

091405T4SLT

SCIENCE LABORATORY TECHNOLOGY LEVEL 5

SLT/OS/SL/CR/03/5

Apply Chemistry Techniques

March/April 2026



**TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL
(TVET CDACC)**

WRITTEN ASSESSMENT

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATE

1. This paper consists of **TWO** sections: **A** and **B**.
2. Answer **ALL** questions in section A and **ANY THREE** (3) questions in section B.
3. Marks for each question are indicated in the brackets.
4. Candidates are provided with a separate answer booklet
5. Do not write on the question paper.

This paper consists of SIX (6) printed pages

Candidate should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing.

SECTION A (40 MARKS)

Answer ALL questions in this section

1.
 - a) Laboratory apparatus are used for various purposes. Give the most suitable apparatus for the following tasks
 - i. Grinding a crystalline solid into a fine powder. (1 Mark)
 - ii. Precisely diluting a solution to a fixed known volume. (1 Mark)
 - iii. Rapidly filtering and drying a solid precipitate under a reduced pressure. (1 Mark)
 - b) For the apparatus named in a (iii) above highlight why it is more efficient for drying a solid than simple gravity filtration. (1 Mark)
2. A field technician is tasked with collecting a representative sample for laboratory analysis from each of the following sources
 - Source A: A large, static pile of powdered industrial fertilizer
 - Source B: A flowing stream of waste water from a chemical plant outlet
 - Source C: A heterogenous mixture of crushed ore in a storage silos
 - a) State the name of standard sampling procedure you will recommend for obtaining a representative primary from Source A, B and C. (3 Marks)
 - b) Give reason for choosing the sampling method in Source A above. (1 Mark)
3. A chemistry Technique trainer was trying to filter some components. State the most appropriate filtration method for the following mixture.
 - i. Removing suspended impurities from a hot saturated solution during recrystallization. (1 Mark)
 - ii. Collecting a large quantity (10g) of coarse crystal from a cold solution. (1 Mark)
 - iii. Separating a very small amount of fine precipitate for quantitative analysis. (1 Mark)
 - iv. Quick drying a solid sample after washing with a volatile solvent (1 Mark)
4. While supervising trainees in a certain college, the supervisor discovered that one trainee clamped a clean burette vertically using a retort stand. The trainee then filled the burette

to 0.00ml mark with the titrant solution using a beaker. Without removing the funnel, they performed a rough titration to determine the end point

- a) Identify ONE error in the burette filling. (1 Mark)
 - b) State the correct procedure. (1 Mark)
 - c) Identify one error in the titration execution step. (1 Mark)
 - d) State the correct procedure. (1 Mark)
5. In an industry to determine the acid content in unrefined water, the technician was required to prepare 250ml of a 0.1M standard solution of sodium carbonate Na_2CO_3 for use in acid base titrations (Molar mass of $\text{Na}_2\text{CO}_3 = 106\text{g/Mol}$)
- a) Calculate the exact mass of anhydrous Na_2CO_3 required to prepare this solution. (2 Marks)
 - b) State TWO important precautions to ensure the accuracy of prepared standard solution. (2 Marks)
6. During EDTA titration for calcium and Magnesium ion determination in water $\text{NH}_3/\text{NH}_4\text{Cl}$ solution is added as a buffer. Outline the working principle of a buffer. (4 Marks)
7. Calculate hydrogen ion concentration and PH of 0.01 molar solution of Propanoic acid $\text{CH}_3\text{CH}_2\text{COOH}$ ($K_a = 2.1 \times 10^{-5} \text{ mol /dm}^3$). (4 Marks)
8. An oil company wanted to determine the quality of the Margarine that they were recently planning to market. List FOUR components of food that they can determine during Proximate analysis. (4 Marks)
9. A water company was examining conductivity of water it distributes in it's area.
- a) Highlights TWO reasons why the temperature of a sample must be controlled or reported when measuring its conductivity. (2 Marks)
 - b) Name the main component of conductivity meter that is immersed in the sample. (1 Mark)
 - c) State its function. (1 Mark)
10. You are required to prepare a fine, homogenous powder from 10g of a dry, crystalline "unknown compound X" for melting point determination and infrared spectroscopy
- a) List TWO specific measure you must take during this process to prevent cross contamination of the sample. (2 Marks)
 - b) State why it is important to clean the grinding apparatus thoroughly with solvent like acetone and not just brush it out before using it for a different sample. (2 Marks)

