



SCHOOL OF NATURAL SCIENCES
DEPARTMENT OF PHYSICS, GEOGRAPHY AND
ENVIRONMENTAL SCIENCE
BACHELOR OF SCIENCE HONOURS DEGREE IN CHEMICAL
TECHNOLOGY
LEVEL 1 SEMESTER 1& 2
EXAMINATION QUESTION PAPER

MODULE CODE	HCT 114/CCHS 122
MODULE NARRATION	Laboratory Techniques
DATE	2025
DURATION	3 HOURS

INSTRUCTIONS TO CANDIDATES:

1. Answer all questions in section A
2. Answer any two questions in section B

Section A: Answer all questions (50 marks)

1a) Explain the following terms.

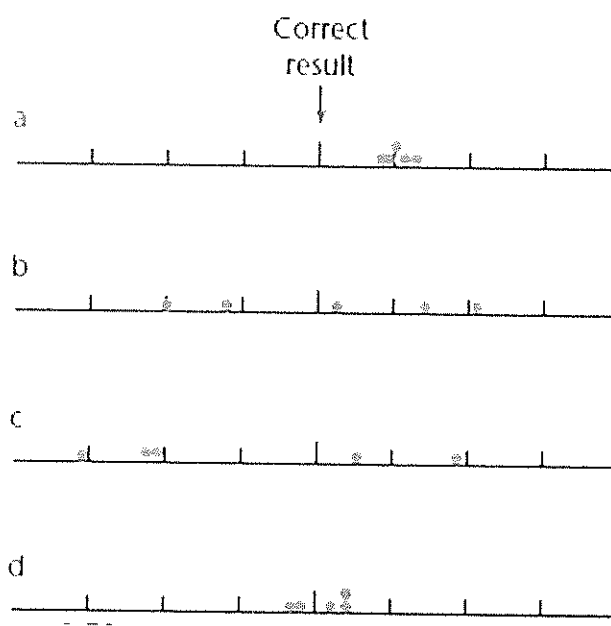
i) Accuracy

ii) Precision

iii) Bias

[3 marks]

b) Four students (A–D) each performed five replicate titrations. Using their results and comparing them to the correct (true) value, analyze and comment on the bias, precision, and accuracy of each student's set of results. **[12 marks]**



(c) List and explain the four common types of errors in scientific experiments and provide an example for each type of error **[8 marks]**

(d) Distinguish between a sample and a population **[2 marks]**

2a) During a titration experiment, a student performed five trials to determine the volume of sodium hydroxide required to neutralize a hydrochloric acid solution. The results in mL are as follows:

25.3, 25.5, 25.2, 25.4, 25.6.

- a) Calculate the mean volume of sodium hydroxide used.
- b) Calculate the standard deviation of the volume measurements. **[8 marks]**
- c)
 - i. Explain what random errors are and identify two possible causes of these errors.
 - ii. Discuss how random errors can be minimized in laboratory experiments.
 - iii. How can the impact of random errors be quantified statistically. **[7 marks]**
- b) Amphoteric chemicals are used when identifying salts in qualitative analysis
 - (i) Explain what is meant by the term amphoteric.
 - (ii) Using water as an example describe how it acts as amphoteric support your answer with relevant chemical equations. **[5 marks]**
 - (iii) Distinguish between a colloidal precipitate and a crystalline precipitate **[5 marks]**

Section B: Answer any 2 questions (50 marks)

3. a) In a laboratory exercise, a student is performing a precipitation reaction where calcium carbonate (CaCO_3) is precipitated from a solution containing calcium ions (Ca^{2+}) and carbonate ions (CO_3^{2-}). The student observes that some magnesium ions (Mg^{2+}) are also precipitated along with the calcium carbonate.

- i) Explain the phenomenon of co-precipitation in this scenario.
- ii) Describe two factors that might influence the extent of co-precipitation in this reaction.

[10 marks]

b) Explain why precipitates composed of larger particles are generally preferred over those with smaller particles in analytical procedure. **[4 marks]**

c) Define Good Laboratory Practices (GLPs) and explain why they are important in ensuring safety and reliability in scientific experiments. **[4 marks]**

d) Provide at least two specific examples of GLPs in action in the laboratory. **[7 marks]**

4 a) Explain the concepts of qualitative analysis and quantitative analysis, providing practical examples of their application using an analytical technique, such as Gas Chromatography. **[6 marks]**

b) A student conducts an experiment to measure the boiling point of water. However, the thermometer was not properly placed in the liquid, and the reading was significantly higher than the true boiling point.

- (i) What type of error occurred in this case
- (ii) How would this error affect the accuracy of the boiling point measurement?
- (iii) Suggest ways to minimize this error in future experiments. **[10 marks]**

c) Explain the differences between systematic errors and random errors, providing one example of each. **[5 marks]**

d) Calibration of instruments is very important in laboratory techniques. Explain what is meant by calibration and explain the importance of calibrating equipment **[4 marks]**

5a) Explain the main steps below as involved in a gravimetric analysis experiment.

- (i) Sample preparation
- (ii) Precipitation
- (iii) Digestion of the precipitate
- (iv) Filtration and washing
- (v) Drying or ignition
- (vi) Weighing and calculation. **[15 marks]**

b) Describe five processes used in identifying salts in a laboratory setting. For each process, explain how it helps to identify the nature of the salt and provide a relevant example where applicable. **[10marks]**