THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATION COUNCIL OF TANZANIA

DIPLOMA IN TECHNICAL EDUCATION EXAMINATION

732 **CHEMISTRY TEACHING METHODS**

Time: 3 Hour. **ANSWERS** **Year: 2004**

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. Identify four (4) challenges that Chemistry teachers may face during practical lessons and briefly explain each.

One major challenge is the shortage of laboratory equipment and chemicals. Without sufficient resources, it becomes difficult to conduct meaningful experiments, and students miss out on the hands-on experience that is essential in learning Chemistry.

Another challenge is the large number of students in one class. In overcrowded laboratories, supervision becomes difficult, increasing the risk of accidents and reducing individual participation in experiments.

Time constraints also hinder effective practical sessions. Most school timetables allow limited time per lesson, making it hard for students to complete procedures, make accurate observations, and discuss findings.

Lack of proper safety facilities is a serious concern. If the laboratory is not equipped with fire extinguishers, first aid kits, or proper ventilation, it exposes students and teachers to unnecessary danger during practical work.

2. State four (4) reasons why it is necessary to evaluate Chemistry lessons regularly in secondary schools.

Evaluation helps the teacher measure whether the lesson objectives have been achieved. This allows for continuous monitoring of student progress and effectiveness of teaching.

It identifies students' learning difficulties. By assessing performance, a teacher can detect areas where students struggle and offer timely intervention or support.

Evaluation also informs the teacher's future planning. It provides feedback on what strategies worked well and which ones need to be changed or improved.

Lastly, regular evaluation motivates students to study consistently. When learners know they will be assessed, they tend to remain more focused and committed throughout the course.

3. Outline four (4) advantages of using a Chemistry laboratory for teaching instead of using an ordinary classroom.

The laboratory provides a hands-on learning environment where students can carry out real experiments, reinforcing theoretical knowledge with direct experience.

It allows students to develop scientific skills such as observation, measurement, and data recording, which are difficult to master in a traditional classroom setting.

In a laboratory, learners can develop a sense of scientific inquiry and curiosity. They become active participants in discovering how chemical reactions occur.

Safety is better managed in laboratories. Unlike ordinary classrooms, labs are designed with safety features like fume chambers, sinks, and fire control equipment suitable for handling chemicals.

4. Explain the meaning of the term "scheme of work" and give three (3) reasons why it is important for Chemistry teachers.

A scheme of work is a detailed breakdown of how the syllabus will be taught over a specific period, often a term or a year. It includes topics to be covered, time allocation, teaching methods, and materials needed.

One reason it is important is that it helps the teacher stay organized and consistent in covering the syllabus within the available time frame.

It also aids in proper resource preparation. With a clear plan, the teacher can ensure that required chemicals, apparatus, and teaching aids are available when needed.

Additionally, it guides assessment planning. The scheme includes points at which tests or reviews will be administered, helping to maintain a structured learning and evaluation process.

5. Define the terms:

Continuous assessment refers to the regular evaluation of students throughout a learning period, using various tools like tests, homework, and class participation to track progress.

Formative assessment is carried out during the learning process to monitor student understanding and provide feedback that can improve performance before final evaluation.

Summative assessment is done at the end of a topic, term, or course to judge the learner's overall achievement, often in the form of exams or final tests.

Diagnostic assessment is given before instruction begins to identify learners' strengths and weaknesses. It helps the teacher to plan lessons that meet students' specific learning needs.

6. Mention four (4) precautions to be observed when using flammable substances during a Chemistry experiment.

Flammable substances should be kept away from open flames or heat sources. This prevents accidental ignition which can lead to explosions or fire.

All containers holding flammable substances must be tightly sealed after use. This reduces the risk of vapour accumulation and accidental spillage.

Experiments involving flammable substances should be conducted in well-ventilated areas. This ensures that vapours do not accumulate to dangerous levels and that inhalation risks are minimized.

Personal protective equipment such as lab coats, gloves, and goggles must be worn during the experiment. These protect the body in case of accidental contact with the flammable chemical.

7. State four (4) characteristics of a good lesson plan in Chemistry education.

A good lesson plan should have clear instructional objectives that describe what students are expected to learn by the end of the lesson.

It should include relevant teaching and learning materials such as apparatus, reagents, or charts that align with the lesson topic.

A proper lesson plan must incorporate well-structured teacher and student activities that reflect the logical flow of the lesson content.

It should also include methods of evaluation such as questions or practical tasks to assess whether students have achieved the lesson objectives.

8. Explain the significance of integrating ICT (Information and Communication Technology) in the teaching and learning of Chemistry.

ICT makes Chemistry content more engaging and interactive. Tools like simulations, animations, and virtual labs help students visualize complex chemical processes and abstract concepts.

It provides access to a wide range of learning materials. Teachers and students can use online videos, e-books, and databases to expand their understanding beyond textbooks.

