UXBRIDGE HIGH SCHOOL

Sixth Form Transition Pack

A Level Chemistry

COURSE INTRODUCTION

A level chemistry is MUCH more demanding than GCSE and requires a greater degree of commitment and independent learning. To enable you to cope with the demands of the course and achieve your target grades, it is essential that you fulfil the following expectations.

- **Attendance = attainment. Attend all lessons, arrive on time and bring all the necessary books. Do not book appointments during lesson hours.**
- **Necessary equipment of pens, paper, and your working folders should be brought to EVERY lesson.**
- **Take responsibility for arriving on time to lessons after break or after a free period.**
- **No mobile phones in use or in view in the lesson.**
- **Work to the best of your ability in class and focus on the lesson.**
- **Listen respectfully to the views of other students.**
- **Complete all homework and classroom work.**
- **Read widely in your own time, including reading the complete set texts for each component as soon as possible.**
- **Attempt all work. If you are unsure of what to do, of course you may ask questions, but there are times when your teacher will want you to work independently without question. You must respect this.**
- **Take advantage of any extra lessons/revision sessions.**
- **Keep to deadlines.**

A level chemistry is one of the most challenging A-Levels anyone can undertake. As such, A level chemistry is one of the most rewarding A-Levels anyone can undertake.

If you are carrying on your chemistry studies to A-Level, it is because your teachers feel you are able to rise to and meet the challenges of A level chemistry. If you are carrying on your studies of chemistry to A level, you have been given the opportunity to achieve something you will cherish for a life-time to come.

"A level chemistry is not simply a progression of GCSE. It is a step-up. Likewise, you must step-up your attitude and work ethic."

Essential summer reading

The difficulty of the material covered at A-Level is MUCH GREATER than that at GCSE. As such, it is VITAL that you begin familiarising yourself with this material over the summer holidays. Completion of the following tasks will ensure that you begin Year 12 in the best way possible, giving yourself the best chance of success.

1. **Buy the textbook and read through the first chapter on your own.**
   You begin your A-Level Chemistry as soon as you arrive back to school after the summer holidays. The first chapter your teacher will cover with you from the AQA A-Level Chemistry Syllabus (7404), will be;
   Chapter 1 – Atomic Structure.

   BUY THE TEXTBOOK NOW! Read through **Chapter 1** in the AQA A-Level Chemistry textbook (ISBN-10: 019835181X) on your own and make some notes.

2. **Answer the exam questions.**
   Once you're done reading the chapter, try answering the exam questions (ANSWERS INCLUDED!) in this handbook. It's fine to not be able to answer them well, but at least you are starting to get into the good habit of self-study. When school then begins in September, you will be so much better equipped to meet the challenges of A-Level.

Ensure your maths is on par.

There is a greater maths demand in Chemistry at A-Level than at GCSE.

Make sure any weaknesses in your GCSE Maths are strengthened, and start looking through worked maths examples in your A-Level textbook.

Essential summer viewing/listening

The following is a list of resources that you will find helpful during your summer work. This list is by no means exhaustive. Please feel free to share other resources with each other.

1. Kerboodle AQA Chemistry A-Level Textbook - www.kerboodle.com

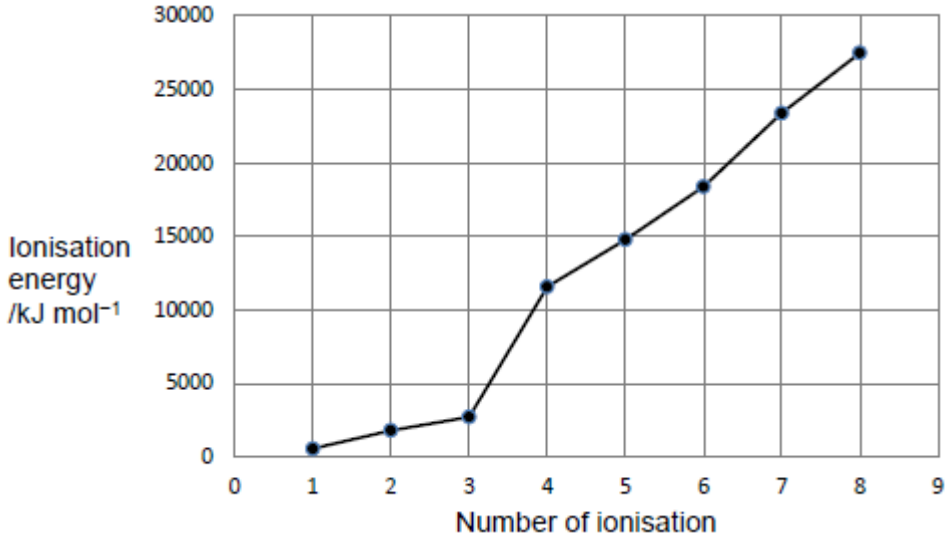
2. CGP revision guides.

