**THE UNITED REPUBLIC OF TANZANIA**

**NATIONAL EXAMINATION COUNCIL OF TANZANIA**

**DIPLOMA IN TECHNICAL EDUCATION EXAMINATION**

**732** **CHEMISTRY TEACHING METHODS**

**Time: 3 Hour.** **ANSWERS** **Year: 2002**

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**Instructions**

1. This paper consists of sections **A**, **B** and **C.**
2. Answer all questions in sections **A** and **B**, and **two (2)** questions from section **C.**
3. Section **A** carries **36 marks**, section **B** carries **40 marks** and section **C** carries **24 marks**.
4. Cellular phones and other unauthorized materials are **not** allowed in the examination room.
5. Write your **Examination Number** on every page of your answer booklet(s).

**SECTION A (36 marks)**

*Answer all questions in this section.*

1. Explain four (4) reasons why teaching chemical bonding is essential in developing students' understanding of matter and chemical reactions.

Teaching chemical bonding helps students understand the structure of substances. It explains how atoms combine to form molecules and compounds, which builds foundational knowledge about matter.

It allows learners to predict the properties of substances. Understanding the types of bonds, ionic, covalent, and metallic, enables students to relate them to melting points, solubility, and conductivity.

Chemical bonding enhances comprehension of reaction mechanisms. When students know how atoms bond or break apart, they understand what happens during chemical changes.

It supports further learning in advanced topics such as organic Chemistry, electrolysis, and chemical energetics. These topics rely on students grasping bond types and interactions between particles.

2. Describe four (4) classroom-based techniques that a Chemistry teacher can use to identify misconceptions among Form II students studying changes of state.

One technique is the use of diagnostic questions at the beginning of the lesson. These questions reveal students' prior knowledge and expose incorrect assumptions, such as thinking evaporation requires boiling.

Another method is concept mapping. Students draw relationships between terms like melting, boiling, condensation, and freezing. Misplaced links or missing connections show misunderstandings.

Think-pair-share discussions allow students to verbalize their ideas with peers. Teachers can walk around and listen to their reasoning, identifying flawed ideas and misconceptions.

Interactive quizzes using real-time apps or card responses help spot patterns of wrong answers. These responses guide the teacher on which concepts need clarification.

3. Outline four (4) reasons why it is important to include practical activities in the teaching of concepts such as acids, bases, and indicators.

Practical activities make abstract concepts observable. When students see colour changes in indicators or test pH with litmus, they better understand the theoretical definitions of acids and bases.

They improve retention of knowledge. Learners remember activities more vividly than lectures, which helps them retain the concepts for longer periods.

Practical work fosters scientific skills. Students learn how to handle chemicals, measure accurately, and record data, essential skills for Chemistry learning and scientific literacy.

It encourages learner engagement and motivation. Participating in experiments excites learners and builds curiosity, making them more interested in the subject.

4. Define the following terms as applied in Chemistry education:
   (a) Instructional objective
   (b) Syllabus
   (c) Evaluation
   (d) Assessment

(a) Instructional objective is a specific statement that describes what learners should know or be able to do by the end of a lesson or unit in Chemistry.

(b) Syllabus is an official document outlining the topics, skills, learning outcomes, and time allocations for teaching Chemistry at a particular education level.

(c) Evaluation refers to the overall judgment of the effectiveness of teaching and learning activities, including both student achievement and instructional quality.

(d) Assessment is the process of measuring students' learning progress through tools like tests, quizzes, assignments, and observations to determine how well they understand Chemistry content.

5. Highlight four (4) common safety breaches that may occur during Chemistry practical sessions and suggest preventive measures for each.

One common breach is eating or drinking in the laboratory, which can lead to ingestion of harmful substances. Teachers must enforce strict no-food policies during lab sessions.

Improper disposal of chemicals may occur, leading to environmental or safety hazards. Teachers should train students on correct disposal methods for each chemical used.

Using damaged glassware or corroded apparatus can cause accidents. Regular inspection and replacement of equipment is essential to ensure student safety.

Students sometimes fail to wear protective gear like goggles or lab coats. The teacher should enforce mandatory safety dress codes and explain their importance before starting any practical.

6. Mention four (4) advantages of using simulations or computer-based models when teaching abstract Chemistry concepts like atomic structure and radioactivity.

Simulations allow students to visualize invisible particles and processes. Concepts like electron orbitals or radioactive decay become easier to grasp through animations and models.

They provide a safe learning environment. Topics like radioactivity, which cannot be demonstrated physically due to safety concerns, can be explored safely using simulations.

Simulations support individualized learning. Students can pause, rewind, or repeat sections to learn at their own pace, which is especially helpful for complex concepts.

