MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATION

2023/2024 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER

SCHOOL OF PURE APPLIED AND HEALTH SCIENCES

BACHELOR OF SCIENCE IN CHEMISTRY

COURSE CODE: CHE 2110-1

COURSE TITLE: ANALYTICAL CHEMISTRY II

DATE: 13/12/2023   TIME: 1430-1630 HRS

INSTRUCTIONS TO CANDIDATES
   a) Answer All questions.
   b) All Examination Rules Apply

Question One (20mks)

a) State the meaning of the following terms as used in analytical chemistry
   i)   Blank **(1mk)**
   ii)   Detection limit **(1mk)**
   iii) Reproducibility **(1mk)**

b) Analytical methods may be classified as classical or instrumental methods, what advantage do instrumental methods have over classical methods **(3mks)**

c) A new method for analysis of mercury was tested against an ore sample that is known to assay 12.63 % Hg. The results were 12.76 %, 12.57%, 12.72%, 12.79%, 12.76%. Is there evidence of a systematic error in the new method at 95% confidence level. **(4mks)**

d) In a titrimetric procedure for determining iron content of a large lump of ore, a student obtained imprecise and inaccurate results.
   i)   Briefly explain the terms used to describe the results **(2mks)**
   ii)   Describe random errors encountered in the analysis and state how these can be minimized? **(2mks)**

e) Analysis of a group of water samples for nitrates (PPM) gave the following data: 29.03, 29.08, 28.97, 29.24. Apply a standard deviation test and decide if the outlying result should be retained or rejected at 95% confidence level. **(6mks)**

QUESTION TWO (15mks)

a) The following data were obtained in calibrating a turbidimeter for the determination of sulphate ions in natural water.

Mg SO_4^{2-}/L	0.00	5.0	10.0	15.0	20.0
Turbidimeter Reading	0.06	1.48	2.28	3.98	4.61

   i)   Calculate the means of the concentrations of sulphate ions and the instrument readings. **(2mks)**

   ii)   Calculate the slope (b) and intercept on y (a) and derive an equation of the best line of fit through the points. **(5mks)**

   iii)   Using the product moment correlation coefficient (r) determine whether there exists a linear relationship between the readings. **(5mks)**

   iv)   Carry out a t-test on r to confirm the linear relationship further. **(2mks)**

b) Explain the term retardation factor as used in chromatography **(1mks)**

QUESTION THREE (15mks)

a) The following figures refer to the albumen concentration in g/Litre in the blood sera of 8 men and 8 women.

MEN	37	39	37	42	39	45	39	42

WOMEN	41	43	47	47	45	39	40	44

Calculate the standard deviations for the albumen levels in men and women. Do they differ significantly at 95% confidence level? **(6mks)**

b) State one application of ion exchange chromatography **(1mk)**
c) Given the following chromatogram, calculate the capacity factors of benzene and toluene and the selectivity for the separation **(5mks)**

Toluene
333 s

Benzene
251 s

Methane
42 s
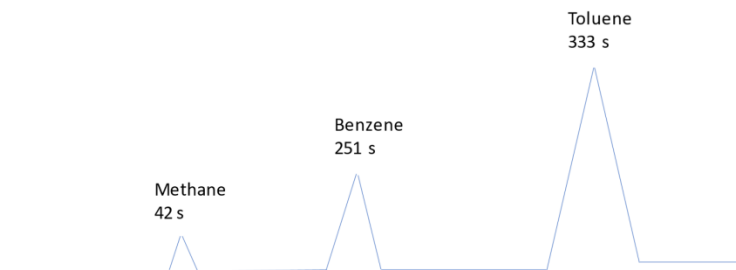
What are the implications of K' and α **(3mks)**

QUESTION FOUR (15mks)
a) Explain the need for separation of mixtures and state the two main categories of separation methods **(3mks)**
b) State any one non-chromatographic techniques. **(1mk)**

c) Explain any two sources of band broadening in column chromatography. **(4mks)**

d) An analyte eluded from a 12.2 M column in 407 s. The width at the base of the peak was measured to be 13 s. Calculate the number of plates and plate heights **(4mks)**

e) The retention time for compounds A and B is 16.4 min and 17.63 min respectively in a 30 cm column. The peak widths is 1.11 min for A and 1.21 min for B. Calculate resolution between the two compounds **(3mks)**

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