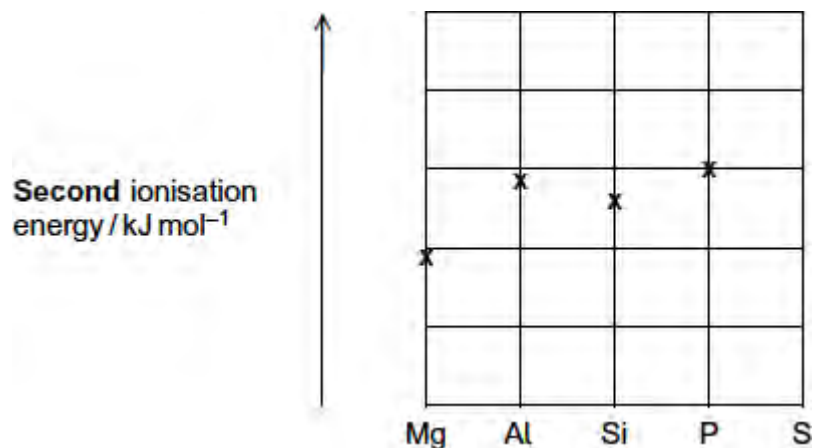


Q1.(a) Use your knowledge of electron configuration and ionisation energies to answer this question. The following diagram shows the **second** ionisation energies of some Period 3 elements.



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

(ii) Write the full electron configuration of the Al²⁺ ion.
 (1)

(iii) Write an equation to show the process that occurs when the **second** ionisation energy of aluminium is measured.
 (1)

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

 (1)

(b) Predict the element in Period 3 that has the highest **second** ionisation energy.

Give a reason for your answer.

Element

Reason

.....

.....

(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^{-1}	786	1580	3230	4360	16100	19800

Identify this element.

.....

(1)

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

.....

.....

.....

(Extra space)

.....

(1)

(Total 8 marks)

Q2. The element rubidium exists as the isotopes ^{85}Rb and ^{87}Rb

- (a) State the number of protons and the number of neutrons in an atom of the isotope ^{85}Rb

Number of protons

Number of neutrons

(2)

- (b) (i) Explain how the gaseous atoms of rubidium are ionised in a mass spectrometer

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

(2)

- (ii) Write an equation, including state symbols, to show the process that occurs when the **first** ionisation energy of rubidium is measured.

.....

(1)

- (c) The table shows the first ionisation energies of rubidium and some other elements in the same group.

Element	sodium	potassium	rubidium
First ionisation energy / kJ mol^{-1}	494	418	402

State **one** reason why the first ionisation energy of rubidium is lower than the first ionisation energy of sodium.

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

(1)

- (d) (i) State the block of elements in the Periodic Table that contains rubidium.

.....

(1)

(ii) Deduce the full electron configuration of a rubidium atom.

.....

(1)

(e) A sample of rubidium contains the isotopes ^{85}Rb and ^{87}Rb only.
The isotope ^{85}Rb has an abundance 2.5 times greater than that of ^{87}Rb

Calculate the relative atomic mass of rubidium in this sample.
Give your answer to one decimal place.

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(3)

(f) By reference to the relevant part of the mass spectrometer, explain how the abundance of an isotope in a sample of rubidium is determined.

Name of relevant part

Explanation

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.....

(2)

(g) Predict whether an atom of ^{88}Sr will have an atomic radius that is larger than, smaller than or the same as the atomic radius of ^{87}Rb . Explain your answer.

Atomic radius of ^{88}Sr compared to ^{87}Rb

Explanation

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Q3.The element nitrogen forms compounds with metals and non-metals.

- (a) Nitrogen forms a nitride ion with the electron configuration $1s^2 2s^2 2p^6$
Write the formula of the nitride ion.

.....

(1)

- (b) An element forms an ion **Q** with a single negative charge that has the same electron configuration as the nitride ion.
Identify the ion **Q**.

.....

(1)

- (c) Use the Periodic Table and your knowledge of electron arrangement to write the formula of lithium nitride.

.....

(1)

- (d) Calcium nitride contains 81.1% by mass of the metal.
Calculate the empirical formula of calcium nitride.
Show your working.

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(3)

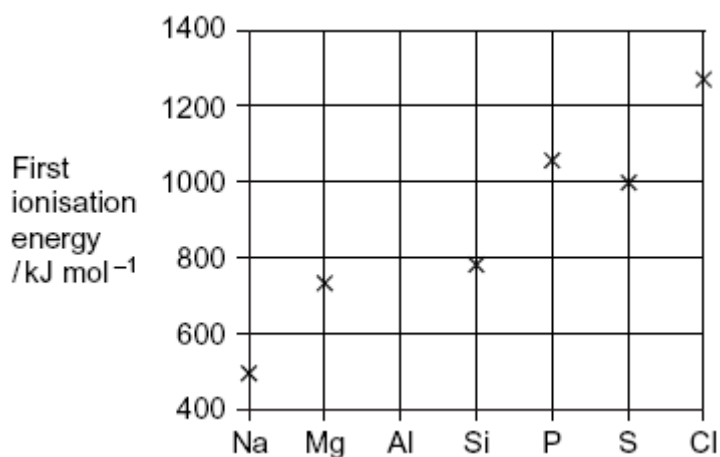
- (e) Write an equation for the reaction between silicon and nitrogen to form silicon nitride, Si_3N_4

.....

(1)

(Total 7 marks)

Q4. The following diagram shows the first ionisation energies of some Period 3 elements.



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

(1)

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

.....

(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)

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

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(2)

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

Element

Electron configuration

(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

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.....
.....

(3)

(Total 11 marks)

Q5. 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

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.....

(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

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(Extra space).....

(3)

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

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(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 $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$

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(1)

(Total 10 marks)