UNIT 1

TOPIC 2 : ATOMIC STRUCTURE AND THE PERIODIC TABLE

SECTION A

Answer ALL questions. Write your answers in the spaces provided.

For each question, select one answer from A to D and put a cross in the box ☒. If you change your mind, put a line through the box ☒ and then mark your new answer with a cross ☒.

1.

Which of these atoms has the most neutrons?

☒ **A** $^{115}_{49}In$

☒ **B** $^{124}_{50}Sn$

☒ **C** $^{123}_{51}Sb$

☒ **D** $^{124}_{52}Te$

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2.

A p-block element in **Period 3** of the Periodic Table reacts to form an ionic compound.

What could be the electronic configuration of the **ion** formed by this element?

☒ **A** $1s^2 2s^2 2p^6 3s^2$

☒ **B** $1s^2 2s^2 2p^6 3s^2 3p^6$

☒ **C** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$

☒ **D** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6$

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3.

The **Period 2** element with the **highest** melting temperature is

- ☒ **A** aluminium
- ☒ **B** boron
- ☒ **C** carbon
- ☒ **D** silicon

4.

The numbers of subatomic particles present in four species **W**, **X**, **Y** and **Z** are given in the table.

Species	Number of protons	Number of neutrons	Number of electrons
W	19	20	18
X	19	20	19
Y	20	20	18
Z	20	22	20

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Which of these species are isotopic?

- ☒ **A** **W** and **X**
- ☒ **B** **W** and **Y**
- ☒ **C** **X** and **Z**
- ☒ **D** **Y** and **Z**

5.

Iodine exists as one isotope with mass number 127.

Chlorine exists as two isotopes with mass numbers 35 and 37.

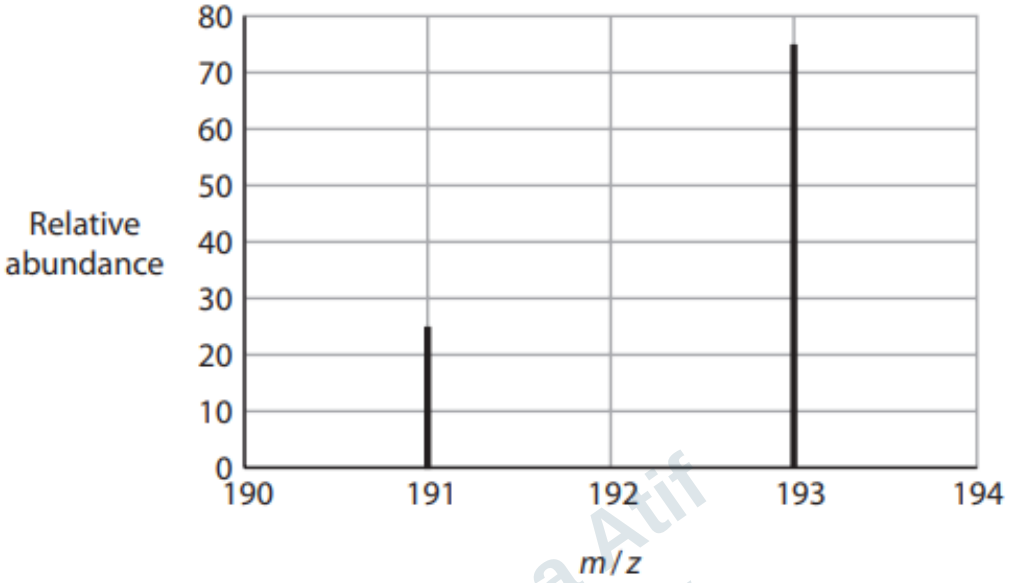
How many molecular ion (ICl_3^+) peaks are there in the mass spectrum of ICl_3?

- ☒ **A** 2
- ☒ **B** 3
- ☒ **C** 4
- ☒ **D** 5

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6.

The mass spectrum of a sample of an element has only two peaks.



What is the approximate relative atomic mass of the element in this sample?

- ☒ **A** 191.5
- ☒ **B** 192.0
- ☒ **C** 192.5
- ☒ **D** 193.0

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7.

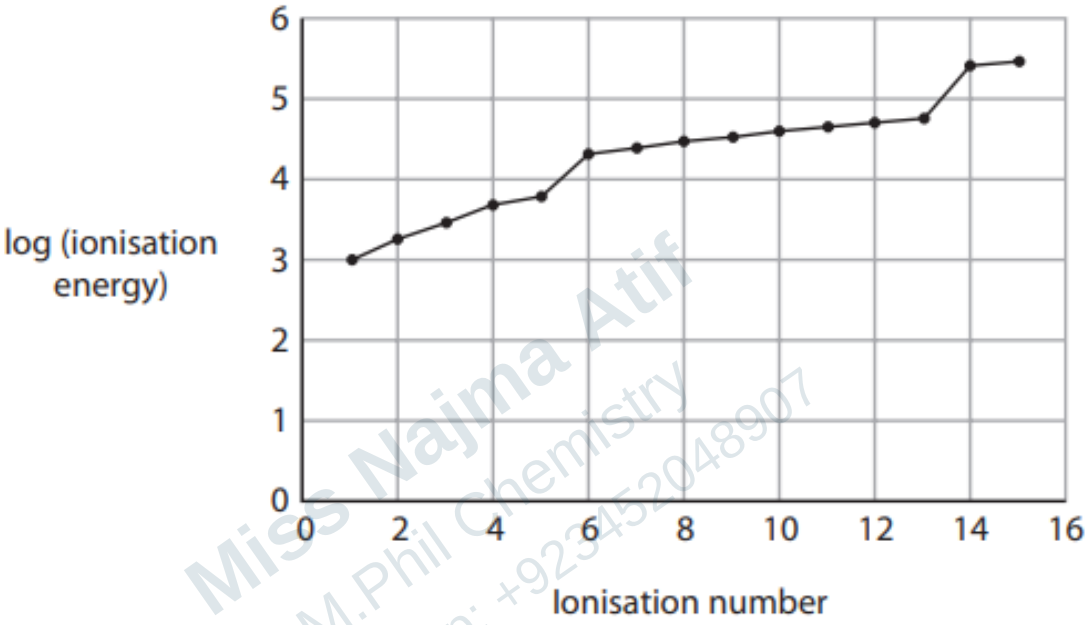
Which equation represents the **second** ionisation energy of magnesium?

- ☒ **A** $Mg(g) \rightarrow Mg^{2+}(g) + 2e^-$
- ☒ **B** $Mg^+(g) \rightarrow Mg^{2+}(g) + e^-$
- ☒ **C** $Mg(s) \rightarrow Mg^{2+}(s) + 2e^-$
- ☒ **D** $Mg^+(s) \rightarrow Mg^{2+}(s) + e^-$

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8.

The graph shows log (ionisation energy) against ionisation number for the successive ionisations of an element.



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In this element, how many quantum shells contain electrons, and how many electrons are in the outer quantum shell?

	Number of quantum shells containing electrons	Number of electrons in the outer quantum shell
☒ **A**	3	2
☒ **B**	3	5
☒ **C**	5	2
☒ **D**	5	5

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9.

Which ion has the electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6$ in its ground state?

- ☒ **A** Al^{3+}
- ☒ **B** Cl^-
- ☒ **C** N^{3-}
- ☒ **D** Na^+

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10.

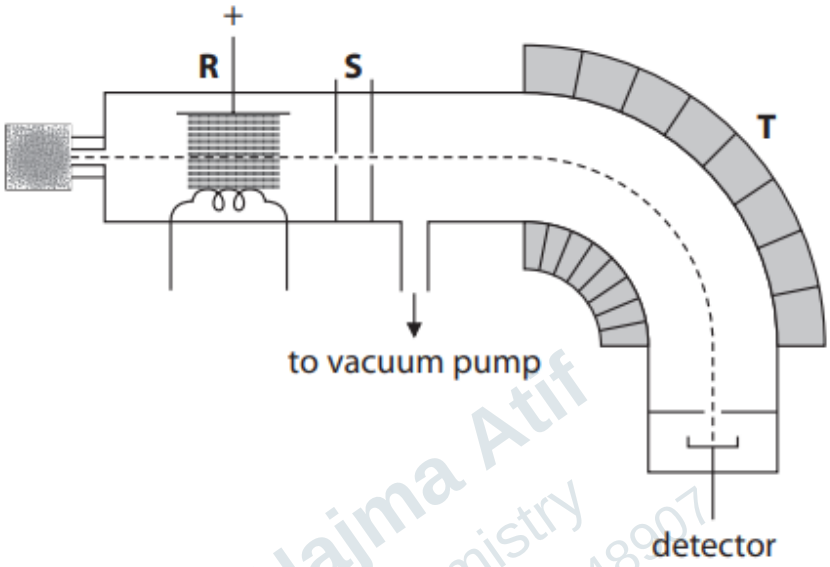
Which equation represents the **second** ionisation energy of chlorine?

- ☒ **A** $Cl^-(g) + e^- \rightarrow Cl^{2-}(g)$
- ☒ **B** $Cl(g) + 2e^- \rightarrow Cl^{2-}(g)$
- ☒ **C** $2Cl(g) \rightarrow 2Cl^+(g) + 2e^-$
- ☒ **D** $Cl^+(g) \rightarrow Cl^{2+}(g) + e^-$

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11.