SECTION B (60 MARKS)

*Answer any **THREE** questions in this section*

11. Trainees in a certain technical institution observed that when 24.4g of $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$ is dissolved in 1 dm^3 and acidified H_2SO_4 , 25ml of this solution required 20ml of 0.022M of MnO_4^- for oxidation.

a) Calculate X in the formula if:-



b) A trainee is required to prepare 500ml of 0.5M standard solution of NaOH for use in titration (Molar Mass of NaOH = 40g/mol).

- i) Calculate the exact mass of anhydrous NaOH required to prepare this solution. (4 Marks)
- ii) Describe the stepwise procedure for preparing this standard solution in the laboratory. (Mention the specific volumetric apparatus to be used at each key stage). (6 Marks)

12. In metal processing industry, an alloy sample containing copper was analyzed. A clean dried platinum cathode was found to weigh 12.4567g. After electrolyzing a dissolved sample at controlled potential, the cathode with the deposited copper weighs 12.8765g

a) Answer the following questions

- i. Calculate the mass of copper deposited. (2 Marks)
- ii. Using Faraday's Law, Calculate the total charge (in Coulombs) required to deposit this mass of Copper from Cu^{2+} solution (Atomic mass of Cu=63.5g/mol, Faraday Constant = 96485C. (5 Marks)
- iii. If electrolysis was performed at constant current of 0.5A. Calculate the time (in minutes) the electrolysis would theoretically need to run. (2 Marks)
- iv. State ONE reason why it might practically take longer than the calculated time. (1 Mark)

b) During electrolysis the following observation were made;

- The cathode was not dried to constant weight before initial weighing

- The deposited metal was not completely washed free of the electrolyte solution before drying
 - A small amount of the metal was not completely washed free of the electrolyte solution before drying
 - The sample contained an impurity metal that was deposited together with analyte
- i. State whether each of the above made observations would cause the reported percentage to be higher, lower or unchanged. (4 Marks)
 - ii. Justify your answer 12 b (i) above. (4 Marks)
 - iii. Explain why Electrogravimetry is considered a Primary method. (2 Marks)

13. A quality assurance company was analyzing a fish muscle sample obtained from the supermarket

- a) Describe the preparation of the sample for oven drying method for moisture determination. (3 Marks)
- b) Explain why the sample must be spread evenly in a thin layer in the moisture dish. (2 Marks)
- c) The analyzer needs to determine both moisture and subsequent components on the same sample batch. Explain how the sample should be handled after moisture analysis to enable the subsequent analysis. (3 Marks)
- d) Highlight TWO ways of safely handling solvent like diethyl ether during fat determination. (2 Marks)
- e) In another analysis an importing company brought 2.0kg of fresh fish muscle sample with high moisture content. As an analyst you air-dried it to a constant weight of 800g.
 - i. Calculate the percentage of air-dried matter. (3 Marks)
 - ii. Out of air-dried matter, 200g of the sample was obtained for final laboratory analysis. Calculate the weight conversion factor that will be used to express all future analytical results back “As Received “. (4 Marks)
 - iii. From your ground, air dried sub sample you use a riffle splitter to obtain a 50g analytical sample. Calculate the percentage of original fresh sample represented by 50g. (3 Marks)

14. During an acid-base titration between sodium hydroxide and Sulphuric acid, 25.0 cm^3 of sodium hydroxide was pipetted into conical flask. It was titrated against 0.1 M Sulphuric acid, if the average volume of Sulphuric acid used was 12.5 cm^3

- a) Write a balanced equation for neutralization reaction. (3 Marks)
- b) Determine the number of moles of the acid used. (3 Marks)
- c) Calculate the number of moles of sodium hydroxide used. (3 Marks)
- d) Determine the molarity of sodium hydroxide used. (3 Marks)
- e) If sodium hydroxide used was prepared in a 250 ml volumetric flask, calculate the mass of sodium hydroxide pellets dissolved. (4 Marks)
- f) Explain why calcium hydroxide is not a suitable base that can be used to standardize a sample of Sulphuric acid. (4 Marks)