Electron Configuration

Question Paper 2

Level	A Level
Subject	Chemistry
Exam Board	AQA
Module	3.1 Physical Chemistry
Topic	3.1.1 Atomic Structure
Sub-Topic	3.1.1.3 Electron Configuration
Booklet	Question Paper 2

Time Allowed: **53** **minutes**

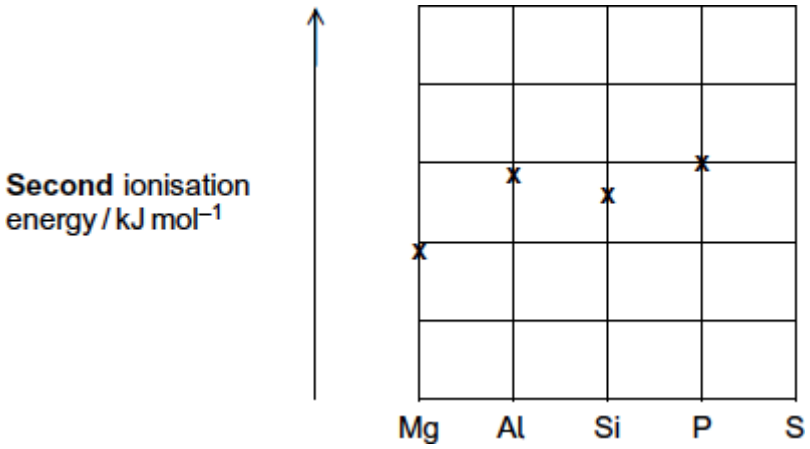
Score: **/52**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	75%	70%	60%	55%	50%	<50%

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 Al^{2+} 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.

.....

.....

.....

.....

(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 .....

.....

.....

(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 .....

.....

.....

.....

(3)
(Total 16 marks)

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.

.....

.....

.....

.....

.....

.....

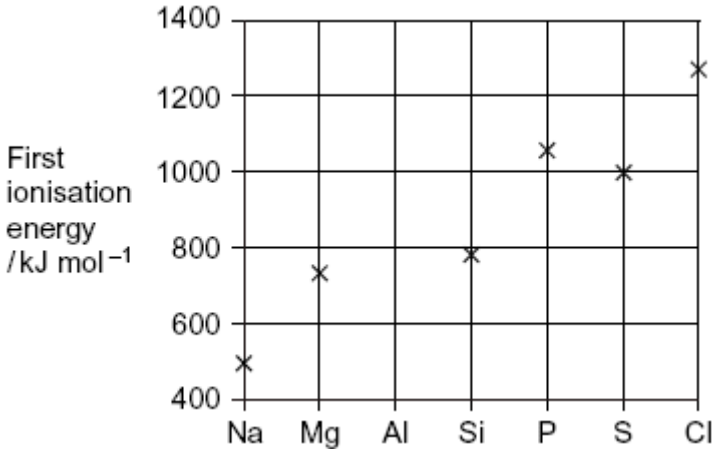
(3)

(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.

.....

.....

.....

.....

(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 .....

.....

.....

.....

(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 .....

.....

.....

(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)