The diagram shows a mass spectrometer.



(a) Which process occurs in region **R**?

(1)

- ☒ **A** the sample is vaporised using a heater
- ☒ **B** electrons are removed from molecules or atoms and positive ions are formed
- ☒ **C** electrons are added to the molecules or atoms and negative ions are formed
- ☒ **D** ions are accelerated by an electric field

(b) Which statement is correct for region **T**?

(1)

- ☒ **A** ions with a greater mass have a smaller deflection
- ☒ **B** ions with a greater mass have a greater deflection
- ☒ **C** ions with a greater charge have a smaller deflection
- ☒ **D** ions are speeded up by a magnetic field

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12.

A stable ion, M^{3+}, contains 18 electrons.

In which block of the Periodic Table is element **M** found?

- ☒ **A** s
- ☒ **B** p
- ☒ **C** d
- ☒ **D** f

13.

Ammonium iron(II) sulfate, $(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$, is a double salt that is used as a source of iron(II) ions.

(a) What is the relative formula mass of the double salt?

[A_r values: H = 1.0 N = 14.0 O = 16.0 S = 32.1 Fe = 55.8]

(1)

- ☒ **A** 277.9
- ☒ **B** 284.0
- ☒ **C** 392.0
- ☒ **D** 447.8

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14.

Element **X** is in Group 2 of the Periodic Table and element **Y** is in Group 7.
X and **Y** are not the symbols of the elements.

(a) What is the formula of the compound formed from **X** and **Y**?

(1)

- ☒ **A** **XY**
- ☒ **B** X_2Y
- ☒ **C** XY_2
- ☒ **D** X_2Y_2

(b) Under what conditions does the compound formed from **X** and **Y** conduct electricity?

(1)

- ☒ **A** in the solid state and in the liquid state and in aqueous solution
- ☒ **B** in the solid state and in aqueous solution only
- ☒ **C** in the solid state and in the liquid state only
- ☒ **D** in the liquid state and in aqueous solution only

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15.

The atomic number of the element scandium is 21 and the mass number of its only isotope is 45.

(a) What is the number of electrons in a scandium ion, Sc^+?

(1)

- ☒ **A** 20
- ☒ **B** 21
- ☒ **C** 22
- ☒ **D** 23

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(b) In a mass spectrometer, scandium forms Sc^+ and Sc^{2+} ions.

What is the *m* / *z* value for the mass spectrum peak due to the Sc^{2+} ions?

(1)

- ☐ **A** 22.5
- ☐ **B** 33.0
- ☐ **C** 45.0
- ☐ **D** 90.0

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16.

Which equation represents the first ionisation energy of iodine?

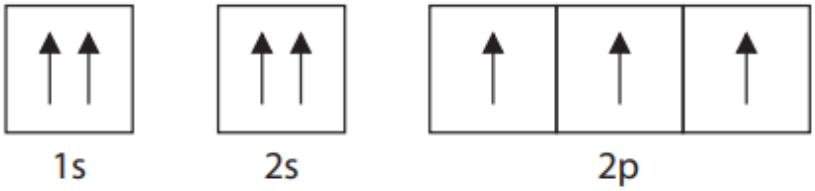
- ☒ **A** $I_2(s) \rightarrow 2I^+(g) + 2e^-$
- ☒ **B** $I_2(g) \rightarrow 2I^+(g) + 2e^-$
- ☒ **C** $\frac{1}{2}I_2(s) \rightarrow I^+(g) + e^-$
- ☒ **D** $I(g) \rightarrow I^+(g) + e^-$

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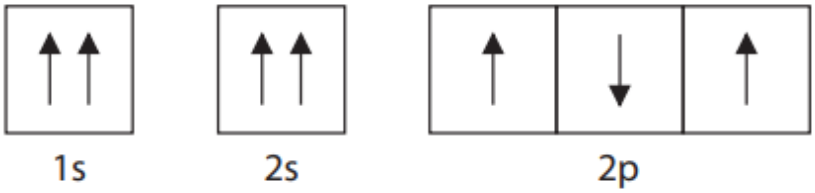
17.

What is the electronic configuration of a nitrogen atom?

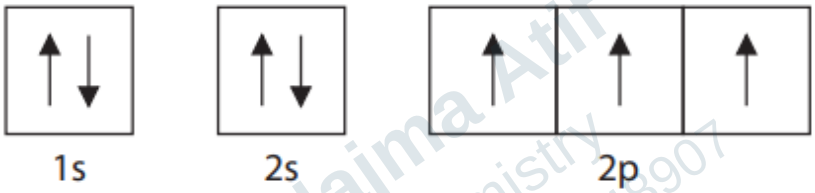
☒ **A**



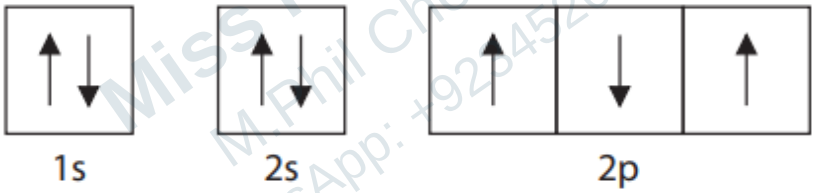
☒ **B**



☒ **C**



☒ **D**



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18.

The element manganese has the atomic number $Z = 25$.

What are the numbers of s, p and d electrons in an atom of manganese?

	s electrons	p electrons	d electrons
☒ **A**	6	12	7
☒ **B**	8	12	5
☒ **C**	6	18	1
☒ **D**	8	17	0

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19.

An atom of $^{15}_{7}N$ forms a nitride ion, N^{3-}.

What are the numbers of protons, neutrons and electrons in this ion?

	Protons	Neutrons	Electrons
☒ **A**	7	8	7
☒ **B**	7	8	4
☒ **C**	7	8	10
☒ **D**	8	7	10

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20.

What is the total number of orbitals in a sulfur atom which contain at least one electron?

☒ **A** 3

☒ **B** 5

☒ **C** 8

☒ **D** 9

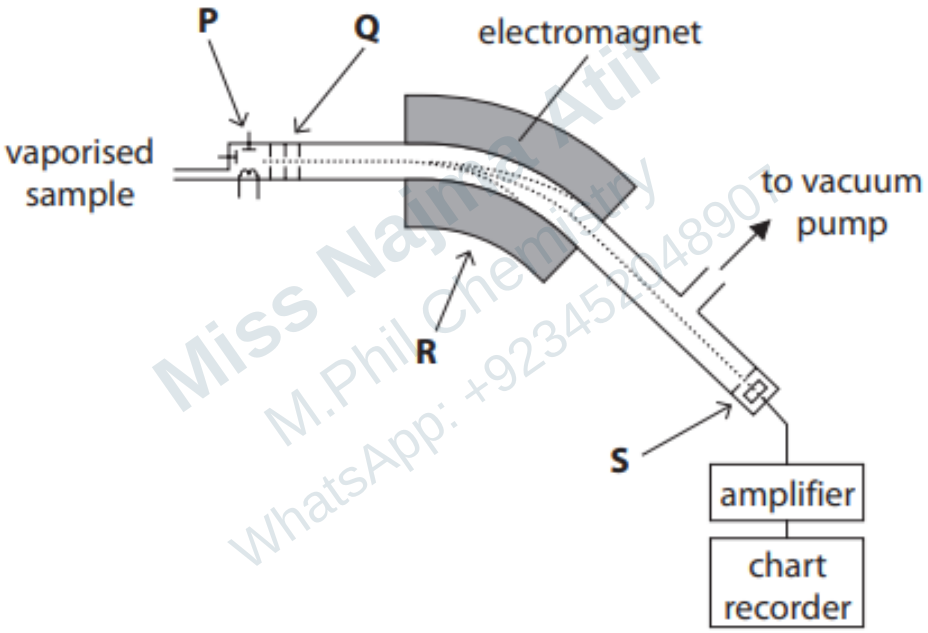
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21.

Mass spectrometers are used in chemical analysis.

(a) In which region of this mass spectrometer are the ions accelerated?

(1)

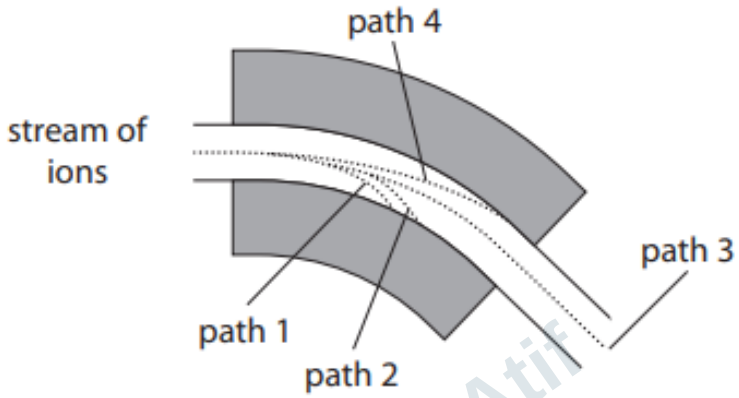


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- ☒ **A** region **P**
- ☒ **B** region **Q**
- ☒ **C** region **R**
- ☒ **D** region **S**

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(b) Four iron ions are present in a stream of ions in a mass spectrometer. The paths of these ions are shown.



