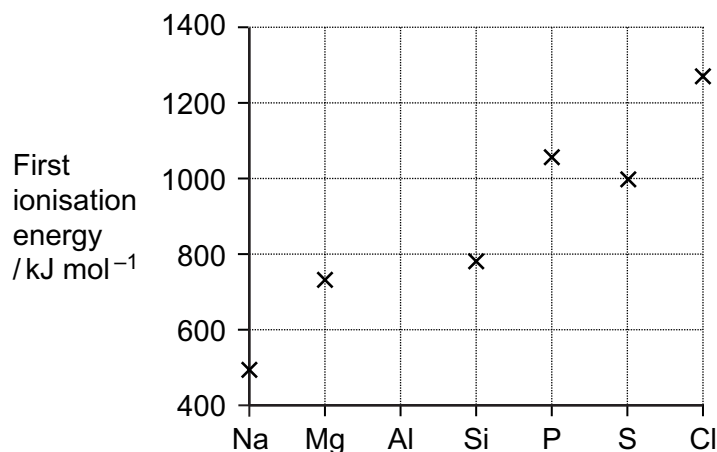


# Periodicity

- 2 The following diagram shows the first ionisation energies of some Period 3 elements.



- 2 (a) Draw a cross on the diagram to show the first ionisation energy of aluminium. (1 mark)

- 2 (b) Write an equation to show the process that occurs when the first ionisation energy of aluminium is measured.

..... (2 marks)

- 2 (c) State which of the first, second or third ionisations of aluminium would produce an ion with the electron configuration  $1s^2 2s^2 2p^6 3s^1$

..... (1 mark)

- 2 (d) Explain why the value of the first ionisation energy of sulfur is less than the value of the first ionisation energy of phosphorus.

.....  
 .....  
 .....  
 .....  
 ..... (2 marks)

(Extra space) .....  
 .....



- 2 (e)** Identify the element in Period 2 that has the highest first ionisation energy and give its electron configuration.

Element .....

Electron configuration .....

(2 marks)

- 2 (f)** State the trend in first ionisation energies in Group 2 from beryllium to barium. Explain your answer in terms of a suitable model of atomic structure.

Trend.....

Explanation .....

.....

.....

.....

(3 marks)

(Extra space) .....

.....

11
----

**Turn over for the next question**

**Turn over ►**



- 1 (c) State and explain the general trend in the first ionisation energies of the Period 3 elements sodium to chlorine.

Trend .....

Explanation .....

.....

.....

(3 marks)

(Extra space) .....

.....

.....

- 1 (d) State how the element sulfur deviates from the general trend in first ionisation energies across Period 3. Explain your answer.

How sulfur deviates from the trend .....

.....

Explanation .....

.....

.....

(3 marks)

(Extra space) .....

.....

.....

- 1 (e) A general trend exists in the first ionisation energies of the Period 2 elements lithium to fluorine. Identify **one** element which deviates from this general trend.

.....

(1 mark)



**5** This question is about the first ionisation energies of some elements in the Periodic Table.

**5 (a)** Write an equation, including state symbols, to show the reaction that occurs when the first ionisation energy of lithium is measured.

.....  
(1 mark)

**5 (b)** State and explain the general trend in first ionisation energies for the Period 3 elements aluminium to argon.

Trend .....

Explanation .....

.....  
.....  
(3 marks)

(Extra space).....

.....

**5 (c)** There is a similar general trend in first ionisation energies for the Period 4 elements gallium to krypton. State how selenium deviates from this general trend and explain your answer.

How selenium deviates from this trend .....

Explanation .....

.....  
.....  
(3 marks)

(Extra space).....

.....

**5 (d)** Suggest why the first ionisation energy of krypton is lower than the first ionisation energy of argon.

.....  
.....  
(1 mark)



5 (e) The table below gives the successive ionisation energies of an element.

	First	Second	Third	Fourth	Fifth
Ionisation energy / $\text{kJ mol}^{-1}$	590	1150	4940	6480	8120

Deduce the group in the Periodic Table that contains this element.

.....  
(1 mark)

5 (f) Identify the element that has a 5+ ion with an electron configuration of  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$

.....  
(1 mark)

Turn over for the next question

10
----

Turn over ►



**Section B**

Answer **all** questions in the spaces provided.

**5** The following table gives the melting points of some elements in Period 3.

Element	Na	Al	Si	P	S
Melting point / K	371	933	1680	317	392

**5 (a)** State the type of structure shown by a crystal of silicon.  
Explain why the melting point of silicon is very high.

.....  
.....  
.....  
.....

(3 marks)

(Extra space) .....

.....  
.....

**5 (b)** State the type of structure shown by crystals of sulfur and phosphorus.  
Explain why the melting point of sulfur is higher than the melting point of phosphorus.