3. Allery Chemistry Youtube channel - https://www.youtube.com/channel/UCPtWS4fCi25YHw5SPGdPz0g

Task to be completed

Chapter 1 – Atomic Structure

Q1. The successive ionisation energies for element X are shown in the following graph.



Which element is X?

A Nitrogen ⬭

B Phosphorus ⬭

C Aluminium ⬭

D Boron ⬭

(Total 1 mark)

Q2. Which of these atoms has the smallest number of neutrons?

A ^{3}H ⬭

B ^{4}He ⬭

C ^{5}He ⬭

D ^{4}Li ⬭

(Total 1 mark)

Q3. Which change requires the largest amount of energy?

A $He^+(g) \longrightarrow He^{2+}(g) + e^-$ ⬭

B $Li(g) \longrightarrow Li^+(g) + e^-$ ⬭

C $Mg^+(g) \longrightarrow Mg^{2+}(g) + e^-$ ⬭

D $N(g) \longrightarrow N^+(g) + e^-$ ⬭

(Total 1 mark)

Q4. This question is about electron configuration.

(a) Give the full electron configuration of an Al atom and of a Cr^{3+} ion.

Al atom.....

Cr^{3+} ion .....

(2)

(b) Deduce the formula of the ion that has a charge of 2+ with the same electron configuration as krypton.

.....

(1)

(c) Deduce the formula of the compound that contains 2+ ions and 3− ions that both have the same electron configuration as argon.

.....

(1)

(Total 4 marks)

Q5.(a) A sample of sulfur consisting of three isotopes has a relative atomic mass of 32.16.
The following table gives the relative abundance of two of these isotopes.

Mass number of isotope	32	33
Relative abundance / %	91.0	1.8

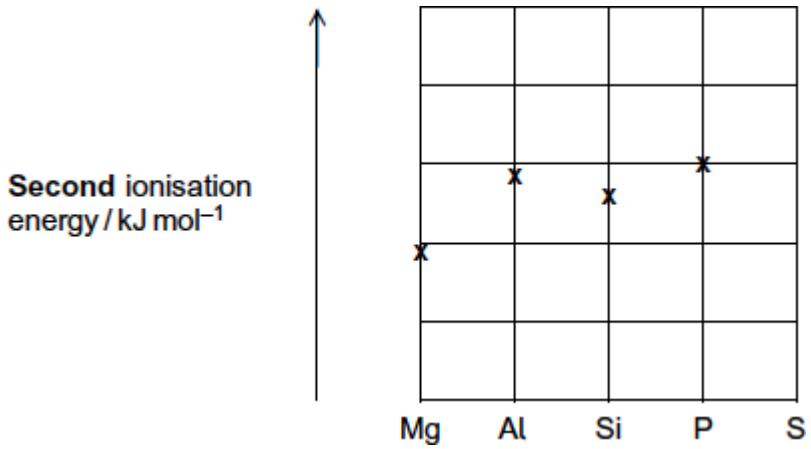
Use this information to determine the relative abundance and hence the mass number of the third isotope.
Give your answer to the appropriate number of significant figures.

Mass number = ...
(4)

(b) Describe how ions are formed in a time of flight (TOF) mass spectrometer.
.....
.....
.....
.....
.....
(2)

(c) A TOF mass spectrometer can be used to determine the relative molecular mass of molecular substances.
Explain why it is necessary to ionise molecules when measuring their mass in a TOF mass spectrometer.
.....
.....
.....
.....
.....
(2)
(Total 8 marks)

Q6.(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)

Q7.(a) Nickel is a metal with a high melting point.