Which of these ions will follow path 1 through the mass spectrometer?

(1)

- ☒ **A** $^{54}Fe^{+}$
- ☒ **B** $^{54}Fe^{2+}$
- ☒ **C** $^{56}Fe^{+}$
- ☒ **D** $^{56}Fe^{2+}$

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(c) Naturally-occurring chlorine has two isotopes, ^{35}Cl and ^{37}Cl.

How many peaks due to the singly-charged **molecular** ions are seen in the mass spectrum of chlorine, Cl_2?

(1)

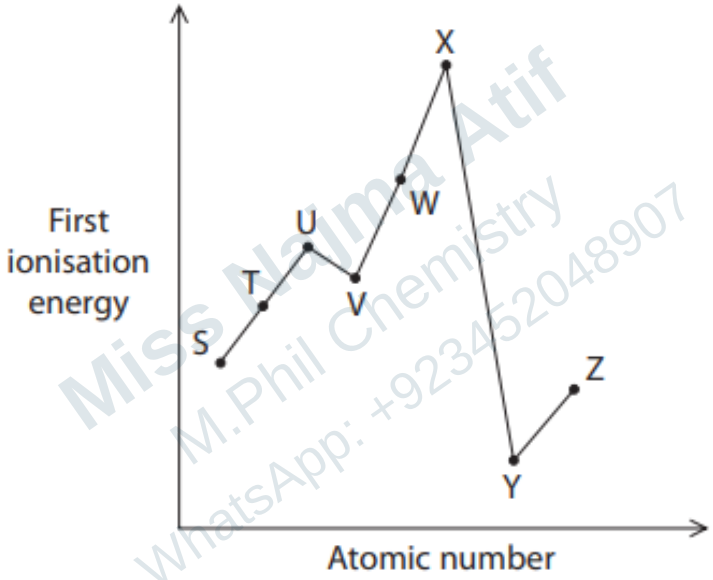
- ☒ **A** 1
- ☒ **B** 2
- ☒ **C** 3
- ☒ **D** 4

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22.

11 The graph shows the first ionisation energies of some consecutive elements from Periods 2 and 3 of the Periodic Table.

The letters used to label the elements are **not** their chemical symbols.



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(a) Which element has only **one** p orbital containing a pair of electrons?

(1)

- ☒ **A** element U
- ☒ **B** element V
- ☒ **C** element W
- ☒ **D** element X

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(b) Which element is the least reactive?

(1)

- ☒ **A** element S
- ☒ **B** element X
- ☒ **C** element Y
- ☒ **D** element Z

(c) Which element has the greatest **second** ionisation energy?

- ☒ **A** element S
- ☒ **B** element T
- ☒ **C** element X
- ☒ **D** element Y

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23.

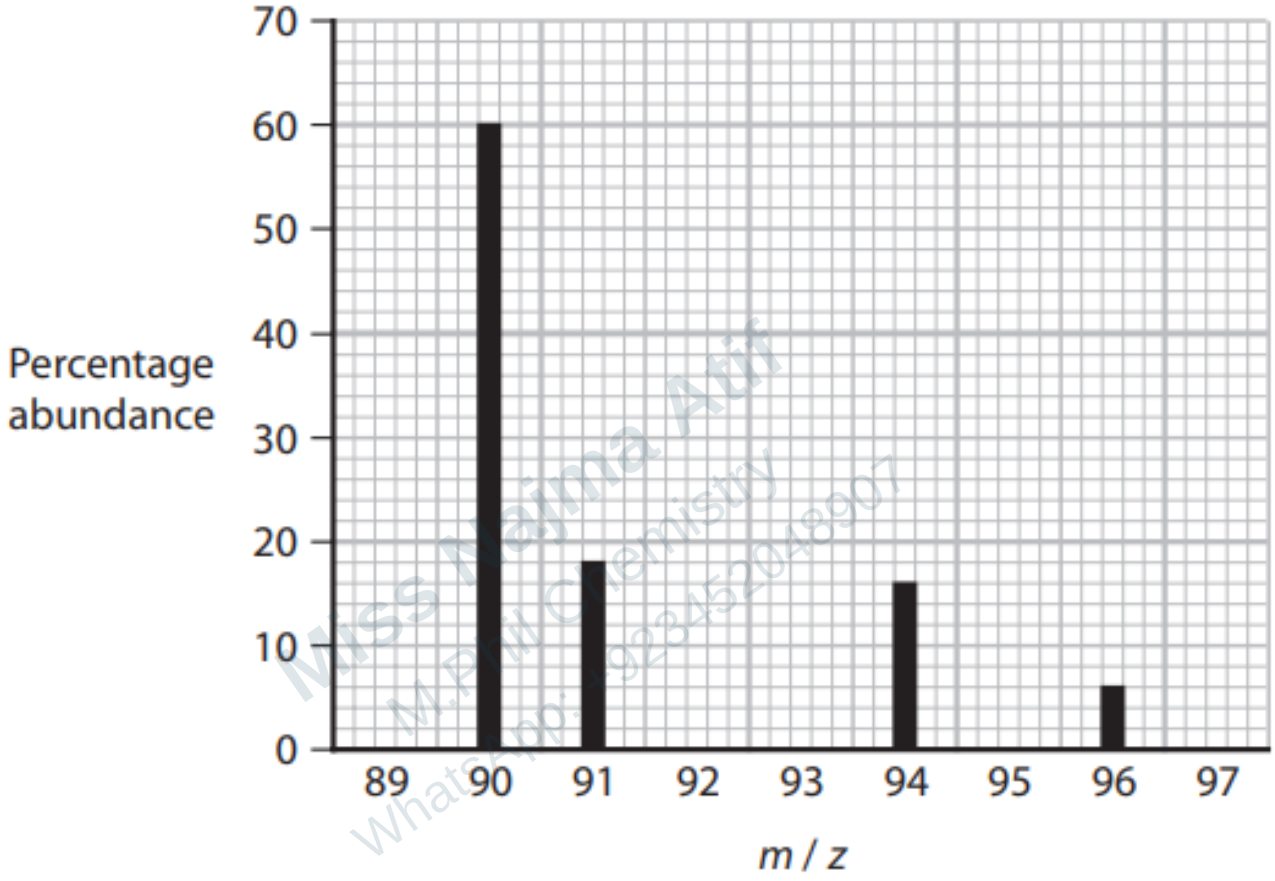
How many neutrons and electrons are there in $^{190}_{79}Au^{2+}$?

	Neutrons	Electrons
☒ **A**	111	77
☒ **B**	111	81
☒ **C**	190	79
☒ **D**	190	77

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24.

The mass spectrum of an element is shown.



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What is the relative atomic mass of this element?

- ☒ **A** 90.0
- ☒ **B** 90.9
- ☒ **C** 91.2
- ☒ **D** 92.8

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25.

Which is the equation for the **second** ionisation of element J?

- ☒ **A** $J(g) \rightarrow J^{2+}(g) + 2e^-$
- ☒ **B** $J^+(g) \rightarrow J^{2+}(g) + e^-$
- ☒ **C** $J^+(g) \rightarrow J^{3+}(g) + 2e^-$
- ☒ **D** $J^{2+}(g) \rightarrow J^{3+}(g) + e^-$

26.

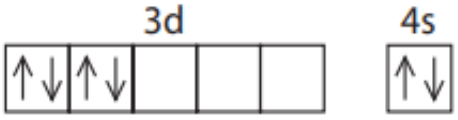
Which is a reason why fluorine has a higher first ionisation energy than oxygen?

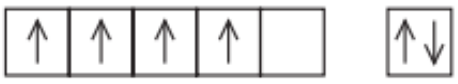
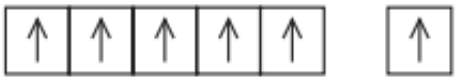
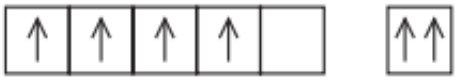
- ☒ **A** a fluorine atom has fewer unpaired electrons
- ☒ **B** a fluorine atom has fewer shells of electrons
- ☒ **C** a fluorine atom has more electrons
- ☒ **D** a fluorine atom has more protons

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27.

Which is the electronic configuration of chromium?

- ☒ **A** [Ar] 

- ☒ **B** [Ar] 
- ☒ **C** [Ar] 
- ☒ **D** [Ar] 

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28.

The first seven ionisation energies, in kJ mol^{-1}, of an element are shown.

1010, 1900, 2910, 4960, 6270, 21 300, 25 400

In which group of the Periodic Table is this element located?

- ☒ **A** Group 3
- ☒ **B** Group 4
- ☒ **C** Group 5
- ☒ **D** Group 6

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29.

What is the electronic configuration of an oxygen atom in its ground state?

	1s	2s	$2p_x$	$2p_y$	$2p_z$	3s
☒ **A**	↑↓	↑↓	↑↓	↑↓		
☒ **B**	↑↓	↑↓	↑↑	↑	↑	
☒ **C**	↑↓	↑↓	↑	↑	↑	↑
☒ **D**	↑↓	↑↓	↑↓	↑	↑	

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30.

Which property shows a **general decrease** across the Periodic Table from sodium to chlorine?

- ☒ **A** atomic radius
- ☒ **B** electronegativity
- ☒ **C** first ionisation energy
- ☒ **D** melting temperature

31.

