	P_4O_{10}	SO_3
A	oxidation number of Period 3 element			+3			
B	pH of solution			—	—		

(i) Complete Table 2.1. [2]

(ii) State why there is no data given in row B for Al_2O_3 and SiO_2.

..... [1]

(c) **(i)** Write an equation for the reaction of Na_2O with dilute hydrochloric acid.

..... [1]

(ii) Construct an equation for the reaction of Al_2O_3 with a base to form $NaAlO_2$.

..... [1]

(d) Group 2 nitrates decompose on heating to form oxides.

(i) State the trend in thermal stability of the Group 2 nitrates down the group.

..... [1]

(ii) Identify the other products of the thermal decomposition of Group 2 nitrates.

..... [1]

[Total: 11]

2 The Period 3 elements show trends in physical and chemical properties across the period.

(a) (i) Explain why the elements Na to A*l* are good electrical conductors.

.....

..... [1]

(ii) Explain why the elements P, S and C*l* do not conduct electricity.

.....

..... [1]

(b) Fig. 2.1 shows the variation in melting point of the Period 3 elements Si to C*l*.

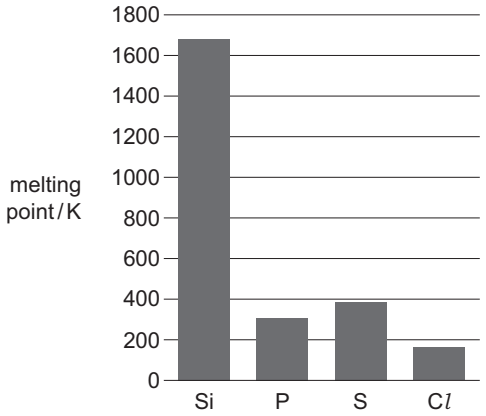


Fig. 2.1

The Period 3 elements Si to C*l* are all non-metals.

Explain why there is a large difference between the melting point of Si and the melting points of P, S and C*l*.

.....

.....

.....

..... [2]

(c) Table 2.1 gives some information about some Period 3 chlorides.

Row B refers to the pH of the solution that forms when the Period 3 chloride is added to water.

Table 2.1

	formula of Period 3 chloride	NaC*l*	MgCl_2	A*l*Cl_3	SiCl_4	PCl_5
A	oxidation number of element bonded to C*l*					
B	pH of solution		6.5			
C	bonding			ionic		
D	structure			giant		

Complete Table 2.1.

You may use the following abbreviations.

I = ionic, C = covalent, M = metallic
G = giant, S = simple

[4]

(d) (i) Write an equation for the formation of A*l*Cl_3 from its elements.

.....

..... [1]

(ii) Write an equation for the formation of H_3PO_4 from PCl_5.

..... [1]

(e) S_2Cl_2(l) reacts with Cl_2(g) in a reversible reaction to form SCl_2(l). Under certain conditions, a dynamic equilibrium is established.

$$S_2Cl_2(l) + Cl_2(g) \rightleftharpoons 2SCl_2(l) \qquad \Delta H = -41\,kJ\,mol^{-1}$$

(i) State what is meant by dynamic equilibrium.

.....

..... [1]

(ii) Identify the condition necessary to establish dynamic equilibrium.

..... [1]

(iii) $S_2Cl_2(l)$ is yellow and $SCl_2(l)$ is red.

$$S_2Cl_2(l) + Cl_2(g) \rightleftharpoons 2SCl_2(l) \qquad \Delta H = -41\,kJ\,mol^{-1}$$

State what is observed when the following changes are made to an equilibrium mixture of $S_2Cl_2(l)$ and $SCl_2(l)$.

Explain your answers.

- The equilibrium mixture is warmed gently.

  observation .....

  explanation .....

  .....

  .....

- The overall pressure of the equilibrium mixture is increased.

  observation .....

  explanation .....

  .....

  .....

[4]

(f) Aqueous $MgCl_2$ reacts with aqueous Na_2CO_3 to form a white precipitate. Upon heating, the white precipitate undergoes thermal decomposition.

(i) Construct an equation to show the reaction of aqueous $MgCl_2$ with aqueous Na_2CO_3. Use state symbols in your equation.

..... [2]

(ii) Identify the products of the thermal decomposition of the white precipitate.

..... [1]

(iii) State the trend in thermal stability of the Group 2 carbonates down the group.

..... [1]

[Total: 20]