(i) State the block in the Periodic Table that contains nickel.

.....

(1)

(ii) Explain, in terms of its structure and bonding, why nickel has a high melting point.

.....

.....

.....

.....

.....

(2)

(iii) Draw a labelled diagram to show the arrangement of particles in a crystal of nickel.
In your answer, include at least six particles of each type.

(2)

(iv) Explain why nickel is ductile (can be stretched into wires).

.....

.....

.....

(1)

(b) Nickel forms the compound nickel(II) chloride ($NiCl_2$).

(i) Give the full electron configuration of the Ni^{2+} ion.

.....

(1)

(ii) Balance the following equation to show how anhydrous nickel(II) chloride can be obtained from the hydrated salt using $SOCl_2$

Identify **one** substance that could react with both gaseous products.

.....$NiCl_2.6H_2O(s)$ + ... $SOCl_2(g)$ ⟶ .....$NiCl_2(s)$ + ...$SO_2(g)$ + ...$HCl(g)$

Substance .....

(2)

(Total 9 marks)

Q8. Aluminium and thallium are elements in Group 3 of the Periodic Table.

Both elements form compounds and ions containing chlorine and bromine.

(a) Write an equation for the formation of aluminium chloride from its elements.

.....

(1)

(b) An aluminium chloride molecule reacts with a chloride ion to form the $AlCl_4^-$ ion.

Name the type of bond formed in this reaction. Explain how this type of bond is formed in the $AlCl_4^-$ ion.

Type of bond .....

Explanation .....

.....

.....

(2)

(c) Aluminium chloride has a relative molecular mass of 267 in the gas phase.

Deduce the formula of the aluminium compound that has a relative molecular mass of 267

.....

(1)

(d) Deduce the name or formula of a compound that has the same number of atoms, the same number of electrons and the same shape as the $AlCl_4^-$ ion.

.....

(1)

(e) Draw and name the shape of the $TlBr_5^{2-}$ ion.

Shape of the $TlBr_5^{2-}$ ion.

Name of shape .....

(2)

(f) (i) Draw the shape of the $TlCl_2^+$ ion.

(1)

(ii) Explain why the $TlCl_2^+$ ion has the shape that you have drawn in part (f)(i).

.....

.....

.....

(1)

(g) Which **one** of the first, second or third ionisations of thallium produces an ion with the electron configuration [Xe] $5d^{10}6s^{1}$?

Tick (✓) one box.

First ☐

Second ☐

Third ☐

(1)

(Total 10 marks)

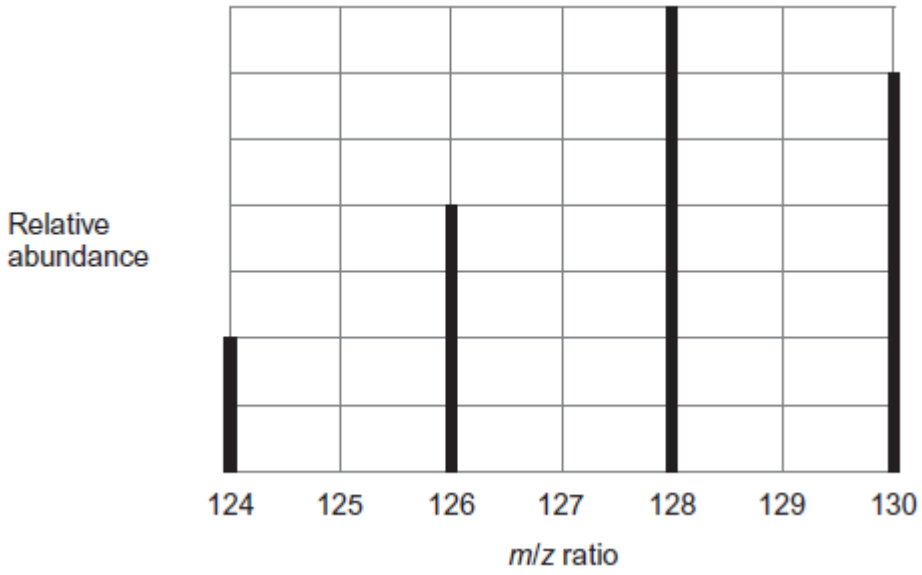
Q9. Tellurium is the element with atomic number of 52

(a) Using information from the Periodic Table, complete the electron configuration of tellurium.