The first ionisation energy of sulfur is lower than that of phosphorus.

Which is the best explanation for this?

- ☒ **A** the atomic radius of sulfur is greater than that of phosphorus
- ☒ **B** the electronegativity of sulfur is greater than that of phosphorus
- ☒ **C** the repulsion between the outer electrons of sulfur is greater than that of phosphorus
- ☒ **D** the shielding by the inner shell electrons of sulfur is greater than that of phosphorus

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32.

An atom of $^{27}_{13}Al$ forms the ion, Al^{3+}.
What are the numbers of protons, electrons and neutrons in this ion?

	protons	electrons	neutrons
☒ **A**	13	13	14
☒ **B**	10	13	14
☒ **C**	14	10	13
☒ **D**	13	10	14

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33.

What is the shape of a p orbital and the maximum number of electrons it can hold?

	shape	maximum number of electrons
☒ **A**		2
☒ **B**		6
☒ **C**		2
☒ **D**		6

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34.

The electronic configurations of the atoms of four elements are shown.

What is the electronic configuration of the atom of element which has the **lowest** first ionisation energy?

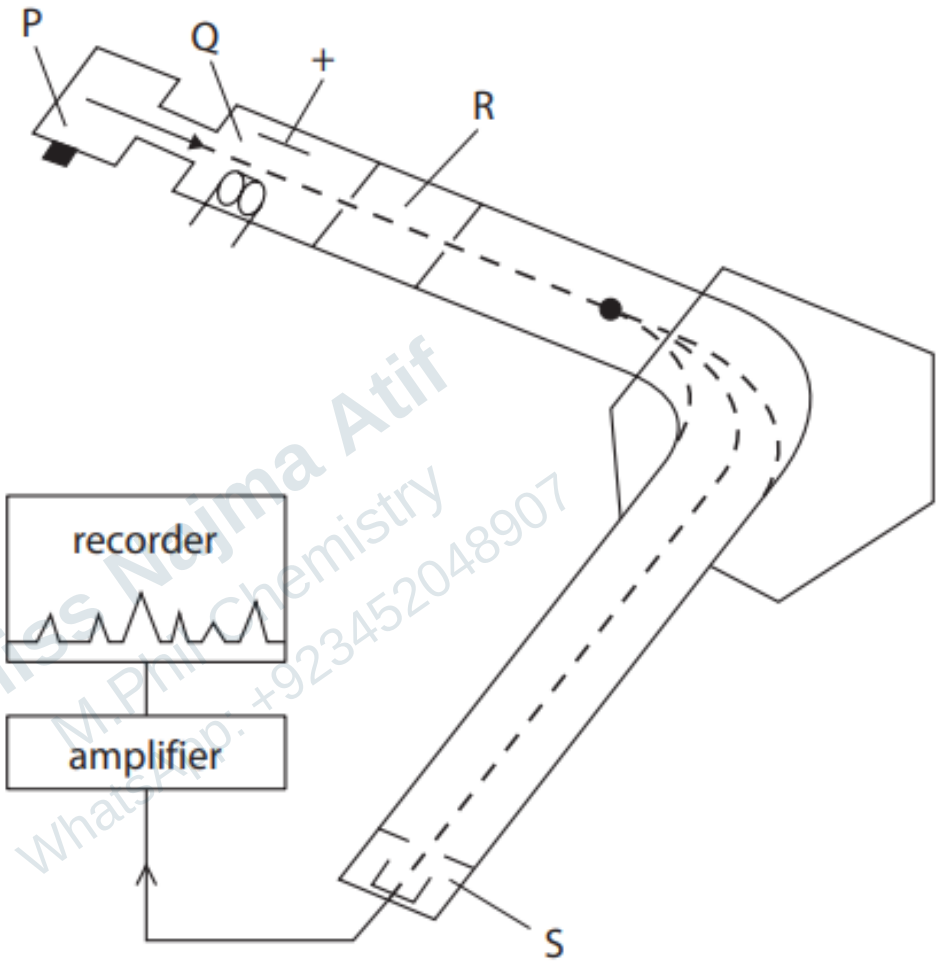
- ☒ **A** $1s^2 2s^2 2p^6 3s^2$
- ☒ **B** $1s^2 2s^2 2p^6 3s^2 3p^1$
- ☒ **C** $1s^2 2s^2 2p^6 3s^2 3p^2$
- ☒ **D** $1s^2 2s^2 2p^6 3s^2 3p^3$

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35.

In which region of a mass spectrometer are particles ionised?



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- ☒ **A** region P
- ☒ **B** region Q
- ☒ **C** region R
- ☒ **D** region S

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36:

A sample of the element chlorine, Cl_2, was analysed in a mass spectrometer. Chlorine has **two** isotopes.

What is the **total** number of peaks, due to ions with a single positive charge, which could be seen in the mass spectrum?

- ☒ **A** two
- ☒ **B** four
- ☒ **C** five
- ☒ **D** six

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37.

Which diagram represents the electronic structure of a nitrogen atom?

	1s	2s	2p		
☒ **A**	↑↓	↑	↑↓	↑	↑
☒ **B**	↑↓	↑	↑↓	↑↓	
☒ **C**	↑↓	↑↓	↑	↑	↑
☒ **D**	↑↓	↑↓	↑↓	↑	

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38.

Which species does **not** contain a total of 16 neutrons?

- ☒ **A** a molecule of ethene, $^{12}C_2{}^{1}H_4$
- ☒ **B** a molecule of oxygen, $^{16}O_2$
- ☒ **C** an atom of silicon, ^{30}Si
- ☒ **D** an ion of sulfur, $^{32}S^{2-}$

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39.

Each response gives the atomic numbers of two elements.
Which pair of atomic numbers are those of elements that are in different blocks of the Periodic Table?

- ☒ **A** 5, 9
- ☒ **B** 10, 16
- ☒ **C** 13, 18
- ☒ **D** 16, 20

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40.

This question is about electronic configurations.

(a) What is the electronic configuration of an atom of calcium?

(1)

- ☒ **A** [Ne] $3s^1$
- ☒ **B** [Ar] $4s^1$
- ☒ **C** [Ne] $3s^2$
- ☒ **D** [Ar] $4s^2$

(b) What is the electronic configuration of a Cr^{3+} ion?

(1)

- ☒ **A** [Ar] $3d^2 4s^1$
- ☒ **B** [Ar] $3d^3$
- ☒ **C** [Ar] $3d^4$
- ☒ **D** [Ar] $3d^5$

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41.

Which equation represents the **second** ionisation energy of magnesium?

- ☒ **A** $Mg(g) \rightarrow Mg^{2+}(g) + 2e^-$
- ☒ **B** $Mg^+(g) \rightarrow Mg^{2+}(g) + e^-$
- ☒ **C** $Mg^+(s) \rightarrow Mg^{2+}(s) + e^-$
- ☒ **D** $Mg(g) \rightarrow Mg^+(g) + e^-$

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42.

The first ionisation energies of four successive elements in the Periodic Table are shown.

Element	P	Q	R	S
First ionisation energy / kJ mol^{-1}	1251	1521	419	590

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(a) Which element has atoms with a full outer shell of electrons?

- ☒ **A** element P
- ☒ **B** element Q
- ☒ **C** element R
- ☒ **D** element S

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43.

The table shows some data about fundamental particles in an atom.

Particle	Mass / g
electron	0.0009×10^{-24}
neutron	1.6748×10^{-24}
proton	1.6725×10^{-24}

(b) Which of the particles would be deflected by an electric field?

(1)

- ☒ **A** electrons only
- ☒ **B** electrons and protons only
- ☒ **C** neutrons and protons only
- ☒ **D** electrons, neutrons and protons

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44.

This question is about the Period 3 elements Na, Mg, Al, Si, P, S and Cl.

(a) Which statement is **not** correct for these Period 3 elements?

(1)

- ☒ **A** atoms of Cl(g) have the highest first ionisation energy
- ☒ **B** ions of Cl^-(g) and S^{2-}(g) have the same ionic radius
- ☒ **C** atoms of Na(g) have the largest atomic radius
- ☒ **D** atoms of P(g) have the most unpaired electrons

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45.

Which ion is isoelectronic with a noble gas atom (Group 0/8)?

- ☒ **A** H^+
- ☒ **B** O^-
- ☒ **C** Sc^{3+}
- ☒ **D** Zn^{2+}

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SECTION B

Answer ALL the questions. Write your answers in the spaces provided.

QUESTION NO 1:

This question is about the elements in Period 3 of the Periodic Table, and some of their compounds.

