THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATION COUNCIL OF TANZANIA

DIPLOMA IN TECHNICAL EDUCATION EXAMINATION

732 **CHEMISTRY TEACHING METHODS**

Time: 3 Hour. **ANSWERS** **Year: 2005**

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) purposes of using instructional objectives in Chemistry teaching.

   Instructional objectives help the teacher to focus the lesson content by clearly identifying the knowledge, skills, and attitudes students should acquire. This guides lesson preparation and ensures all classroom activities are purposeful.

   They assist in selecting appropriate teaching and learning resources. When objectives are defined, the teacher can determine the most suitable experiments, charts, and textbooks to support effective delivery.

   They provide a framework for assessment. Teachers use the objectives to develop tests, quizzes, or practical tasks that evaluate whether students have achieved the intended outcomes.

   They help communicate expectations to students. Learners become more motivated and focused when they understand what they are expected to learn during the lesson.

2. Briefly describe four (4) advantages of using practical work in the teaching and learning of Chemistry.

   Practical work gives students the opportunity to see Chemistry concepts in real life. When learners observe chemical reactions, they understand theory better and remember concepts longer.

   It promotes active participation. Involving students in experiments encourages hands-on learning, which increases engagement and reduces boredom in the classroom.

   It develops scientific skills. Through practical work, learners learn how to observe, measure, record data, and draw conclusions — all of which are essential scientific competencies.

   It encourages teamwork and cooperation. Many Chemistry experiments are done in groups, helping students develop communication and collaboration skills useful beyond the classroom.

3. Outline four (4) functions of a Chemistry syllabus in secondary school education.

   The syllabus acts as a guide for teachers, showing the scope and sequence of topics to be covered during the academic year. This ensures that important content is not skipped or repeated unnecessarily.

   It serves as a standardizing tool. By following the syllabus, all schools in the country offer similar content and maintain national education standards.

   It supports evaluation. Examiners use the syllabus to design tests and exams, while teachers refer to it when assessing students' understanding of different topics.

It helps in organizing teaching and learning resources. With a clear syllabus, teachers can plan for the required chemicals, apparatus, textbooks, and teaching aids in advance.

4. Mention four (4) characteristics of a good teaching aid as used in the Chemistry subject.

A good Chemistry teaching aid must be relevant. It should directly relate to the topic and help learners grasp the intended concept more easily.

It should be clear and easy to understand. Diagrams, models, or charts must be labeled and structured in a way that is accessible to students of the intended level.

It must be durable and safe. Teaching aids used in Chemistry must be able to withstand frequent use and should not pose any safety risk, especially in practical sessions.

It should stimulate learners' interest. A good aid captures students' attention, makes learning more enjoyable, and encourages curiosity and exploration.

5. Define and differentiate between:
   (a) Diagnostic test and summative test.
   (b) Achievement test and aptitude test.

A diagnostic test is conducted before instruction begins to identify learners' strengths and weaknesses. It helps the teacher to plan appropriate remedial measures. In contrast, a summative test is given at the end of a topic, term, or course to assess the overall learning outcomes and assign grades.

An achievement test is used to measure what a student has learned after a period of instruction. It reflects performance in a specific subject like Chemistry. On the other hand, an aptitude test measures a learner's potential to learn or perform in the future, such as their ability to think logically or solve scientific problems even before formal instruction.

6. Explain four (4) reasons why it is important to assess learners after a Chemistry lesson.

Assessment helps the teacher to determine whether the instructional objectives have been achieved. If most students fail to perform well, it shows that the teaching approach or resources may need to be improved.

It provides feedback to learners. By knowing their performance, students can identify their own weaknesses and make necessary efforts to improve their understanding of Chemistry concepts.

It informs future planning. Teachers use assessment results to plan for remedial teaching, group work, or differentiated instruction based on student needs.

It helps in grading and certification. Continuous assessment contributes to the final grades that represent learners' overall performance in the subject, which are important for academic progression.

7. Briefly describe four (4) qualities of a well-constructed Chemistry test.

A good Chemistry test must be valid. This means it should measure exactly what it is intended to measure, such as knowledge of chemical reactions, not general language skills.

It should be reliable. This means that if the test is repeated under similar conditions, it should give consistent results.

It must be comprehensive. A well-constructed test should cover all important topics and skills taught, giving a fair representation of the syllabus content.

It should be clear and unambiguous. The language and instructions in the test must be simple and straightforward to avoid confusing learners.

8. Why is it important for a Chemistry teacher to plan lessons before entering the classroom?

Lesson planning ensures that the teacher is prepared and confident. A well-planned lesson allows smooth delivery of content and better time management during teaching.