They reduce the cost of teaching. Schools with limited laboratory resources can use free or low-cost digital tools to deliver effective Chemistry instruction without purchasing expensive materials.

7. List four (4) key factors to consider when selecting teaching methods for a Form III class during a topic involving quantitative analysis.

The complexity of the topic must be considered. Since quantitative analysis involves mathematical calculations, the teacher should choose methods that support step-by-step explanations, such as guided instruction or worked examples.

The availability of materials and equipment should influence the method. If burettes, pipettes, and indicators are available, practical demonstrations or group experiments can be used effectively.

Student ability level is important. For classes with diverse academic strengths, the teacher should balance between lecture-based explanations and peer-assisted learning to cater to all learners.

Time allocation must be factored in. Quantitative analysis involves procedures and calculations that require enough time. The teacher should choose methods that allow full concept development within the given time.

8. Explain four (4) ways in which a Chemistry teacher can motivate students who are underperforming in theoretical Chemistry topics.

One way is through differentiated instruction. The teacher can design simpler tasks or provide step-by-step guides for weaker students, allowing them to build confidence before moving to complex problems.

The teacher can connect theoretical content to real-life applications. For example, linking acids and bases to common household products like lemon juice or soap helps students find Chemistry relevant and interesting.

Using praise and positive reinforcement encourages struggling learners. Recognizing small improvements motivates them to put in more effort, boosting self-esteem and willingness to engage.

Incorporating group work and peer tutoring helps low performers learn from stronger classmates in a non-threatening environment, fostering collaboration and better understanding.

9. Give four (4) challenges a teacher may face when using performance-based assessment in Chemistry and suggest a practical solution to each.

Time limitation is a challenge, as practical assessments take longer to administer. Teachers can solve this by scheduling sessions in shifts or using stations to assess different skills separately.

Lack of resources can hinder practical evaluation. Sharing apparatus in groups and rotating tasks can help manage this challenge without compromising assessment quality.

Subjectivity in marking may occur, especially when assessing process-based skills. Using detailed rubrics with clear performance indicators improves fairness and consistency.

Managing large class sizes is difficult during practical assessments. The teacher can prepare simplified tasks that still assess essential competencies and rotate small groups through the activity while others engage in written work.

## SECTION B (40 marks)

*Answer both questions in this section.*

10. A Chemistry teacher plans to teach the topic "Neutralization" using a problem-solving approach.
    (a) Define the problem-solving method and explain its relevance in Chemistry teaching.
    (b) Describe how the teacher would introduce the lesson, facilitate student exploration, and conclude the session.
    (c) Identify four (4) possible real-life problems that can be solved using neutralization and explain how to relate them to classroom learning.

(a) Problem-solving is a learner-centered approach where students are given a problem and guided to explore possible solutions using their knowledge. In Chemistry, it helps learners apply theoretical understanding to practical situations, such as predicting product formation or correcting pH imbalances.

(b) To introduce the lesson, the teacher might present a scenario: "A farmer's field has become too acidic for crops to grow. What can be done?"
Students brainstorm possible solutions using prior knowledge. During exploration, students test different household bases (e.g., baking soda, limewater) on acidic solutions and record pH changes.
In the conclusion, the teacher guides a class discussion on their findings, connects the results to the neutralization reaction, and summarizes the chemical equation:
Acid + Base → Salt + Water.

(c) Treating acidic soil using lime can be related to agriculture and food production.
Using antacids to relieve stomach acid connects Chemistry to human health.
Neutralizing industrial acidic waste before disposal introduces environmental protection.
Treating insect stings (acidic or basic) with opposite pH substances links to first aid and personal safety.
These examples help students see Chemistry in daily life.

11. In an experiment, 50 $cm^3$ of 1.0 M sodium hydroxide solution was mixed with 50 $cm^3$ of 1.0 M hydrochloric acid solution in a calorimeter. The temperature rose from 25.0°C to 31.7°C. (Specific heat capacity of water = 4.2 J/g°C, Density of solution = 1.0 $g/cm^3$)
    (a) Calculate the heat evolved in the reaction.
    (b) Calculate the number of moles of water formed.

(c) Calculate the enthalpy change per mole of water formed (in kJ/mol).
(d) Suggest two (2) sources of error in this experiment and how to minimize them.

(a) Total volume = 50 + 50 = 100 $cm^3$ = 100 g
Temperature change = 31.7 - 25.0 = 6.7°C
Heat (q) = $mc\Delta T$ = 100 × 4.2 × 6.7 = **2814 J**

(b) Moles of NaOH = 1.0 × 0.050 = 0.050 mol
Moles of HCl = 1.0 × 0.050 = 0.050 mol
The reaction is 1:1, so 0.050 mol of water is formed.