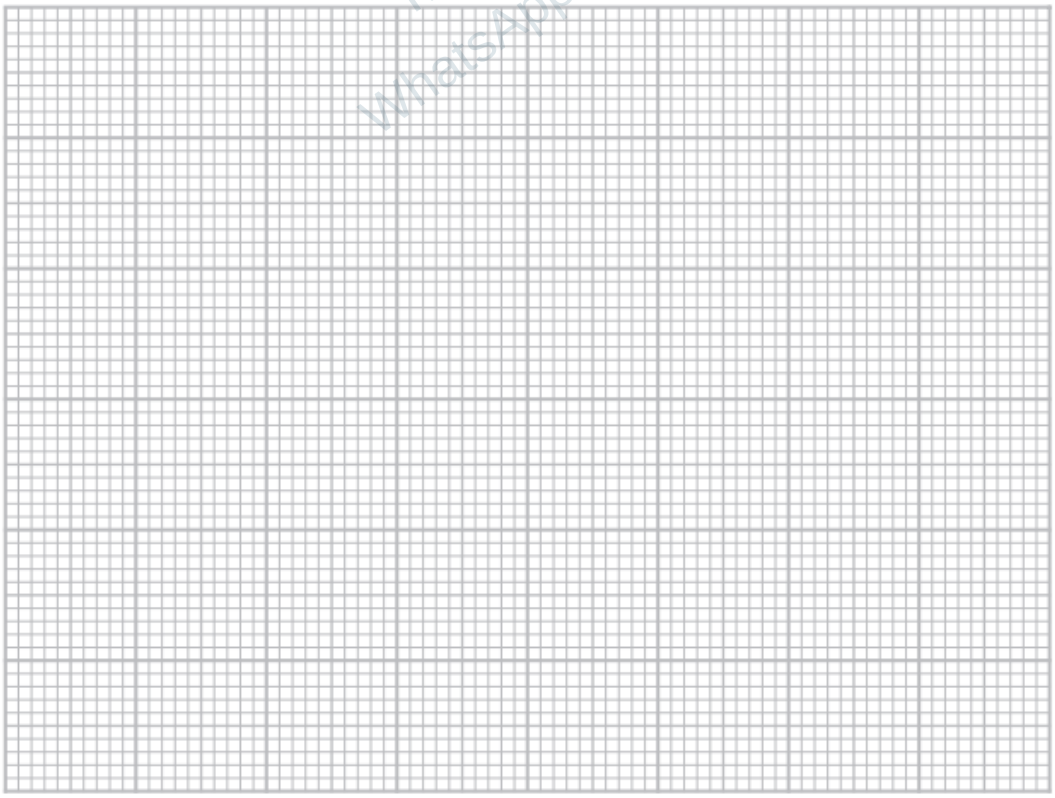
(a) The atomic radii of six of the elements are given.

Symbol	Na	Mg	Al	Si	P	S	Cl	Ar
Atomic number	11	12	13	14	15	16	17	18
Atomic radius / nm	0.191	0.160	0.130			0.102	0.099	0.095

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(i) Plot a graph of atomic radius against atomic number.

(2)



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(ii) Use the graph to estimate the atomic radius of silicon, Si.

(1)

(iii) Suggest an explanation for the decrease in atomic radius as atomic number increases across a period.

(3)

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TOTAL QUESTION 1: 6 MARKS

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QUESTION NO 2:

This question is about iron and some of its compounds.

(a) Complete the table to show the numbers of subatomic particles in $^{56}Fe^{2+}$.

(1)

Number of protons	Number of neutrons	Number of electrons

(b) A sample of iron contains the following isotopes.

Isotope	Percentage abundance
^{54}Fe	5.84
^{56}Fe	91.68
^{57}Fe	2.17
^{58}Fe	0.31

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Calculate the relative atomic mass of this sample of iron.
Give your answer to **three** significant figures.

(2)

TOTAL FOR QUESTION 2 : 3

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QUESTION NO 3:

This question is about the chlorides of beryllium and calcium.

(a) Complete the electronic configurations of the atoms of beryllium and calcium using the s, p, d notation.

(2)

Be $1s^2$

Ca $1s^2$

QUESTION NO 4:

This question is about silicon and carbon.

(a) Silicon is a semiconductor.

(i) Data obtained using the mass spectrum of silicon are shown.

Isotope mass number	Relative abundance
28	92.17
29	4.71
30	3.12

Calculate the relative atomic mass of silicon to **two** decimal places.

(2)

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(ii) Suggest a reason why there is a small peak in the mass spectrum of silicon at $m/z = 14$

(1)

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.....

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(iii) Complete the table to show the number of protons and neutrons in each isotope of silicon.

Isotope	Number of protons	Number of neutrons
^{28}Si		
^{29}Si		
^{30}Si		

(1)

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QUESTION 5:

Aluminium is an abundant metal with many uses.

(a) The first four ionisation energies of aluminium are shown.

Ionisation number	Energy / kJ mol^{-1}
1	578
2	1820
3	2750
4	11 600

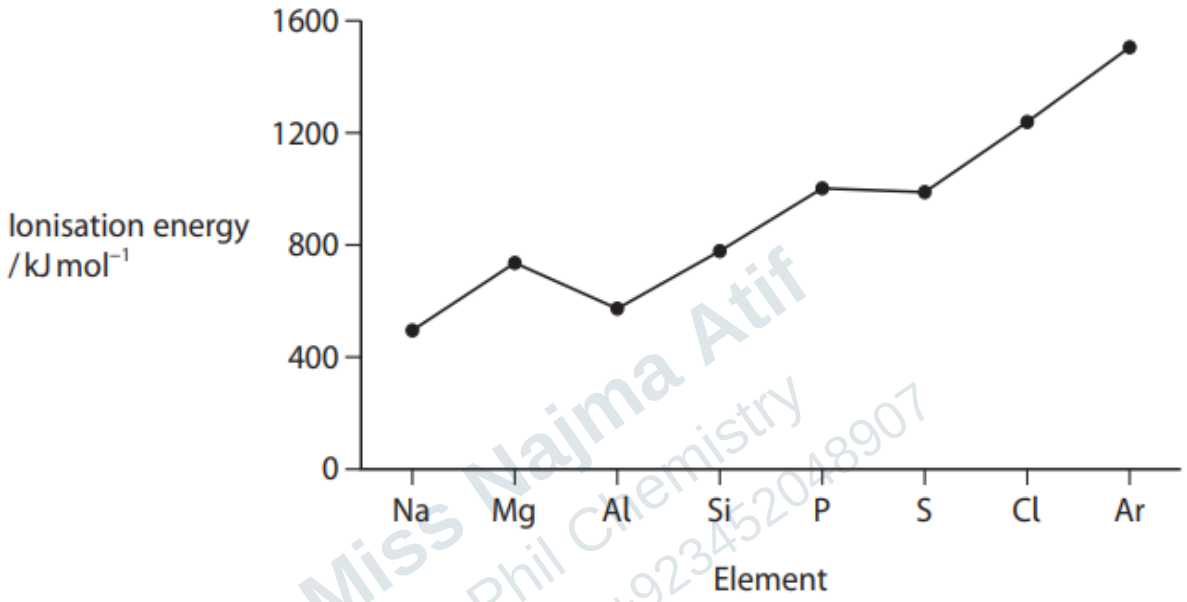
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Explain how this information shows that aluminium is in Group 3 of the Periodic Table.

(2)

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(b) The graph shows the first ionisation energies for the elements in Period 3.



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(i) Explain the general increase in the first ionisation energy from sodium to argon.

(2)

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(ii) Explain why the first ionisation energy of aluminium is less than the first ionisation energy of magnesium.

(2)

.....

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TOTAL FOR QUESTION 5: 6

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QUESTION NO 6:

20 This question is about copper and its compounds.

(a) Complete the electronic configurations of Cu and Cu^{2+}.

(2)

Cu [Ar] .....

Cu^{2+} [Ar] .....

(b) A sample of copper contains the isotopes ^{63}Cu and ^{65}Cu.

(i) Complete the table to show the numbers of subatomic particles in the atoms of these two isotopes of copper.

(2)

Isotope	Protons	Neutrons	Electrons
^{63}Cu			
^{65}Cu			

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(ii) Explain the term isotopes, using the information in the table.

(2)

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(iii) State why the two isotopes of copper have the same chemical reactions.

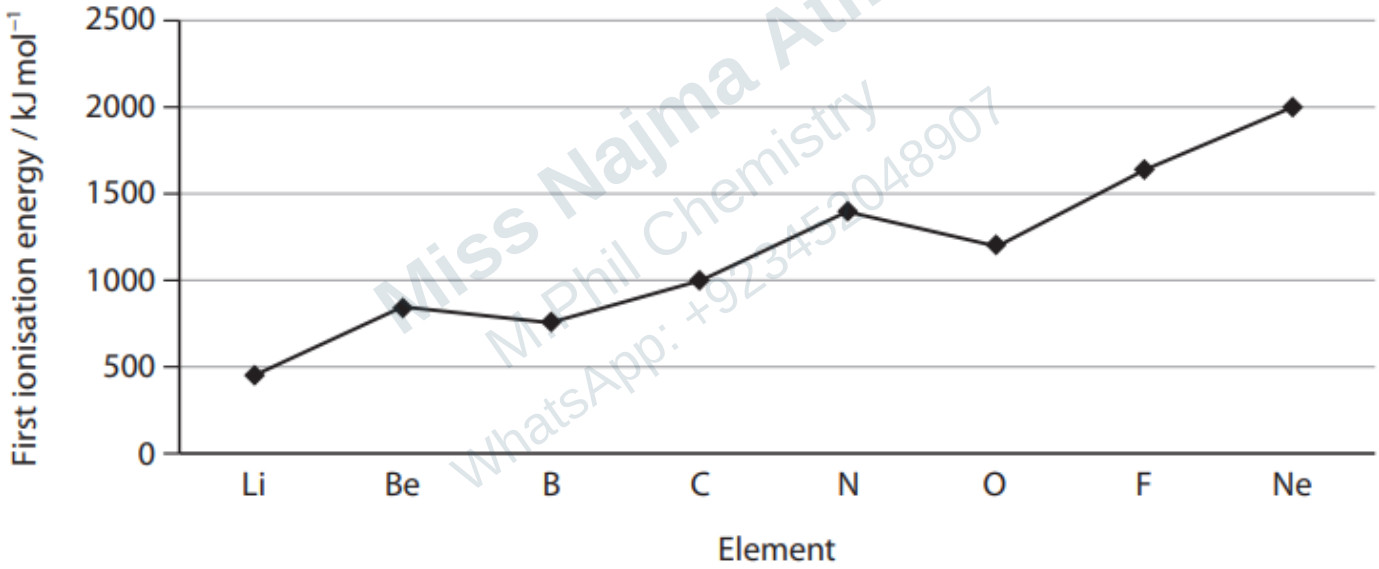
(1)

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QUESTION NO 7:

This question is about the ionisation energies of the elements in Period 2 of the Periodic Table.

