**CEM8X03 2022 EXAM B**

## QUESTION ONE

1.1. Elemental analysis has a wide range of applications. Give at least five areas of applications of elemental analysis with examples. (5)

1.2. Analytical techniques such as ICP-MS are used for simultaneous multi-element detection. You are tasked to prepare mixed standard solutions containing four elements for ICP-MS analysis. You are given stock solutions of four elements in four different vials with the label concentrations shown in brackets (ppm): Mn (1000); Zn (1000); Pb (500); As (500). From these stock solutions, you are asked to describe the preparation of the following mixed standard solutions in 10 mL volumetric flask with concentration of each element shown in bracket below.

(a) Standard 3 (ppm): Mn (1), Zn (1), Pb (0.5), As (0.5)

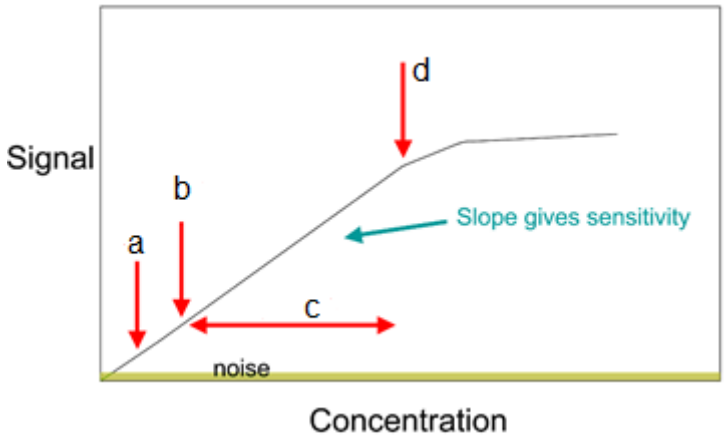
(b) Standard 2 (ppb): Mn (200), Zn (200), Pb (100), As (100)

(c) Standard 1 (ppb): Mn (20), Zn (20), Pb (10), As (10)

Please note that you have 10 – 100 μL and 100 – 1000 μL variable micropipettes to transfer the standard solutions. Follow the best economical approach to prepare the standard solutions. (12)

1.3. Briefly explain robustness and ruggedness of a method. (4)

1.4. A curve showing a linear relationship between detector response (Y-axis) and concentration (X-axis) is shown below. Correctly label from (a) to (d) and briefly explain these analytical figures of merit which are depicted in the figure from (a) to (d). (12)




1.5. For two solutions containing the same concentration of nickel, the atomic absorption at 352.4 nm was about 30% greater for a solution that contained 50% ethanol than for an aqueous solution that contained no ethanol. Rationalise. (4)

**[37]**

**QUESTION TWO**

2.1. Discuss the role of matrix modifiers in GF-AAS. Give at least two examples of matrix modifiers. (6)

2.2. An experiment was carried out to determine the levels of Pb accumulated in bovine meat. A 1.00 g portion of the homogenised meat sample was taken and digested with 5 mL of nitric acid. The mixture was cooled, filtered and then made up to a volume of 1.00 L with de-ionised water. A 10.00 mL aliquot of this solution was then further diluted to a 100 mL volumetric flask. This solution was then analysed using atomic absorption spectrometer and gave an absorbance of 0.351.

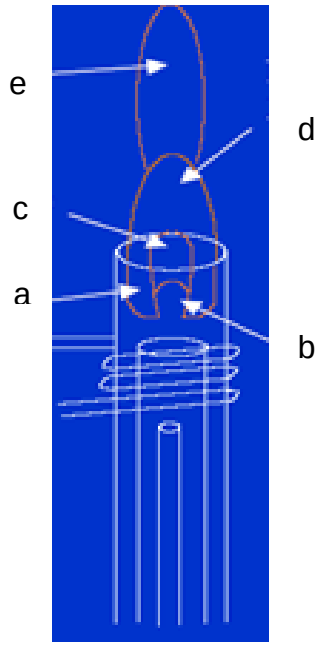
The absorbance values of a series of standard solutions of Pb in ppm were also measured and a least-squares analysis of calibration data yielded the equation y = 0.435X - 0.25. Answer questions (a) through (c) based on the provided data.

(a) What is the concentration, in ppm, of Pb in the 100 mL volumetric flask? (2)

(b) Calculate the concentration of Pb in the 1.00 L solution of meat sample. (3)

(c) Calculate the concentration, in µg/g, of Pb in the original meat sample. (3)

2.3. The figure below schematically depicts plasma generation. Correctly name different zones of the plasma labelled (a) to (e) and comment on each zone. (10)




2.4. What are advantages of axial arrangement over radial configuration in ICP-OES? (2)

2.5. Differentiate between soft and hard lines. How should the observation height be set for detecting hard and soft lines? [5]

2.6. Why are arc/spark emission spectrometers ideal for industrial applications? [2]

**[33]**

## QUESTION THREE

3.1. What are the applications of isotope ratio measurements? Illustrate your answer by giving example. [5]

3.2. Interferences are commonly encountered in chemical analysis. Answer questions (a) and (b) based on types of interferences encountered in ICP-MS analysis.

(a) Briefly explain non-spectroscopic interferences in ICP-MS. (2)

(b) Briefly explain spectroscopic interferences in ICP-MS. (5)

3.3. An ICP-MS is routinely used for the quantitative analysis of multiple elements in solutions or liquid samples.

(a) Explain how you would extend the application of ICP-MS to solid sample analysis. (4)

(b) Why is solid sample analysis so important even though we can still dissolve solids to analyse them in liquid form? (3)

3.4. What types of information can be acquired in speciation studies? (5)

3.5. Why do we use hyphenated techniques if standard techniques are available? Illustrate your answer by providing examples. (6)

**[30]**

## The Periodic Table