Q1. This question is about the elements in Period 3 of the Periodic Table.

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

Element .....

Explanation .....

.....

.....

.....

.....

(3)

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

Element .....

Explanation .....

.....

.....

.....

.....

(3)

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

.....

(1)

(d) Chlorine is a Period 3 element.
Chlorine forms the molecules ClF_3 and CCl_2

(i) Use your understanding of electron pair repulsion to draw the shape of ClF_3 and the shape of CCl_2
Include any lone pairs of electrons that influence the shape.

Shape of ClF_3 Shape of CCl_2

(2)

(ii) Name the shape of CCl_2

.....

(1)

(iii) Write an equation to show the formation of one mole of ClF_3 from its elements.

.....

(1)

(Total 11 marks)

Q2. Indium is in Group 3 in the Periodic Table and exists as a mixture of the isotopes ^{113}In and ^{115}In.

(a) Use your understanding of the Periodic Table to complete the electron configuration of indium.

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6$.....

(1)

(b) A sample of indium must be ionised before it can be analysed in a mass spectrometer.

(i) State what is used to ionise a sample of indium in a mass spectrometer.

.....

.....

(1)

(ii) Write an equation, including state symbols, for the ionisation of indium that requires the minimum energy.

.....

(1)

(iii) State why more than the minimum energy is **not** used to ionise the sample of indium.

.....

.....

(1)

(iv) Give two reasons why the sample of indium must be ionised.

Reason 1 .....

Reason 2 .....

(2)

(c) A mass spectrum of a sample of indium showed two peaks at *m/z* = 113 and *m/z* = 115. The relative atomic mass of this sample of indium is 114.5

(i) Give the meaning of the term *relative atomic mass*.

.....

.....

.....

.....

(2)

(ii) Use these data to calculate the ratio of the relative abundances of the two isotopes.

.....

.....

.....

(2)

(d) State and explain the difference, if any, between the chemical properties of the isotopes ^{113}In and ^{115}In

Difference in chemical properties .....

Explanation .....

(2)

(e) Indium forms a compound **X** with hydrogen and oxygen. Compound **X** contains 69.2% indium and 1.8% hydrogen by mass.
Calculate the empirical formula of compound **X**.

.....

.....

.....

.....

.....

(3)
(Total 15 marks)

Q3. Which of these elements has the highest second ionisation energy?

A Na ⬭

B Mg ⬭

C Ne ⬭

D Ar ⬭

(Total 1 mark)

Q4. This question is about the first ionisation energies of some elements in the Periodic Table.

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

.....

(1)

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

Trend .....

Explanation .....

.....

.....

(Extra space).....

.....

(3)

(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 .....

.....

.....

(Extra space).....

(3)

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

.....

.....

.....

(1)

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

	First	Second	Third	Fourth	Fifth

Ionisation energy / kJ mol^{-1}	590	1150	4940	6480	8120

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

.....

(1)

(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)

(Total 10 marks)

Q5.(a) Explain why the atomic radii of the elements decrease across Period 3 from sodium to chlorine.

.....

.....

.....

.....

.....

.....

(2)

(b) Explain why the melting point of sulfur (S_8) is greater than that of phosphorus (P_4).

.....

.....

.....

.....

.....

.....

(2)

(c) Explain why sodium oxide forms an alkaline solution when it reacts with water.

.....

.....

.....

.....

.....

(2)

(d) Write an ionic equation for the reaction of phosphorus(V) oxide with an excess of sodium hydroxide solution.

.....

(1)
(Total 7 marks)

Q6. The elements in Period 2 show periodic trends.

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

Element .....

Explanation .....

.....

.....

.....

(3)

(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)

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

.....

(1)

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

.....

.....

.....

.....

(1)

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

.....

(1)
(Total 10 marks)