[Kr] .....

(1)

(b) The mass spectrum of a sample of tellurium is shown in the graph.



(i) Use the graph to calculate the relative atomic mass of this sample of tellurium. Give your answer to one decimal place.

.....

.....

.....

.....

.....

(3)

(ii) Suggest what might cause the relative atomic mass of this sample to be different from the relative atomic mass given in the Periodic Table.

.....

.....

(1)

(c) Write an equation for the reaction that occurs when a tellurium ion hits the detector.

.....

(1)

(d) State the m / z value of the ions that produce the biggest current at the detector when the spectrum in the graph is recorded.

Give a reason for your answer.

m / z value .....

Reason .....

.....

.....

(2)

(e) The mass spectrum of tellurium also has a small peak at $m / z = 64$

Explain the existence of this peak.

.....

.....

.....

.....

(2)

(f) Predict whether the atomic radius of ^{124}Te is larger than, smaller than or the same as the atomic radius of ^{130}Te

Explain your answer.

Atomic radius of ^{124}Te compared to ^{130}Te .....

Explanation .....

.....

.....

.....

(2)

(Total 12 marks)

Q10.(a) Explain how ions are accelerated, detected and have their abundance determined in a time of flight (TOF) mass spectrometer.

.....

.....

.....

.....

.....

(3)

(b) Calculate the mass, in kg, of a single $^{52}Cr^{+}$ ion.

Assume that the mass of a $^{52}Cr^{+}$ ion is the same as that of a ^{52}Cr atom.

(The Avogadro constant L = 6.022×10^{23} mol^{-1})

.....

.....

(1)

(c) In a TOF mass spectrometer the kinetic energy (KE) of a $^{52}Cr^{+}$ ion was 1.269×10^{-13} J

Calculate the velocity of the ion using the equation.

$$KE = \frac{1}{2}mv^2$$

(m = mass/kg and v = velocity/ms^{-1})

.....

.....

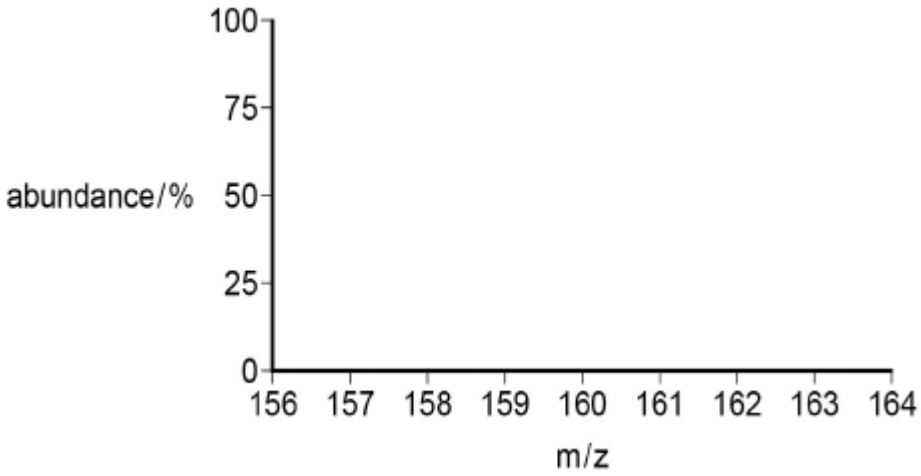
.....

.....

(2)

(d) Bromine has two isotopes, ^{79}Br and ^{81}Br, in approximately equal abundance. In a TOF mass spectrometer bromine forms ions with formula $[Br_2]^{+}$

Sketch the pattern of peaks you would expect to see in the mass spectrum of a sample of bromine.



(2)

(e) A sample of xenon has A_r = 131.31. The sample consists of four isotopes. The abundances of three of the isotopes are shown in the table below. The data for one of the isotopes, ^{m}Xe, is missing.

Isotope	^{129}Xe	^{131}Xe	^{132}Xe	^{m}Xe
% abundance	28.0	25.0	27.0	To be calculated

Use the data to calculate the abundance of isotope ^{m}Xe and calculate m, the mass number of ^{m}Xe. Show your working.

