

Name of the Student: _____

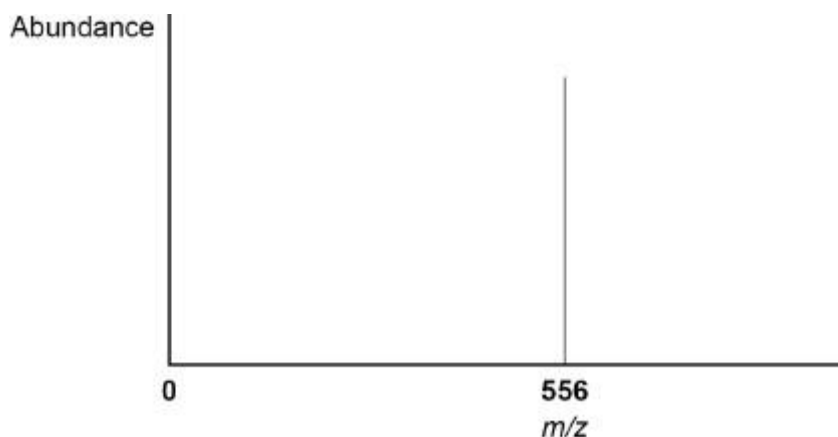
Max. Marks : 26 Marks

Time : 26 Minutes

Q1.

Time of flight (TOF) mass spectrometry can be used to analyse large molecules such as the pentapeptide, leucine enkephalin (**P**).

P is ionised by electrospray ionisation and its mass spectrum is shown in the diagram.



(a) Describe the process of electrospray ionisation.

Give an equation to represent the ionisation of **P** in this process.

Description _____

Equation

(4)

- (b) What is the relative molecular mass of **P**?
Tick (✓) **one** one box.

555

☐

556

☐

557

☐

(1)

- (c) A molecule **Q** is ionised by electron impact in a TOF mass spectrometer.
The **Q**⁺ ion has a kinetic energy of $2.09 \times 10^{-15} \text{ J}$
This ion takes $1.23 \times 10^{-5} \text{ s}$ to reach the detector.
The length of the flight tube is 1.50 m

Calculate the relative molecular mass of **Q**.

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

where m = mass (kg) and v = speed (m s^{-1})

The Avogadro constant, $L = 6.022 \times 10^{23} \text{ mol}^{-1}$

Relative molecular mass _____

(5)

(Total 10 marks)

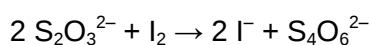
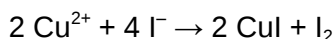
Q2.

A student does an experiment to determine the percentage of copper in an alloy.

The student

- reacts 985 mg of the alloy with concentrated nitric acid to form a solution (all of the copper in the alloy reacts to form aqueous copper(II) ions)
- pours the solution into a volumetric flask and makes the volume up to 250 cm³ with distilled water
- shakes the flask thoroughly
- transfers 25.0 cm³ of the solution into a conical flask and adds an excess of potassium iodide
- uses exactly 9.00 cm³ of 0.0800 mol dm⁻³ sodium thiosulfate (Na₂S₂O₃) solution to react with all the iodine produced.

The equations for the reactions are



- (a) Calculate the percentage of copper by mass in the alloy.

Give your answer to the appropriate number of significant figures.

% copper _____

(6)

- (b) Suggest **two** ways that the student could reduce the percentage uncertainty in the measurement of the volume of sodium thiosulfate solution, using the same apparatus as this experiment.

1 _____

2 _____

3

(2)

- (c) State the role of iodine in the reaction with sodium thiosulfate.

(1)

- (d) Give the full electron configuration of a copper(II) ion.

(1)

- (e) Copper(I) iodide is a white solid.

Explain why copper(I) iodide is white.

(2)

- (f) Iodine vaporises easily.

Calculate the volume, in cm^3 , that 5.00 g of iodine vapour occupies at 185°C and 100 kPa

The gas constant $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$

Give your answer to 3 significant figures.

Volume _____ cm³ (4)
(Total 16 marks)