.....  
.....  
.....  
.....

(3 marks)

(Extra space) .....

.....  
.....



**5 (c)** Draw a diagram to show how the particles are arranged in aluminium and explain why aluminium is malleable.  
(You should show a minimum of six aluminium particles arranged in two dimensions.)

.....

.....

.....

.....

.....

.....

(3 marks)

(Extra space) .....

.....

.....

**5 (d)** Explain why the melting point of aluminium is higher than the melting point of sodium.

.....

.....

.....

.....

.....

.....

(3 marks)

(Extra space) .....

.....

.....

12
----

Turn over ►





**2** Trends in physical properties occur across all Periods in the Periodic Table. This question is about trends in the Period 2 elements from lithium to nitrogen.

**2 (a)** Identify, from the Period 2 elements lithium to nitrogen, the element that has the largest atomic radius.

.....  
(1 mark)

**2 (b) (i)** State the general trend in first ionisation energies for the Period 2 elements lithium to nitrogen.

.....  
(1 mark)

**2 (b) (ii)** Identify the element that deviates from this general trend, from lithium to nitrogen, and explain your answer.

Element .....

Explanation .....

.....

.....  
(3 marks)

(Extra space) .....

.....

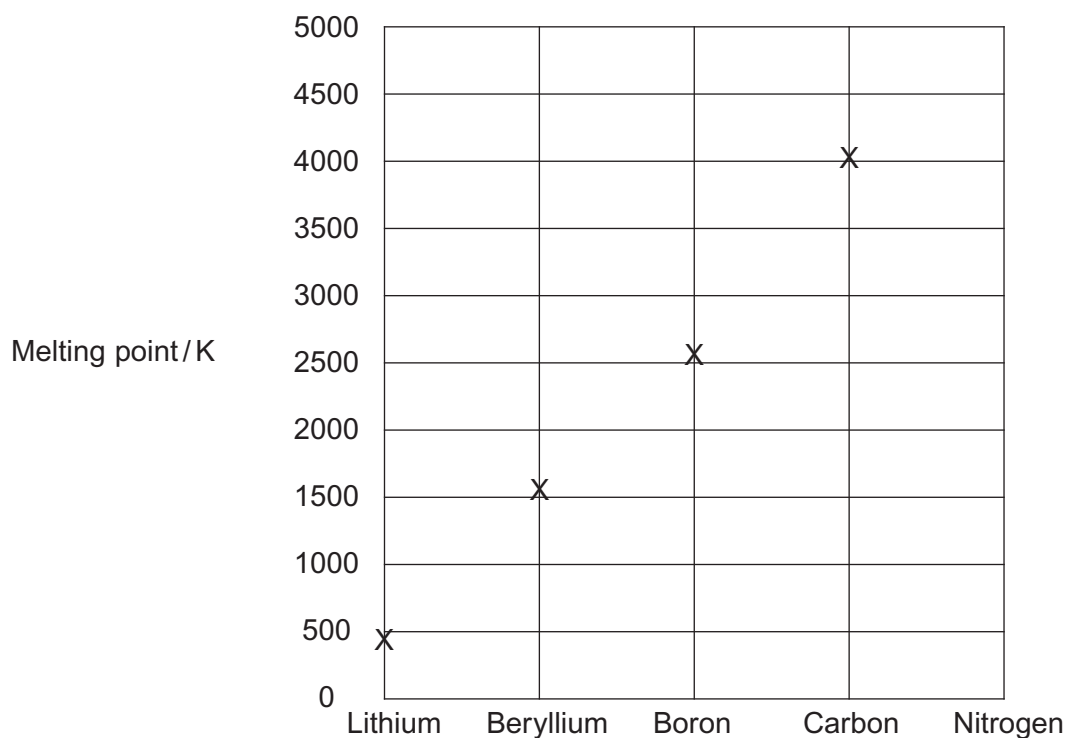
**2 (c)** Identify the Period 2 element that has the following successive ionisation energies.

	First	Second	Third	Fourth	Fifth	Sixth
Ionisation energy / kJ mol <sup>-1</sup>	1090	2350	4610	6220	37 800	47 000

.....  
(1 mark)



2 (d) Draw a cross on the diagram to show the melting point of nitrogen.



(1 mark)

2 (e) Explain, in terms of structure and bonding, why the melting point of carbon is high.

.....

.....

.....

.....

.....

.....

(3 marks)

(Extra space) .....

.....

.....

10

Turn over ►



**6** The elements in Period 2 show periodic trends.

**6 (a)** Identify the Period 2 element, from carbon to fluorine, that has the largest atomic radius. Explain your answer.

Element .....

Explanation .....

.....

.....

.....

(3 marks)

**6 (b)** State the general trend in first ionisation energies from carbon to neon. Deduce the element that deviates from this trend and explain why this element deviates from the trend.