(a) The first ionisation energies of the Period 2 elements are shown.



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(i) Give an equation that represents the first ionisation energy of lithium. Include state symbols.

(1)

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(ii) Explain why there is a general increase in the first ionisation energy across the period.

(2)

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(iii) Explain why the first ionisation energy of oxygen is lower than that of nitrogen.

(2)

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(b) All the successive ionisation energies of nitrogen are shown in the table.

Ionisation number	1	2	3	4	5	6	7
Ionisation energy / kJ mol^{-1}	1402	2856	4578	7475	9445	53 267	64 360

Explain the trend in the successive ionisation energies of nitrogen.

(2)

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TOTAL FOR QUESTION 7: 7

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QUESTION NO 8:

Naturally occurring bromine has two isotopes: bromine-79 and bromine-81.

(a) State what is meant by the term isotopes.

(1)

(b) Complete the table to show the numbers of subatomic particles in the two isotopes of bromine.

(2)

Isotope	Protons	Neutrons	Electrons
bromine-79			
bromine-81			

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(ii) Describe the formation of the molecular ion of bromine in the mass spectrometer. Include an equation.
State symbols are not required.

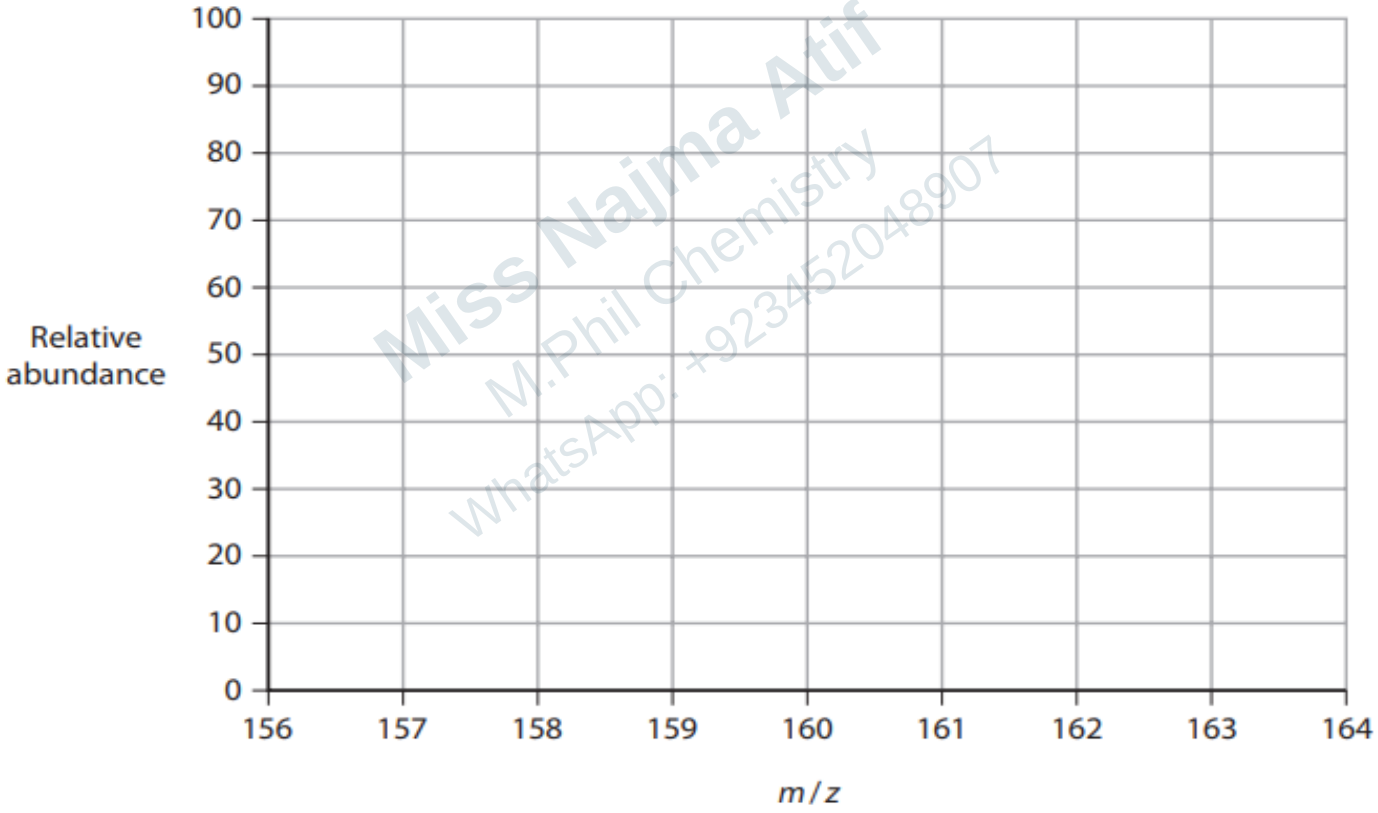
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(iii) On the mass spectrum grid, draw the peaks for the bromine molecular ions, showing the relative peak heights.

The bromine isotopes in this sample have the **same** relative abundance.

(2)



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(d) The percentage abundances of the isotopes in a different sample of bromine are shown.

Isotope	Percentage abundance
bromine-79	56.38%
bromine-81	43.62%

Calculate the relative **molecular** mass of this sample of bromine, giving your answer to **two** decimal places.

(3)

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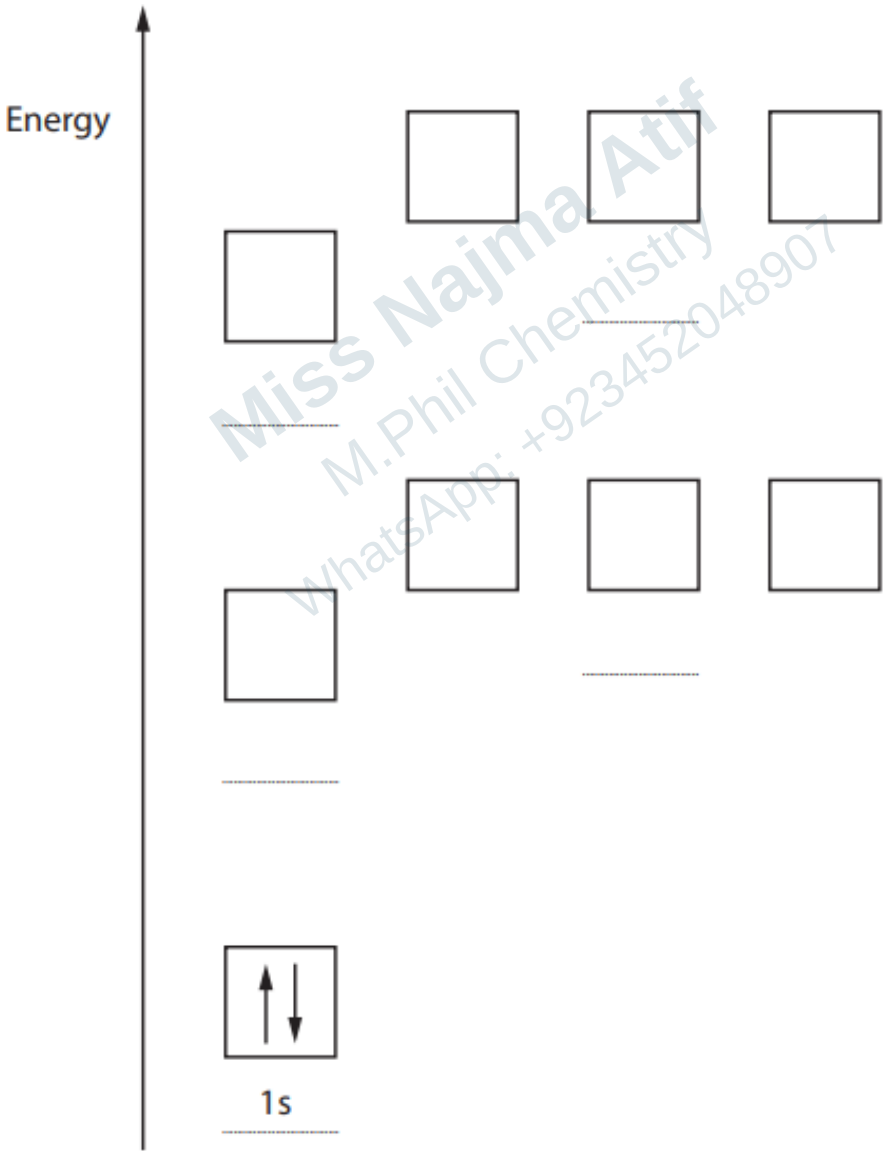
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QUESTION NO 9:

This question is about the element sulfur.

