Q1. The values of the first ionisation energies of neon, sodium and magnesium are 2080, 494 and 736 kJ mol^{-1}, respectively.

(a) Explain the meaning of the term *first ionisation* of an atom.

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(2)

(b) Write an equation to illustrate the process occurring when the **second** ionisation energy of magnesium is measured.

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(2)

(c) Explain why the value of the first ionisation energy of magnesium is higher than that of sodium.

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(2)

(d) Explain why the value of the first ionisation energy of neon is higher than that of sodium.

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(2)
(Total 8 marks)

Q2. Lithium hydride, LiH, is an ionic compound containing the hydride ion, H^-
The reaction between LiH and aluminium chloride, $AlCl_3$, produces the ionic compound $LiAlH_4$

(a) Balance the equation below which represents the reaction between LiH and $AlCl_3$

$$LiH + AlCl_3 \rightarrow LiAlH_4 + LiCl$$

(1)

(b) Give the electronic configuration of the hydride ion, H^-

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(1)

(c) Predict the shape of the AlH_4^- ion. Explain why it has this shape.

Shape .....

Explanation .....

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(3)

(d) A bond in AlH_4^- can be represented by H → Al

Name this type of bond and explain how it is formed.

Type of bond .....

Explanation .....

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(3)
(Total 8 marks)

Q3. (a) State the meaning of the term *electronegativity*.

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(2)

(b) State and explain the trend in electronegativity values across Period 3 from sodium to chlorine.

Trend .....

Explanation .....

(3)

(c) What is meant by the term *first ionisation energy*?

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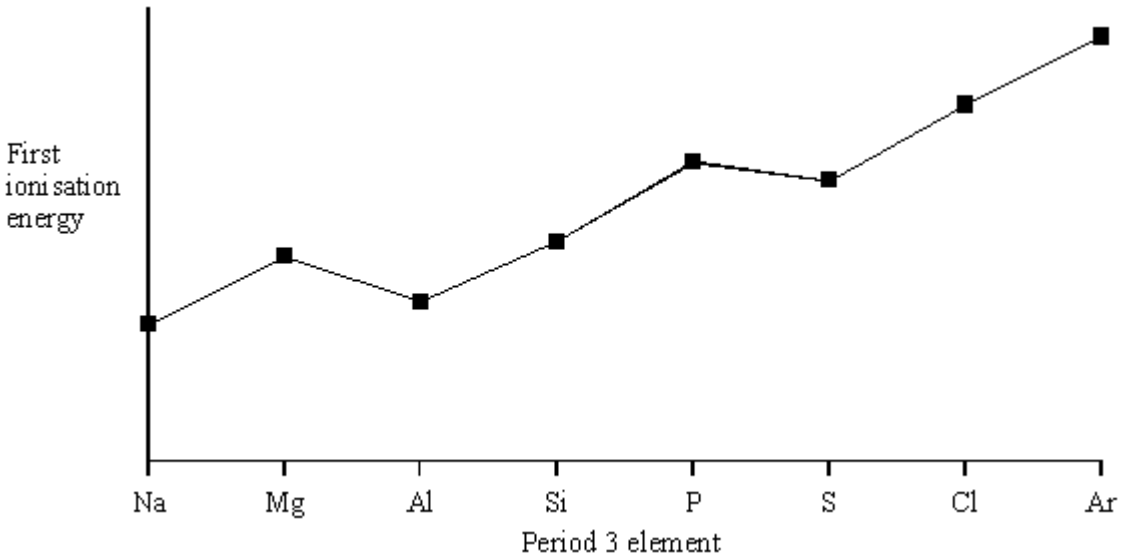
(2)

(d) The diagram below shows the variation in first ionisation energy across Period 3.



(i) What is the maximum number of electrons that can be accommodated in an s sub-level?

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(ii) What evidence from the diagram supports your answer to part (d)(i)?

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(iii) What evidence from the diagram supports the fact that the 3p sub-level is higher in energy than the 3s?

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(iv) What evidence from the diagram supports the fact that no more than three unpaired electrons can be accommodated in the 3p sub-level?

