

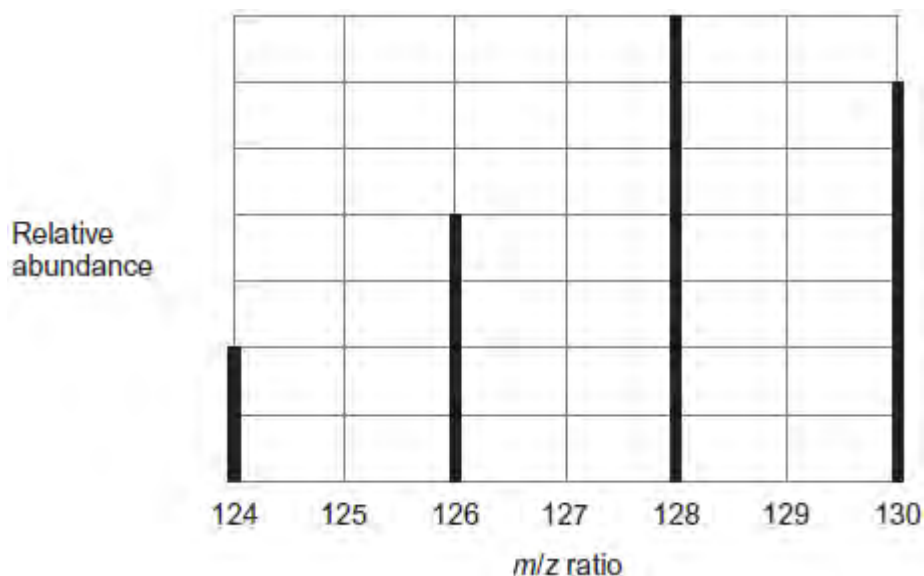
Q1. Tellurium is the element with atomic number of 52

- (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)

Q2.(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)

Q3. Which of these atoms has the smallest number of neutrons?

A ^3H

B ^4He

C ^5He

D ^4Li

(Total 1 mark)

Q4.(a) State the meaning of the term *mass number* of an isotope.

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

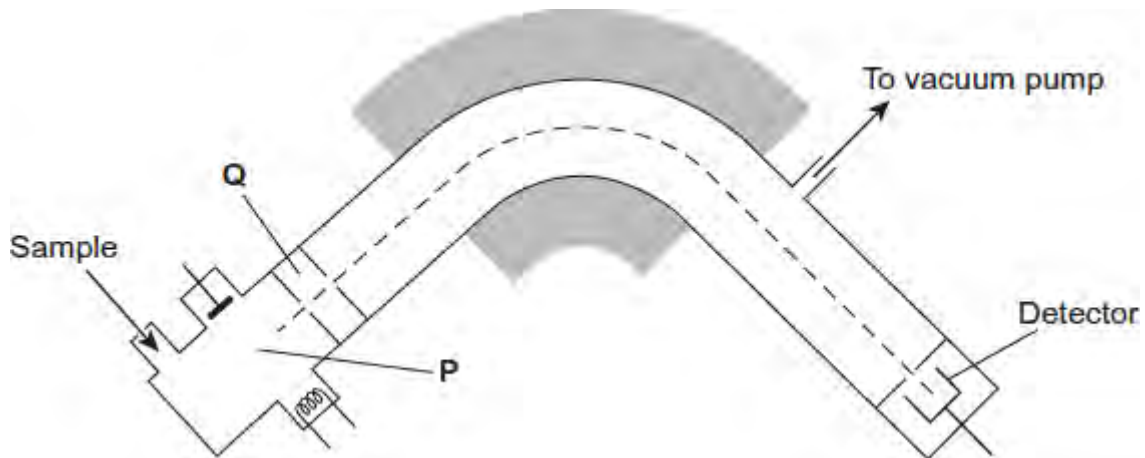
(1)

(b) Give the symbol of the element that has an isotope with a mass number of 68 and has 38 neutrons in its nucleus.

.....

(1)

(c) The following shows a simplified diagram of a mass spectrometer.



(i) State what happens to the sample in the parts labelled **P** and **Q**.

P

Q

(2)

(ii) In a mass spectrometer, the isotopes of an element are separated. Two measurements for each isotope are recorded on the mass spectrum.

State the **two** measurements that are recorded for each isotope.

Measurement 1

Measurement 2

(2)

(d) A sample of element **R** contains isotopes with mass numbers of 206, 207 and 208 in a 1:1:2 ratio of abundance.

(i) Calculate the relative atomic mass of **R**. Give your answer to one decimal place.

.....

(3)

(ii) Identify **R**.

.....

(1)

(iii) All the isotopes of **R** react in the same way with concentrated nitric acid.