It helps the teacher to organize materials and resources such as chemicals, apparatus, and textbooks, ensuring that practical activities are carried out efficiently and safely.

It promotes effective learning. A planned lesson includes a logical sequence of activities and assessment strategies, which help students understand and retain new information more easily.

It allows for flexibility and anticipation of challenges. By planning in advance, the teacher can prepare alternative activities or approaches in case of time limitations, equipment failure, or different learner needs.

9. Give four (4) roles of instructional materials in the teaching and learning of Chemistry.

Instructional materials help to simplify abstract concepts. For example, molecular models and reaction diagrams make it easier for learners to visualize invisible particles and processes.

They provide a basis for practical learning. Chemicals and apparatus allow students to perform experiments and observe reactions, which strengthens their understanding through direct experience.

They promote learner engagement. When students interact with materials such as charts or videos, they become more active participants in the learning process.

They support retention and recall. Visual aids and physical objects make learning more memorable, helping students to remember concepts during revision and exams.

10. As a Chemistry teacher, you are preparing to use the demonstration method to introduce the topic "Acids and Bases" to Form Two students.
    (a) State five (5) preparations you would make before the lesson.
    (b) Explain four (4) advantages and three (3) limitations of using demonstration method.
    (c) Describe three (3) classroom management techniques you would apply during the demonstration.

Before the lesson, the teacher would review the specific learning objectives to ensure clarity about what students should understand regarding acids and bases. This helps focus the demonstration on key concepts like pH, neutralization, or indicators.

The teacher would gather and organize all necessary apparatus and chemicals such as litmus paper, hydrochloric acid, sodium hydroxide, and phenolphthalein, to avoid interruptions during the demonstration.

Safety measures would be put in place, including checking the availability of goggles, gloves, and fire extinguishers, to ensure a safe classroom environment for all students.

The demonstration would be rehearsed in advance. This allows the teacher to anticipate any technical issues and perfect the timing and flow of the experiment.

Clear instructions and explanation points would be prepared. The teacher would plan what to say during each step to ensure students understand what is happening and why.

One advantage of demonstration is that it makes abstract ideas tangible. Students can see how acids react with bases, which improves conceptual understanding. It also stimulates interest and curiosity because students often find experiments exciting and enjoyable.

Demonstration saves time compared to group practicals, especially in large classes where not all students can perform experiments individually. It also minimizes the risk of accidents since only the teacher handles dangerous chemicals.

However, demonstrations may limit student participation. Watching an experiment is less engaging than doing it oneself. Also, visibility may be a problem in crowded classrooms where not all students can see clearly. Finally, it assumes the teacher has high competence and confidence in handling chemicals, which may not always be the case.

To manage the classroom effectively, the teacher should arrange students so they can all observe the demonstration clearly, either in a semi-circle or front rows. Clear rules and instructions must be given before starting the experiment, especially about silence and asking questions. The teacher must maintain eye contact and move around to monitor student attention and prevent distractions.

11. In a practical session, Form Three students carried out an experiment to investigate the effect of concentration on the rate of reaction using magnesium and hydrochloric acid.
    (a) Write a brief aim for the experiment.
    (b) Mention three (3) precautions to be taken during the experiment.
    (c) Outline step by step how you would guide students in recording observations and plotting the reaction

rate graph.
(d) Suggest how you would evaluate student understanding after the practical lesson.

The aim of the experiment is to investigate how the concentration of hydrochloric acid affects the rate at which it reacts with magnesium metal to produce hydrogen gas.

One precaution is to ensure that students wear safety goggles and lab coats to protect themselves from possible splashes of acid. Hydrochloric acid is corrosive and can damage skin and eyes.

Another precaution is to use clean and dry measuring equipment such as cylinders, test tubes, and stopwatches to avoid contamination or dilution of the acid, which would affect the results.

Students should also be instructed not to lean over the reaction vessels, especially when gas is being produced, to avoid inhaling hydrogen or being harmed by any unexpected splashing.

To guide students in recording observations, the teacher should first demonstrate how to measure and pour specific volumes of hydrochloric acid and how to add magnesium strips safely. The stopwatch should be started immediately after adding the magnesium, and students should record the volume of gas collected at regular time intervals.

For plotting the graph, students should use graph paper or software, placing time on the x-axis and volume of gas on the y-axis. They should connect the plotted points smoothly to observe how the rate changes over time.

To evaluate understanding, the teacher can ask oral questions, assign a worksheet with interpretation questions on the graph, or ask students to write a report explaining the relationship between concentration and rate of reaction.

