



MACHAKOS UNIVERSITY

University Examinations 2020/2021

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FIRST YEAR SECOND SEMESTER EXAMINATION

FOR BACHELOR OF SCIENCE (BIOLOGY)

SAN 101: LABORATORY PROCEDURES AND CLASSICAL ANALYSIS

DATE: 18/6/2021

TIME: 8:30 – 10:30 AM

INSTRUCTIONS:

- Question **ONE** is **COMPULSORY (SECTION A)** (30 marks).
- Answer **ANY** other **TWO** questions (**SECTION B**) (each 20 marks).
- Critical values for rejection quotient are as indicated in Table 1.

SECTION A (COMPULSORY) (30 MARKS)

QUESTION ONE (30 MARKS)

- Define a laboratory notebook and state two of its functions in the laboratory (3 marks)
- Differentiate between precision and accuracy (2 marks)
- State three reasons why reagents should not be placed directly on the weighing balance (3 marks)
- Discuss three characteristics of complexation reactions that can be analysed by volumetric method (3 marks)
- Calculate percentage by volume of ethanol, C_2H_6O in final solution when 85 mL of ethanol is diluted to a volume of 250 mL with water. (3 marks)
- Define the following terms as used in gravimetric analysis (3 marks)
 - Mixed crystal formation
 - Occlusion
 - Mechanical entrapment

- g) State two properties of a good precipitating agent as used in the gravimetric analysis (2 marks)
- h) Distinguish between qualitative and quantitative analysis (2 marks)
- i) Identify use of the following apparatus in a laboratory (3 marks)
- i. Volumetric flask
 - ii. Desiccator
 - iii. Measuring pipet
- j) Identify three factors to consider when sampling (3 marks)
- k) By giving suitable examples explain why most acids and alkalis cannot be used as primary standards (3 marks)

SECTION B: ANSWER ANY OTHER TWO QUESTIONS

QUESTION TWO (20 MARKS)

- a) Differentiate between systematic errors and random errors (6 marks)
- b) Discuss four ways of increasing selectivity of EDTA in complexometric titration (8 marks)
- c) Aluminum in 2.0 g of an ore sample is determined by dissolving it then precipitating it with $\text{Al}(\text{OH})_3$ and then igniting it to form Al_2O_3 . The ignited product is finally weighed. What percentage of aluminum was in the sample if the ignited precipitate weighed 0.2385 g ($\text{Al} = 27$, $\text{O} = 16$, $\text{H} = 1$) (6 marks)

QUESTION THREE (20 MARKS)

- a) Compare and contrast classical and instrumental methods as used in chemical analysis (6 marks)
- b) Discuss three types of EDTA titrations and identify at least one metal ion that can be analysed using the method (6 marks)
- c) The following weights were obtained in chemical determination of calcium in a sewage effluent sample. 29.8, 30.2, 28.6 and 29.9 mg. Calculate
- i. The average deviation and standard deviation of individual values (express these as absolute and relative values) (4 marks)
 - ii. The average deviation and standard deviation of the mean (2 marks)
 - iii. Range (2 marks)

QUESTION FOUR (20 MARKS)

- a) Calculate the concentration of a solution that contains 5.85 g of NaCl, in 200 cm³ of solution. (Na = 23, Cl = 35.5) (3 marks)
- b) calculate the mole fraction of each component in a solution in which 3.57 g of NaCl dissolved in 25.0 g of water (Na = 23, Cl = 35.5) (4 marks)
- c) A sample of calcium carbonate is dissolved in 20 mL of 0.225 M hydrochloric acid and the excess acid is titrated against 0.104 M sodium hydroxide. After dissolution a mass of 0.272 g of the calcium carbonate sample requires a titre of 12.39 mL of sodium hydroxide to reach phenolphthalein end point.
- Identify this type of titration (1 mark)
 - Explain the difference between end point and equivalence point (2 marks)
 - Determine the percentage of the CaCO₃ in the sample (6 marks)
- d) Write the term that refers to the following description (4 marks)
- An element in a sample whose quantitative information is required
 - A compound within a sample with similar characteristics to compound/element of interest and impedes analysis of the element/compound of interest
 - The process of leaving a precipitate in mother liquor at high temperature
 - A substance that is almost 100% pure that is employed in titration

QUESTION FIVE (20 MARKS)

- a) Soda fizz comes from sodium bicarbonate and citric acid (H₃C₆H₅O₇) reacting to make carbon dioxide, sodium citrate (Na₃C₆H₅O₇) and water. If 1.0 g of sodium bicarbonate and 1.0 g citric acid are reacted. Determine the limiting reagent and calculate the amount of carbon dioxide is produced. (Na = 23, C = 12, O = 16, H = 1) (6 marks)
- b) Perform a Q-test on the data set given below and determine if you can statistically designate data point 5 as an outlier within a 95% CL. If so, recalculate the mean and standard deviation at 95% CL (7 marks)

Cup Number	1	2	3	4	5	6	7	8	9	10
Caffein in ppm	78	82	81	77	72	79	82	81	78	83

- c) Identify three roles of a research analytical chemist (3 marks)
- d) State four properties of a good precipitate as obtained in gravimetric analysis (4 marks)

TABLE 1: Critical values for rejection quotient

Number of observations	90% CL	95%	99%
3	0.941	0.970	0.994
4	0.765	0.829	0.926
5	0.642	0.710	0.821
6	0.560	0.625	0.740
7	0.507	0.568	0.680
8	0.468	0.526	0.634
9	0.437	0.493	0.598
10	0.412	0.466	0.568