(c) Enthalpy change per mole = q / moles = 2814 ÷ 0.050 = 56,280 J/mol = **–56.28 kJ/mol**
(The negative sign shows it is exothermic.)

(d) One source of error is heat loss to the surroundings, which lowers the temperature rise. This can be minimized by using a better-insulated calorimeter with a lid.

Another error is incomplete mixing of reactants. Stirring the solution consistently and quickly after mixing improves reaction uniformity and accurate temperature recording.

## SECTION C (24 marks)

*Answer two (2) questions from this section.*

12. (a) Explain the concept of backward design in Chemistry lesson planning.
(b) Identify and describe three (3) stages of backward design with reference to a topic like "Electrolysis."
(c) Suggest two (2) benefits and one (1) challenge of using backward design in Chemistry education.

(a) Backward design is a planning strategy where the teacher begins by identifying desired learning outcomes, then plans assessments, and finally develops instructional activities. It ensures that all teaching aligns with the intended goals.

(b)
Stage 1 – Identify desired results: For electrolysis, the teacher defines goals like "Students should be able to describe the movement of ions and write electrode reactions."

Stage 2 – Determine acceptable evidence: Design assessments such as practicals, written equations, or diagrams to test if students meet the goal.

Stage 3 – Plan learning experiences: Prepare lessons with diagrams, simulations, experiments (e.g., electrolysis of copper sulfate), and group discussions that help learners reach the outcome.

(c) Benefits include focused teaching, since the plan is built around what students must achieve, and better assessment alignment.
A challenge is the time required to design every lesson around outcomes and assessments, which may be difficult in packed school schedules.

13. Discuss six (6) key roles of a Chemistry teacher in promoting ethical scientific behavior during practical work and experiments in secondary schools.

The teacher must model ethical behavior by demonstrating correct and honest reporting of experimental results, setting an example for learners to follow.

They should emphasize safety by training students to handle chemicals properly and report any accidents immediately, reinforcing the responsibility tied to scientific work.

The teacher must discourage cheating during practical exams by supervising closely and setting individual or small-group tasks that minimize copying.

Promoting environmental responsibility is key. Teachers should instruct students to dispose of chemicals safely and avoid wasting reagents.

Teachers should encourage respect for laboratory property by monitoring how students handle apparatus and taking disciplinary action when materials are misused.

They must ensure inclusivity and fairness by giving all students equal opportunities to participate in experiments regardless of gender or ability.

14. A teacher administered a Chemistry test to Form IV students. The mean score was 55, with a standard deviation of 10. One student scored 35.
    (a) Calculate the z-score for this student.
    (b) Interpret this score.
    (c) Suggest three (3) supportive teaching strategies for helping low-performing students in Chemistry.
    (d) Identify two (2) limitations of using z-scores to evaluate student progress.

(a) $z = (35 – 55) \div 10 = –20 \div 10 =$ **–2.0**

(b) A z-score of –2.0 means the student scored two standard deviations below the mean, indicating that they performed significantly below average compared to their classmates.

(c) Use remedial sessions to reteach basic concepts slowly and clearly.
Apply formative assessments like short quizzes to monitor progress.
Encourage peer tutoring by pairing the student with a more proficient classmate in cooperative tasks.

(d) Z-scores measure relative performance, not mastery. A low z-score does not show whether a student met specific objectives.

They may also discourage learners emotionally if they are consistently below average, reducing confidence and motivation.

15. Using the topic "Types of Chemical Reactions," construct a detailed lesson plan outline for Form III students. Your plan should include:
    (a) Specific objectives
    (b) Teaching/learning materials
    (c) Lesson introduction strategy
    (d) Learning activities for students
    (e) Assessment methods
    (f) Reflection/evaluation questions for the teacher.

(a) By the end of the lesson, students should be able to:

- Define and identify types of chemical reactions (combination, decomposition, displacement, double decomposition).
- Write balanced equations for each reaction type.

(b) Materials: Sample equations on flashcards, reaction videos, chalkboard, chemical samples (e.g., magnesium, dilute acids), and test tubes.

(c) Introduction strategy: Begin by showing a video clip of fireworks and ask students to describe what they observe. Use the discussion to introduce the concept of chemical reactions.

(d) Activities:

- Group students to classify given reactions.
- Demonstrate a simple displacement reaction and ask students to record observations.
- Assign students to match equations to reaction types.

(e) Assessment:

- Oral questioning during class.
- Short written quiz with reaction classification and equation balancing.
- Observation of group discussions.

(f) Reflection questions:

- Did students meet the objectives?

- Which reaction type was most misunderstood and why?
- What changes should I make next time to improve clarity?