12. Describe five (5) uses of Chemistry in modern society and show how they relate to daily life applications.

Chemistry is used in medicine for the production of drugs and vaccines. Understanding chemical reactions and compounds allows chemists to formulate treatments that cure or manage diseases, improving public health.

In agriculture, Chemistry contributes through the production of fertilizers and pesticides. These chemicals enhance crop growth and control pests, increasing food production and ensuring food security.

The field of energy relies heavily on Chemistry, especially in the development of batteries, fuels, and solar panels. Chemical reactions are used to generate, store, and transfer energy for daily use.

In sanitation and hygiene, Chemistry is involved in manufacturing soaps, detergents, and disinfectants. These products help maintain cleanliness, reduce the spread of disease, and improve quality of life.

In environmental protection, Chemistry helps in water treatment and waste management. Scientists use chemical principles to purify water, recycle materials, and reduce pollution, thus safeguarding natural ecosystems.

13. Discuss the major types of test items used in Chemistry assessment. Give at least two examples for each type.

Multiple choice items consist of a stem (the question), a key (correct answer), and distracters (incorrect options). They test recall and understanding quickly. For example:
(i) What is the formula of calcium carbonate?
A. $CaCO_3$ B. $CaCl_2$ C. $Ca(OH)_2$ D. $CaSO_4$
(ii) Which of the following is a noble gas?
A. Oxygen B. Nitrogen C. Helium D. Hydrogen

Matching items require students to pair items in one column with corresponding items in another. They assess recognition and classification skills. For example, matching elements to their symbols or equipment to their functions.

True/False items require students to identify whether a statement is correct. They are useful for assessing quick factual knowledge. For example:
(i) Sodium reacts with water to produce hydrogen gas. (True)
(ii) Copper is more reactive than potassium. (False)

Short answer items require a brief response, often one word or sentence. They test specific knowledge. For example:
(i) State the colour of phenolphthalein in base.
(ii) Name one element in Group I of the periodic table.

Essay items require students to explain, describe, or discuss a concept in detail. These test understanding, organization, and communication. For example:
(i) Explain the process of fractional distillation of crude oil.
(ii) Describe the laboratory preparation of oxygen gas.

14. (a) What is brainstorming as a teaching strategy?
(b) Discuss four (4) benefits of using brainstorming in Chemistry lessons.
(c) Explain three (3) challenges of applying this strategy in large classes.

Brainstorming is a teaching strategy where learners are encouraged to generate ideas freely and spontaneously in response to a question or problem. It emphasizes idea generation without immediate criticism or evaluation.

One benefit of brainstorming is that it encourages creativity. Students feel free to express their thoughts and come up with new ways of thinking about Chemistry problems or concepts.

It promotes active participation. Every learner has a chance to contribute, which increases engagement and helps build confidence, especially in students who are usually shy.

It allows the teacher to assess prior knowledge. By listening to students' ideas, the teacher gains insight into what they already understand and what misconceptions may exist.

It fosters collaborative learning. As students build on each other's ideas, they develop teamwork and communication skills, which are important in both classroom and professional environments.

However, applying brainstorming in large classes can be difficult because it is hard to manage many voices at once. Noise levels may rise and some students may dominate while others are left out.

Time management becomes a challenge. Brainstorming takes time and in large classes, the session may go off track or take longer than planned.

It may be hard to record and organize all the ideas presented. Without clear structuring, valuable contributions may be lost or forgotten before they can be used in the lesson.

15. Using the reaction between zinc and hydrochloric acid, explain how you would guide Form Two students to understand the concept of displacement reactions. Include the procedures, expected observations, and chemical equation.

To teach displacement reactions, I would start by explaining that a more reactive element can displace a less reactive one from its compound. Zinc is more reactive than hydrogen, so it displaces hydrogen from hydrochloric acid.

In the procedure, I would give each student group a small amount of hydrochloric acid in a test tube and a piece of clean zinc metal. I would instruct them to carefully place the zinc into the acid and observe.

They would observe effervescence or bubbling as hydrogen gas is released. This visual effect confirms that a chemical reaction is taking place. I would also ask them to feel the test tube to notice the increase in temperature due to the exothermic reaction.

The word equation for the reaction is:
Zinc + Hydrochloric acid → Zinc chloride + Hydrogen gas

The balanced chemical equation is:
$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$

After the reaction, I would guide students to identify the type of reaction as a displacement, because zinc has displaced hydrogen from the acid. I would end with follow-up questions to check their understanding.