State why isotopes of an element have the same chemical properties.

.....

.....

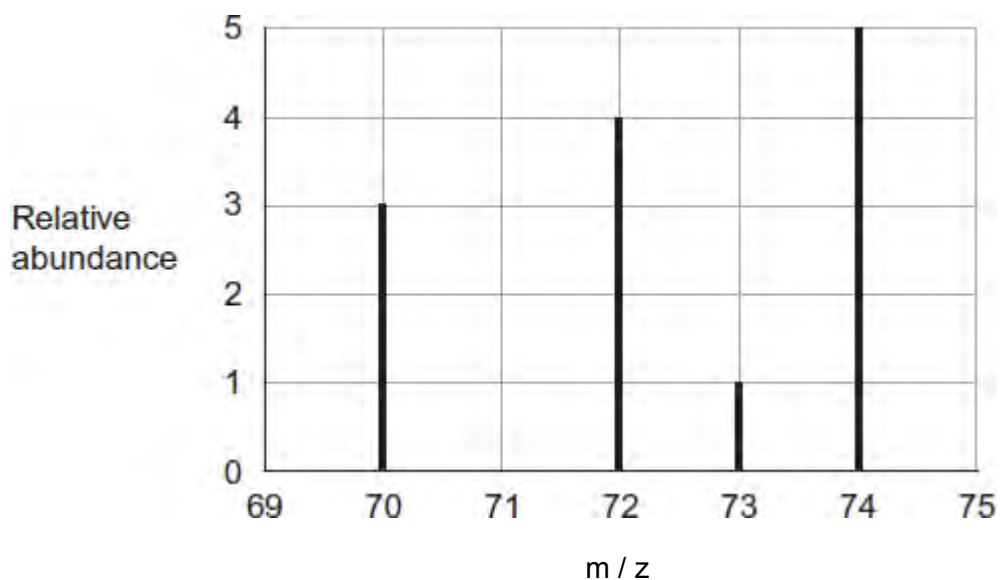
(Extra space)

.....

(1)

(Total 11 marks)

Q5.The mass spectrum of the isotopes of element **X** is shown in the diagram.



(a) Define the term *relative atomic mass*.

.....

.....

.....

.....

(2)

(b) Use data from the diagram to calculate the relative atomic mass of **X**.

Give your answer to one decimal place.

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

(3)

(c) Identify the ion responsible for the peak at 72

.....

(1)

(d) Identify which one of the isotopes of **X** is deflected the most in the magnetic field of a mass spectrometer. Give a reason for your answer.

Isotope

Reason

(2)

(e) In a mass spectrometer, the relative abundance of each isotope is proportional to the current generated by that isotope at the detector.

Explain how this current is generated.

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

(2)

(f) **X** and **Zn** are different elements.

.....
.....

Explain why the chemical properties of ^{70}X and ^{70}Zn are different.

(1)
(Total 11 marks)

Q6.A sample of ethanedioic acid was treated with an excess of an unknown alcohol in the presence of a strong acid catalyst. The products of the reaction were separated and analysed in a time of flight (TOF) mass spectrometer. Two peaks were observed at $m/z = 104$ and 118 .

(a) Identify the species responsible for the two peaks.

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

(2)

(b) Outline how the TOF mass spectrometer is able to separate these two species to give two peaks.

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

(4)
(Total 6 marks)

Q7.(a) **Table 1** shows some data about fundamental particles in an atom.

Table 1

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

(i) An atom of hydrogen can be represented as ${}^1\text{H}$

Use data from **Table 1** to calculate the mass of this hydrogen atom.

.....

(1)

(ii) Which **one** of the following is a fundamental particle that would **not** be deflected by an electric field?

A electron

B neutron

C proton

Write the correct letter, **A**, **B** or **C**, in the box.

(1)

(b) A naturally occurring sample of the element boron has a relative atomic mass of 10.8.

In this sample, boron exists as two isotopes, ${}^{10}\text{B}$ and ${}^{11}\text{B}$

(i) Calculate the percentage abundance of ${}^{10}\text{B}$ in this naturally occurring sample of boron.

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

(2)

- (ii) State, in terms of fundamental particles, why the isotopes ^{10}B and ^{11}B have similar chemical reactions.

.....

(1)

- (c) Complete **Table 2** by suggesting a value for the third ionisation energy of boron.

Table 2

	First	Second	Third	Fourth	Fifth
Ionisation energy / kJ mol^{-1}	799	2420		25 000	32 800

(1)

- (d) Write an equation to show the process that occurs when the **second** ionisation energy of boron is measured. Include state symbols in your equation.

.....

(1)

- (e) Explain why the second ionisation energy of boron is higher than the first ionisation energy of boron.

.....

(1)

(Total 8 marks)