(a) Complete the diagram to show the electronic configuration for a sulfur atom in the ground state.
Include labels for each subshell.

(2)



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(b) Write an equation for the **first** ionisation energy of sulfur.
Include state symbols.

(2)

(c) Explain why the first ionisation energy of sulfur is less than the first ionisation energies of **both** phosphorus and chlorine.

(3)

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(d) A sample of sulfur contains four isotopes.

Isotope	^{32}S	^{33}S	^{34}S	^{36}S
Percentage abundance	94.88	0.83	4.27	0.02

(i) State what is meant by the term **isotopes**, in terms of subatomic particles.

(2)

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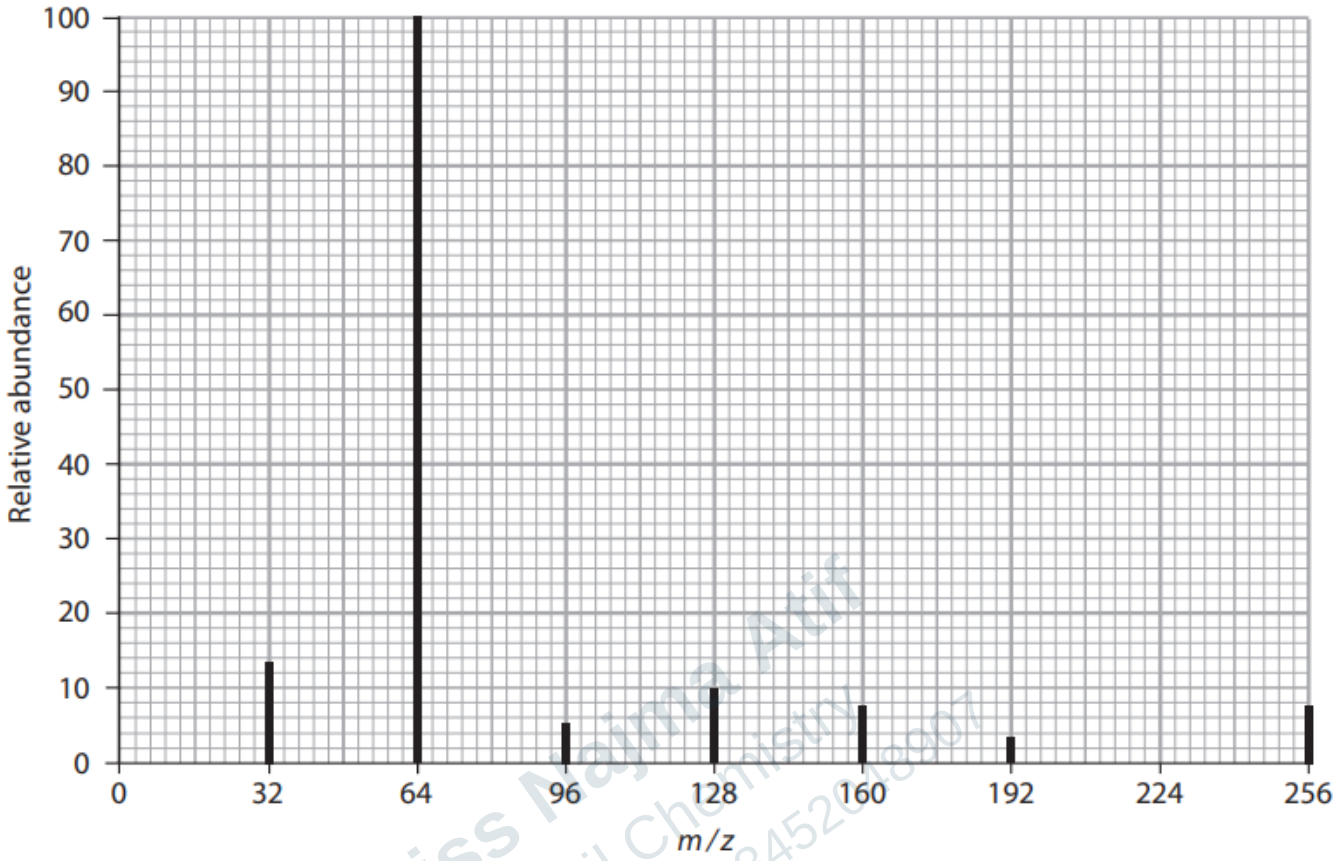
(ii) Calculate the relative atomic mass of sulfur in this sample.

Give your answer to **two** decimal places.

(2)

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(e) The mass spectrum of a sample of sulfur with ^{32}S as the only isotope is shown.



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(i) Calculate the number of sulfur atoms in the molecular ion.

You **must** show your working.

(1)

(ii) Suggest the **formula** of the **most stable ion** shown by this spectrum.

(2)

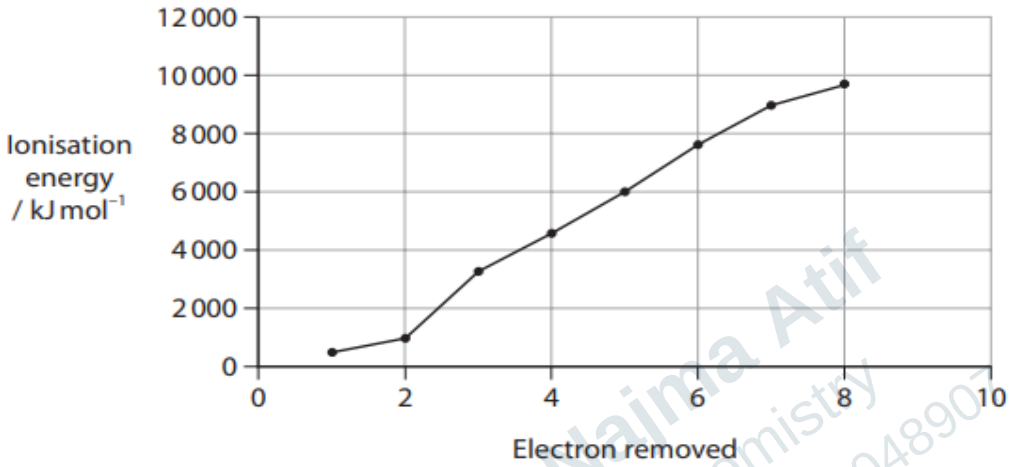
TOTAL FOR QUESTION 9: 14

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QUESTION NO 10:

This question is about barium and barium compounds.

(a) The graph shows the first eight ionisation energies of barium.



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(i) Write an equation, including state symbols, for the **third** ionisation energy of barium.

(1)

(ii) State how the graph confirms that barium is in Group 2 in the Periodic Table.

(1)

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QUESTION NO 11:

This question is about the Group 4 element germanium and some of its compounds.

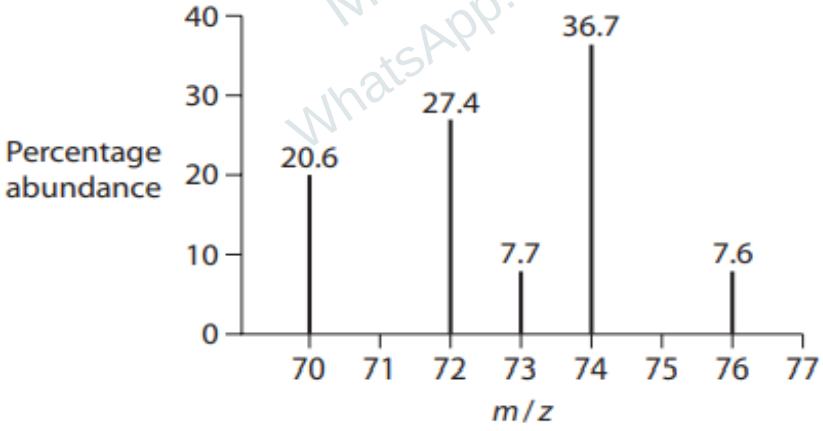
(a) Naturally-occurring germanium consists of five stable isotopes.

Explain what is meant by the term isotopes.

(2)

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(b) The mass spectrum of a sample of germanium is shown.



Calculate the relative atomic mass of this sample of germanium.

(2)

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(c) Give the electronic configuration of a germanium atom.

(1)

.....

QUESTION NO 12:

This question is about mass spectrometry and the shapes of molecules.

(a) In a mass spectrometer vaporised atoms are ionised, and the ions formed are accelerated, deflected and detected.

(i) State how atoms are ionised in the mass spectrometer.

(1)

.....

.....

.....

(ii) State how the ions formed are accelerated.

(1)

.....

.....

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(iii) Explain why isotopes of an element have the same chemical reactions but their ions are deflected differently in a mass spectrometer.

(2)

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(b) Data from mass spectra may be used to determine the relative atomic masses of elements.

(i) State what is meant by relative atomic mass.

(2)

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(ii) A sample of chlorine contains 75.53 % of ^{35}Cl and 24.47 % of ^{37}Cl.