.....

.....

.....

.....

.....

.....

.....

(4)

(Total 12 marks)

Answers

M1.C

[1]

M2.D

[1]

M3.A

[1]

M4.(a) $1s^2 2s^2 2p^6 3s^2 3p^1$

1

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^3$

1

If noble gas core used correctly in both then scores 1

Allow subscripts and capitals

Ignore $4s^0$

(b) Sr^{2+}

Ignore name and correct proton/mass number

Allow Sr^{+2}

1

(c) Ca_3P_2

Allow reversed or ionic formula

Ignore name

1

[4]

M5.(a) Abundance of third isotope = 100 - 91.0 -1.8 = 7.2%

1

$$\frac{(32 \times 91) + (33 \times 1.8) + (y \times 7.2)}{100} = 32.16$$

1

$7.2y = 32.16 \times 100 - 32 \times 91 - 33 \times 1.8 = 244.6$

1

$y = 244.6 / 7.2 = 33.97$

$y = 34$

Answer must be rounded to the nearest integer

1

(b) (for electrospray ionisation)

A high voltage is applied to a sample in a polar solvent

1

the sample molecule, M, gains a proton forming MH^+

1

OR

(for electron impact ionisation)

the sample is bombarded by high energy electrons

1

the sample molecule loses an electron forming M^+

1

(c) Ions, not molecules, will interact with and be accelerated by an electric field

1

Only ions will create a current when hitting the detector

1

[8]

M6.(a) (i) Higher than P

1

(ii) $1s^2\ 2s^2\ 2p^6\ 3s^1$

Allow any order

1

(iii) $Al^+(g) + e^{(-)} \longrightarrow Al^2+(g) + 2e^{(-)}$

OR

$Al^+(g) \longrightarrow Al^{2+}(g) + e^{(-)}$

OR

$Al^+(g) - e^{(-)} \longrightarrow Al^{2+}(g)$

1

(iv) Electron in Si (removed from) (3)p orbital / electron (removed) from higher energy orbital or sub-shell / electron in silicon is more shielded

Accept converse arguments relating to Al

Penalise incorrect p-orbital

1

(b) Sodium / Na

Allow Na^+

1

Electron (removed) from the 2nd shell / 2p (orbital)

M2 is dependent on M1

Allow electron from shell nearer the nucleus (so more attraction)

1

(c) Silicon / Si

Not SI

1

(d) Heat or energy needed to overcome the attraction between the (negative) electron and the (positive) nucleus or protons

Not breaking bonds

QoL

Or words to that effect eg electron promoted to higher energy level (infinity) so energy must be supplied

1

[8]

M7.(a) (i) d (block) **OR** D (block)

Ignore transition metals / series.

Do not allow any numbers in the answer.

1

(ii) Contains positive (metal) ions or protons or nuclei and delocalised / mobile / free / sea of electrons

Ignore atoms.

1

Strong attraction between them or strong metallic bonds

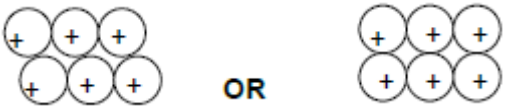
Allow 'needs a lot of energy to break / overcome' instead of 'strong'.

If strong attraction between incorrect particles, then CE = 0 / 2.

If molecules / intermolecular forces / covalent bonding / ionic bonding mentioned then CE=0.

1

(iii)



M1 is for regular arrangement of atoms / ions (min 6 metal particles).

M2 for + sign in each metal atom / ion.

Allow 2^+ sign.

2

(iv) Layers / planes / sheets of atoms or ions can slide over one another

QoL.

1

(b) (i) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^8\ (4s^0)$

Only.

1

(ii) $NiCl_2.6H_2O + \mathbf{6}\ SOCl_2 \longrightarrow NiCl_2 + \mathbf{6}\ SO_2 + \mathbf{12}\ HCl$

Allow multiples.

1

$NaOH$ / NH_3 / $CaCO_3$ / CaO

Allow any name or formula of alkali or base.

Allow water.

1

[9]

M8.(a) $Al + 1.5Cl_2 \rightarrow AlCl_3$

Accept multiples.