Trend .....

Element that deviates .....

Explanation .....

.....

.....

.....

(4 marks)

**6 (c)** Write an equation, including state symbols, for the reaction that occurs when the first ionisation energy of carbon is measured.

.....

(1 mark)



- 6 (d)** Explain why the second ionisation energy of carbon is higher than the first ionisation energy of carbon.

.....

.....

.....

.....

(1 mark)

- 6 (e)** Deduce the element in Period 2, from lithium to neon, that has the highest second ionisation energy.

.....

(1 mark)

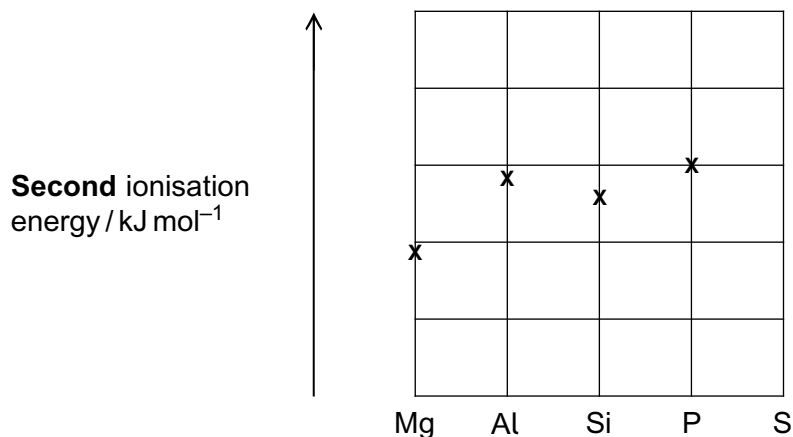
10
----

**Turn over for the next question**

**Turn over ►**



- 2 (a)** Use your knowledge of electron configuration and ionisation energies to answer this question.  
The following diagram shows the **second** ionisation energies of some Period 3 elements.



- 2 (a) (i)** Draw an 'X' on the diagram to show the **second** ionisation energy of sulfur. (1 mark)

- 2 (a) (ii)** Write the full electron configuration of the  $\text{Al}^{2+}$  ion.

..... (1 mark)

- 2 (a) (iii)** Write an equation to show the process that occurs when the **second** ionisation energy of aluminium is measured.

..... (1 mark)

- 2 (a) (iv)** Give **one** reason why the **second** ionisation energy of silicon is lower than the **second** ionisation energy of aluminium.

.....  
 .....  
 ..... (1 mark)



- 2 (b)** Predict the element in Period 3 that has the highest **second** ionisation energy. Give a reason for your answer.

Element .....

Reason .....

.....

.....

(2 marks)

- 2 (c)** The following table gives the successive ionisation energies of an element in Period 3.

	First	Second	Third	Fourth	Fifth	Sixth
Ionisation energy / kJ mol <sup>-1</sup>	786	1580	3230	4360	16 100	19 800

Identify this element.

.....

(1 mark)

- 2 (d)** Explain why the ionisation energy of every element is endothermic.

.....

.....

.....

(1 mark)

(Extra space) .....

.....

8

Turn over ►



**Section A**Answer **all** questions in the spaces provided.

**1** This question is about the elements in Period 3 of the Periodic Table.

**1 (a)** State the element in Period 3 that has the highest melting point.  
Explain your answer.

**[3 marks]**

Element .....

Explanation .....

.....

.....

.....

.....

**1 (b)** State the element in Period 3 that has the highest first ionisation energy.  
Explain your answer.

**[3 marks]**

Element .....

Explanation .....

.....

.....

.....

.....

**1 (c)** Suggest the element in Period 3 that has the highest electronegativity value.

**[1 mark]**

.....



**Section B**

Answer **all** questions in the spaces provided.

**5** This question is about the periodicity of the Period 3 elements.

**5 (a)** State and explain the general trend in first ionisation energy across Period 3.

**[4 marks]**

---

---

---

---

---

---

---

---

---

---

**5 (b)** Give one example of an element which deviates from the general trend in first ionisation energy across Period 3.

Explain why this deviation occurs.

**[3 marks]**

---

---

---

---

---

---

---

---

**Turn over ►**





5 (c) Table 3 shows successive ionisation energies of an element Y in Period 3.

Table 3

Ionisation number	1	2	3	4	5	6	7	8
Ionisation energy / kJ mol <sup>-1</sup>	1000	2260	3390	4540	6990	8490	27 100	31 700

Identify element Y.

Explain your answer using data from Table 3.

[2 marks]

---

---

---

---

---

---

---

---

5 (d) Identify the Period 3 element that has the highest melting point.

Explain your answer by reference to structure and bonding.

[4 marks]

---

---

---

---

---

---

---

---

---

---

