

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

**FIRST YEAR EXAMINATION FOR BACHELOR OF SCIENCE IN
CHEMISTRY, BACHELOR OF SCIENCE INDUSTRIAL CHEMISTRY AND
BACHELOR OF SCIENCE**

CHAL 101: STATISTICAL METHODS FOR ENVIRONMENTAL CHEMISTRY I

STREAMS: BSc (Y1S2)

TIME: 2 HOURS

DAY/DATE: THURSDAY 01/04/2021

8.30 A.M. – 10.30 A.M.

INSTRUCTIONS

- *Answer question one and any two questions*
- *Use of calculators and statistical tables is allowed*
- *Do not write on the question paper*

Question one (30 marks) compulsory question

- (a) Explain the following as used in analytical chemistry:
- | | |
|-------------------------|-----------|
| (i) Analyte. | (2 marks) |
| (ii) Matrix. | (2 marks) |
| (iii) Blank. | (2 |
| marks) | |
| (iv) Limit of decision. | (2 marks) |
| (v) Sampling unit. | (2 marks) |
- (b) i) Differentiate between stratified and cluster random sampling (4 marks)
- ii) Outline six purposes of sampling in chemical analysis. (3 marks)
- iii) Explain sampling error, giving its possible sources. (3 marks)
- (c) Discuss coning and quartering method of sampling reduction. (3 marks)
- (d) i) Discuss two uses of sampling experiments. (4 marks)

- ii) A repeated sampling from a certain process resulted in standard deviation of 0.187 in measurements of the property of interest. Determine the sample required to ensure 95% confidence that the average quality of a shipment lies within the limits ± 0.15 of the mean. (3 marks)

Question two (20 marks)

The following set of measurements was taken from a soil sample to determine ion in ppm: 60,55,64,49,55,65,55,65,63,55,55,66,63,55,58,65,61 and 55.

- (i) Calculate the mean, standard deviation, coefficient of variation and Pearson measure of skewness. (12 marks)
- (ii) Comment on the results obtained in 5(i) above (2 marks)
- (iii) Construct a 95% and 99% confidence interval for the population mean. (6 marks)

Question three (20 marks)

- (a) An analytical chemist claims that it is faster to test water quality using analytical kit A than kit B. To justify the claim, eight technicians of proven ability were assigned each to the two kits and the time taken in minute to carry out the analysis was recorded as follows:

Technician	1	2	3	4	5	6	7	8
Kit A	26	38	40	22	32	38	36	46
Kit B	34	44	44	28	28	42	34	48

At a 5% level of significance, determine if the analytical chemists' claim is valid. (8 marks)

- (b) Describe how you reduce systematic errors in chemical analysis. (12 marks)

Question four (20 marks)

- (a) In the determination of strontium in river water by flame emission spectrometry using the methods of standards additions, the following results were obtained:

Sr standard added (μmL^{-1})	0.0	10.0	15.0	20.0	25.0	30.0
Emission signal	2.3	4.4	5.3	6.1	7.5	8.7

- (i) Fit a simple linear regression model. (8 marks)
 - (ii) Determine the strontium concentration in the river water. (2 marks)
 - (iii) Obtain a correlation coefficient. (4 marks)
- (b) To test the amount of a given contaminant in two sites, samples were taken and analysed giving following statistics:

	Site	
	A	B
Sample size	12	18
Sample mean	10	8
Sample standard deviation	3	4

Using the statistics provide, test the claim that the two site are equally contaminated at 5% probability level. (6 marks)

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