Also $2Al + 3Cl_2 \rightarrow Al_2Cl_6$

Ignore state symbols.

1

(b) Coordinate / dative (covalent)

If wrong CE=0/2 if covalent mark on.

1

Electron pair on Cl^- donated to $Al(Cl_3)$

QoL

Lone pair from Cl^- *not just Cl*

Penalise wrong species.

1

(c) Al_2Cl_6 or $AlBr_3$

Allow Br_3Al *or* Cl_6Al_2

Upper and lower case letters must be as shown.

Not $2AlCl_3$

1

(d) $SiCl_4$ / silicon tetrachloride

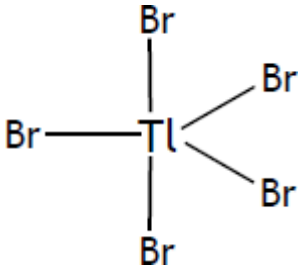
Accept silicon(4) chloride or silicon(IV) chloride.

Upper and lower case letters must be as shown.

Not silicon chloride.

1

(e)



Accept shape containing 5 bonds and no lone pairs from Tl to each of 5 Br atoms.

Ignore charge.

1

Trigonal bipyramid(al)

1

(f) (i) Cl – Tl – Cl

Accept this linear structure only with no lone pair on TI

1

(ii) (Two) bonds (pairs of electrons) repel equally / (electrons in) the bonds repel to be as far apart as possible

Dependent on linear structure in (f)(i).

Do not allow electrons / electron pairs repel alone.

1

(g) Second

1

[10]

M9.(a) $5s^2\ 4d^{10}\ 5p^4$ / $4d^{10}\ 5s^2\ 5p^4$

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^4$

or $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6\ 4d^{10}\ 5s^2\ 5p^4$

Allow any order but must finish with $5p^4$

1

(b) (i) $\frac{(124\times2)+(126\times4)+(128\times7)+(130\times6)}{19}$ or $\frac{2428}{19}$

M1 for top line

1

127.8

M2 for correct denominator

1

127.8 with no working shown scores 3 marks

1

Or

$\frac{(124\times10.5)+(126\times21.1)+(128\times36.8)+(130\times31.6)}{100}$

1

Mark for 100 dependent on top line correct

1

127.8

1

(ii) Other isotopes present / some isotopes absent / different abundances of isotopes

1

(c) $Te^{+} + e^{(-)} \rightarrow Te$

Ignore state symbols

Allow $Te^{2+} + 2e^{(-)} \rightarrow Te$

1

(d) 128

Only

1

Most abundant ion (QoL – superlative)

M2 dependent on correct M1

1

(e) 2+ ion formed / 2 electrons removed

Due to $^{128}Te^{2+}$ = 2 marks

1

From ^{128} (Te)

Mark independently

1

(f) Same

If not same CE = 0 / 2

1

(Each isotope has the) same number of protons / same nuclear charge and same number of electrons / electronic configuration

Ignore more neutrons in ^{130}Te

1

[12]

M10.(a) (Ions accelerated by) attraction to negatively charged plate /electric field

Mark independently

1

Ions detected by gaining electrons

Allow the transfer of electrons

1

Abundance determined by (size) of current flowing (or amount of electrons gained) in the detector

Allow current is proportional to abundance

1

(b) Mass = $\frac{52/1000}{6.022\times10^{23}}$

Mass = $8.6(4) \times 10^{-26}$

1

(c) $V^2 = (2 \times 1.269 \times 10^{-13}) / 8.64 \times 10^{-26}$

Allow correct rearrangement for V or V^2

1

$V = 1.71 \times 10^6$ ms^{-1}

Allow ecf from (b) (note if 8.6×10^{-23} in (b) leads to approx. 5.4×10^4 ms^{-1})

1

(d) Sketch with peaks at 158, 160, 162

Mark independently

1

In ratio 25%:50%:25%

Allow approx. ratio 1:2:1

1

(e) % abundance ^{m}Xe = 20(%)

Working must be shown

1

131.31 = (0.28*129) + (0.25*131) + (0.27*132) + (0.20*m)

1

131.31 - 104.51 = 0.2m

1

Mass number = 134

Answer must be an integer

1

[12]