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(5)
(Total 12 marks)

Q4. Which one of the following is the electronic configuration of the strongest reducing agent?

A $1s^2\ 2s^2\ 2p^5$

B $1s^2\ 2s^2\ 2p^6\ 3s^2$

C $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

D $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$

(Total 1 mark)

Q5. There is a general trend in the values of the first ionisation energies of the elements Na to Ar. The first ionisation energies of the elements Al and S deviate from this trend.

(a) Write an equation, including state symbols, to represent the process for which the energy change is the first ionisation energy of Na.

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(2)

(b) State and explain the general trend in the values of the first ionisation energies of the elements Na to Ar.

Trend .....

Explanation .....

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(3)

(c) State how, and explain why, the values of the first ionisation energies of the elements Al and S deviate from the general trend.

How the values deviate from the trend .....

Explanation for Al .....

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Explanation for S .....

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(5)

(Total 10 marks)

Q6. (a) One isotope of sodium has a relative mass of 23.

(i) Define, in terms of the fundamental particles present, the meaning of the term *isotopes*.

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(ii) Explain why isotopes of the same element have the same chemical properties.

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(iii) Calculate the mass, in grams, of a single atom of this isotope of sodium. (The Avogadro constant, L, is 6.023×10^{23} mol^{-1})

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(5)

(b) Give the electronic configuration, showing all sub-levels, for a sodium atom.

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(1)

(c) Explain why chromium is placed in the d block in the Periodic Table.

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(1)

(d) An atom has half as many protons as an atom of ^{28}Si and also has six fewer neutrons than an atom of ^{28}Si. Give the symbol, including the mass number and the atomic number, of this atom.

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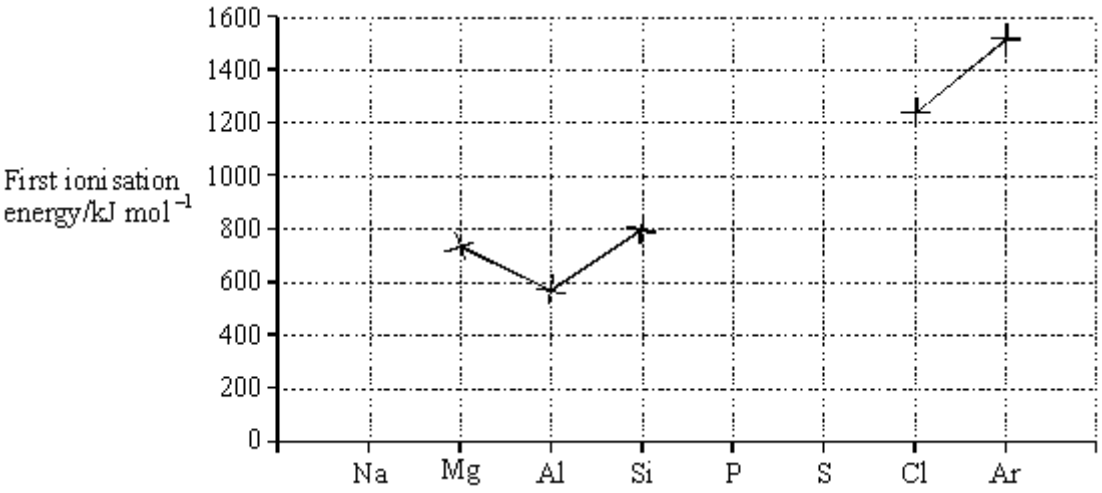
(2)
(Total 9 marks)

Q7. The diagram below shows the values of the first ionisation energies of some of the elements in Period 3.



(a) On the above diagram, use crosses to mark the approximate positions of the values of the first ionisation energies for the elements Na, P and S. Complete the diagram by joining the crosses.

(3)

(b) Explain the general increase in the values of the first ionisation energies of the elements Na–Ar.

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(3)

(c) In terms of the electron sub-levels involved, explain the position of aluminium and the position of sulphur in the diagram.

Explanation for aluminium .....

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Explanation for sulphur .....

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(4)
(Total 10 marks)