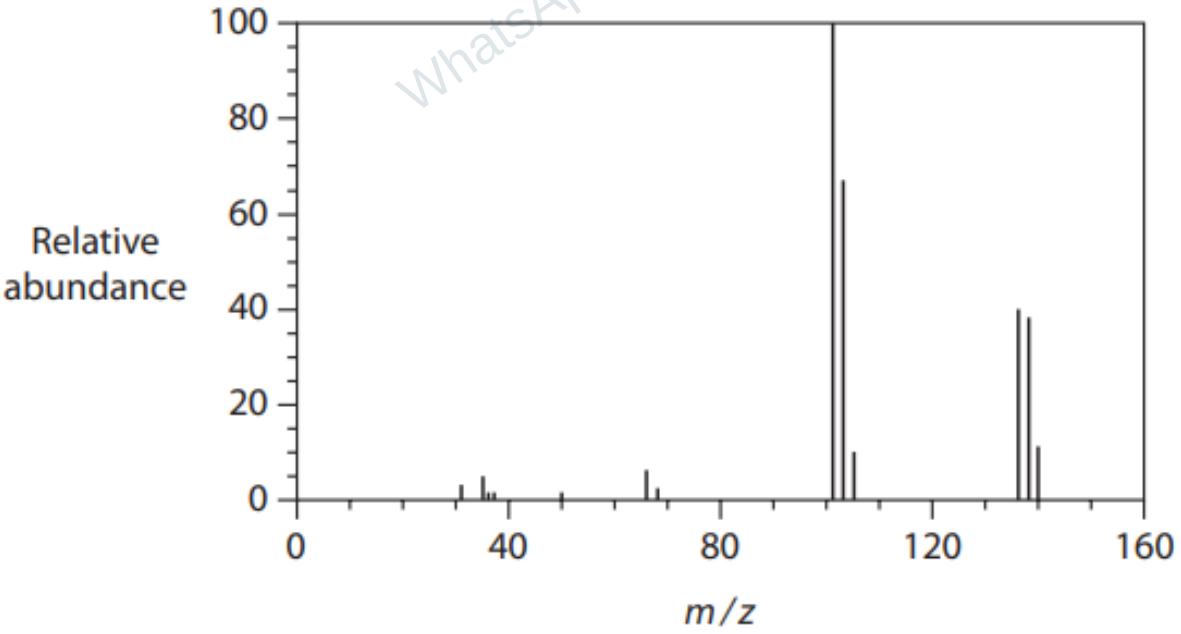
Calculate the relative atomic mass of this sample of chlorine, giving your answer to **four** significant figures.

(2)

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(c) The mass spectrum of phosphorus trichloride, PCl_3, is shown.

Phosphorus has only one isotope, ^{31}P.



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(i) There are three peaks in the region of $m/z = 101–105$.

Complete the table to show the ions responsible for these peaks.

(2)

m/z	Formula of ion	Relative peak height
101		9
103		6
105		1

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(ii) Show that the relative peak heights given in the table are consistent with the isotopic ratio of ^{35}Cl to ^{37}Cl being 3 : 1.

(2)

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QUESTION NO 13:

This question is about the elements in Period 2 of the Periodic Table.

(a) The first ionisation energies of some elements in Period 2 are shown.

Element	Li	Be	B	C	N	O	F	Ne
First ionisation energy / kJ mol^{-1}	520	900	801	1086	1402		1681	2081

(i) Explain the **general** trend in first ionisation energy across Period 2.

(2)

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(ii) Predict a value for the first ionisation energy of oxygen.
Justify your answer.

(3)

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(b) The second ionisation energy of lithium, Li, is 7298 kJ mol^{-1}.

(i) Write the equation for the second ionisation energy of lithium.
Include state symbols.

(2)

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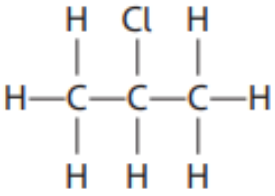
(ii) Explain the large difference between the first and second ionisation energies of lithium.

(2)

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QUESTION NO 14:

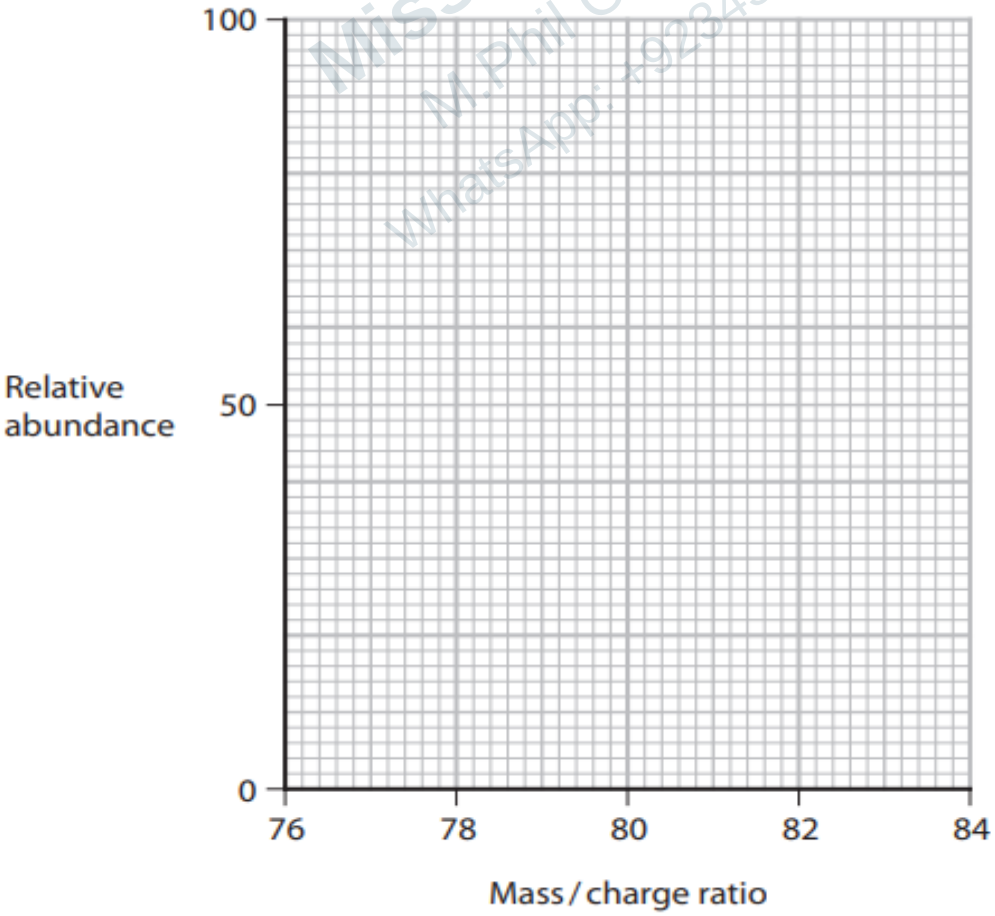
This question is about 2-Chloropropane.



(a) 2-Chloropropane has a relative molecular mass of 78.5 g mol^{-1}.
Chlorine has two common isotopes, ^{35}Cl and ^{37}Cl.
There are three times more ^{35}Cl atoms than ^{37}Cl atoms.
The main isotope of hydrogen is ^{1}H and that of carbon is ^{12}C.
The diagram shows a mass spectrum grid.

Draw the peaks for the molecular ions of 2-Chloropropane resulting from these isotopes.

(2)



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QUESTION NO 15:

This question is about magnesium, magnesium oxide and magnesium sulfate.

(a) A sample of magnesium contains three isotopes and has a relative atomic mass of 24.32.
The table gives the relative abundances of two of these isotopes.

Mass number	24	25
Relative abundance / %	78.99	10.00

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(i) Calculate the relative abundance and hence the mass number of the third isotope.
Give your answer to the appropriate number of significant figures.
You must show all your working.

(4)

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(ii) State **one** similarity and **one** difference between these isotopes.

(1)

(iii) State which of these isotopes would be deflected most in a mass spectrometer. Justify your answer.

(1)

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QUESTION NO 16:

This question is about silicon.

(a) (i) Define relative atomic mass.

(2)

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(ii) Calculate the relative atomic mass of a sample of silicon, using the isotopic abundance data provided.
Give your answer to 3 significant figures.

Isotope	Abundance (%)
^{28}Si	91.07
^{29}Si	4.62
^{30}Si	3.00
^{32}Si	1.31

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(2)

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(iii) In the mass spectrum of silicon, there is also a small peak at $m/z = 14$. Deduce the formula of this particle.

(1)

(b) Consider the elements Al, Si, P and S.

(i) Explain the trend in the first ionisation energies of Al, Si and P.

(3)

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(ii) Explain why sulfur does **not** follow this trend.

(2)

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QUESTION NO 17:

The periods in the Periodic Table show trends in physical properties.

(a) (i) Explain the general trend in first ionisation energies for the Period 2 elements.

(2)

(ii) Explain which **one** of the elements from **lithium** to **nitrogen** deviates from this general trend.

(3)

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(b) Identify the **Period 3** element that has the following successive ionisation energies.

Ionisation energy / kJ mol^{-1}							
First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth
1000	2251	3361	4564	7012	8496	27 107	31 671

(1)

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