

**UNIVERSITY EXAMINATIONS****1ST SEMESTER 2022/2023 ACADEMIC YEAR****FOURTH YEAR EXAMINATION FOR THE DEGREES
OF BACHELOR OF EDUCATION (SCIENCE),
BACHELOR OF SCIENCE (GEN)****CHEM 415: ANALYTICAL CHEMISTRY II*****STREAM: R******TIME: 2 HRS******DAY: MONDAY [11.30AM – 13.30] DATE: 19/12/2022*****THIS QUESTION PAPER CONSISTS OF FOUR (4) PAGES****PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.**

INSTRUCTIONS: ATTEMPT ALL QUESTIONS. QUESTION ONE CARRIES 30 MARKS, QUESTIONS TWO AND THREE CARRY 20 MARKS EACH.

A STATISTICAL t- test TABLE IS PROVIDED

QUESTION ONE

- (a) Define the following terms
- (i) Limit of detection
 - (ii) Thermal gravimetric Analysis(TGA)
 - (iii) Chemical shift
 - (iv) Absorption edge in X-Ray
 - (v) Gradient elution (5 marks)
- (b) Distinguish between
- (i) Normal- and reverse phase chromatography (2 marks)
 - (ii) Molecular ion- and base peak (2 marks)
 - (iii) DTA and DSC (2 marks)
- (c) What infrared bands would you expect if you thought an unknown compound was
- (i) An alcohol (1 marks)
 - (ii) An aldehyde (2 marks)
 - (iii) An ester (2 marks)
- (d)
- (i) State three advantages of double -beam over single-beam spectrophotometers (3 marks)
 - (ii) An X-Ray tube is operated at 75 kV. What wavelength of X-rays is emitted? (2 marks)
 - (iii) What are the main advantage and the main weakness of neutron activation analysis? (2 marks)
- (e)
- (i) Describe electrophoresis and show how it differs from ion exchange chromatography (2 marks)
 - (ii) What is the difference between NMR and ESR? (2 marks)
 - (iii) Write the structure and the spectrum of 1,1, 2- trichloroethane. (3 marks)

QUESTION TWO

(a) The following results were obtained when each of a series of standard silver solutions was

Concentration mols/L:	0	1	2	3	4	5	6
Signal (intensity):	1.05	2.5	4.5	6.3	8.65	10.5	12.35

Determine the: -

- Correlation coefficient
- Slope and intercept and the line of best fit
- Standard deviations and the confidence limits of the line of regression
- X_0 , X_0 for a sample giving a signal of 13.5 units

X_i	y_i	$x_i - \bar{x}$	$y_i - \bar{y}$	$(y_i - \bar{y})^2$	$(y_i - \bar{y})(x_i - \bar{x})$
0	1.05	-3	-5.5	30.25	
1	2.5	-2	-4.05		
2	4.5	-1	-2.05		
3	6.3	0	-0.25		
4	8.65	1	2.1		
5	10.5	2	3.95		
6	12.35	3	6		
21	45.85				
3	6.55				

$$r = 0.9989$$

$$b = \text{mmmmmmmm}$$

- a) What are the advantages and disadvantages of Electron Impact sources in mass spectrometry? (4 marks)

QUESTION THREE

- a) Derive Bragg's equation (5marks)

- b) To a crude mixture of organic compounds containing some benzoic acid and benzoate was added 40.0 mg of benzoic acid ^{14}C (activity = 2000 counts/min). After equilibration, the mixture was acidified and extracted with an immiscible solvent. The extracted solid, following removal of solvent, was purified by crystallization of the benzoic acid to a constant melting point. The purified material weighed 60.0 mg and gave a count rate of 500 counts/min. Compute the weight of benzoic acid in *the* crude mixture. (7 marks)
- c) By use of an energy level diagram describe how fluorescence spectroscopy works. (8 marks)