ICT improves the efficiency of lesson delivery. Teachers can prepare and present content using slides and projectors, saving time and enhancing clarity.

It supports remote and individualized learning. Through ICT, students can learn at their own pace, revisit difficult topics, or attend virtual classes when physical attendance is not possible.

9. List four (4) criteria to consider when selecting a topic for classroom demonstration in Chemistry.

The topic should be relevant to the current syllabus and aligned with the learning objectives of the lesson.

It must be safe and manageable within the available laboratory conditions. Risky demonstrations should be avoided unless proper precautions and equipment are in place.

The materials required for the demonstration must be readily available and affordable to prevent interruptions or delays in the lesson.

The topic should be conceptually challenging or abstract, where visual demonstration would significantly aid student understanding and retention.

10. As a Chemistry teacher, you are preparing to teach the topic "Separation of Mixtures" to Form One students.
    (a) Identify three (3) common separation techniques you would teach and explain briefly how each works.
    (b) State five (5) reasons why separation of mixtures is important in real life.
    (c) Outline four (4) safety measures to observe during the lesson.
    (d) Design a suitable lesson objective for each separation technique identified in (a).

Filtration is used to separate an insoluble solid from a liquid. For example, sand can be separated from water using filter paper and a funnel.

Evaporation is used to obtain a solid solute from its solution. For example, salt can be recovered from saltwater by heating until the water evaporates.

Decantation involves carefully pouring off a liquid from a settled solid. For example, water can be decanted from sand after sedimentation.

Separation techniques are important in water purification, allowing us to obtain clean drinking water. In mining, mixtures are separated to extract valuable minerals.

In medicine, separation is used to purify drugs and chemicals. In food processing, it helps in refining products like sugar or cooking oil.

Environmental management uses separation to treat waste and reduce pollution. Also, in laboratories, separation is essential in preparing pure samples for experiments.

Safety measures include wearing protective gear such as gloves and goggles, handling hot equipment or chemicals with care, working in a well-ventilated space, and ensuring that all apparatus are clean and dry before use.

A suitable lesson objective for filtration would be: "By the end of the lesson, students should be able to set up and carry out a simple filtration experiment."
For evaporation: "Students should be able to explain and demonstrate how to obtain salt from saltwater using evaporation."
For decantation: "Students should be able to describe the process of decanting and perform it using sand and water mixture."

SECTION B (continued)

Answer both questions in this section.

11. In a titration experiment, 25.0 cm^3 of sodium hydroxide (NaOH) solution of unknown concentration was titrated against 0.100 M hydrochloric acid (HCl). The average volume of acid used was 22.5 cm^3.

(a) Write a balanced chemical equation for the reaction.
(b) Calculate the number of moles of HCl used.
(c) Determine the concentration of NaOH in mol/dm³.
(d) Convert the concentration of NaOH to g/dm³ (Relative Molecular Mass of NaOH = 40).

(a) The balanced chemical equation is:
$NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$

(b) Number of moles of HCl = Molarity × Volume (in dm³)
= 0.100 mol/dm³ × 22.5 cm³ ÷ 1000
= 0.100 × 0.0225
= 0.00225 mol

(c) From the balanced equation, the mole ratio of NaOH to HCl is 1:1.
So, moles of NaOH = 0.00225 mol
Volume of NaOH = 25.0 cm³ = 0.025 dm³
Concentration of NaOH = moles / volume
= 0.00225 ÷ 0.025
= 0.09 mol/dm³

(d) To convert to g/dm³:
Concentration in g/dm³ = mol/dm³ × molar mass
= 0.09 × 40
= 3.6 g/dm³

SECTION C (24 marks)

Answer two (2) questions from this section.

12. Describe the roles and responsibilities of a Chemistry teacher in ensuring laboratory safety. Provide six (6) points.

A Chemistry teacher must ensure that all students wear proper protective equipment such as lab coats, gloves, and safety goggles before beginning any practical session. This prevents exposure to harmful chemicals.

The teacher is responsible for briefing students on safety rules and emergency procedures, including the location and use of fire extinguishers, eyewash stations, and first aid kits.

The teacher must supervise all laboratory activities closely to prevent accidents. This includes checking that students are handling chemicals and apparatus correctly.

The teacher should inspect and maintain all equipment to ensure it is safe and functional. Any broken glassware or leaking containers should be repaired or discarded.

Chemicals must be labeled and stored properly. The teacher must ensure that incompatible substances are not stored together and that flammable items are kept in secure, ventilated areas.

The teacher should conduct a risk assessment before any experiment, identifying possible hazards and taking measures to minimize them before allowing students to proceed.

13. (a) Define the term "lesson evaluation."
    (b) Explain four (4) aspects a Chemistry teacher must reflect on when evaluating a lesson.
    (c) Discuss two (2) ways of improving lesson delivery after evaluation.

(a) Lesson evaluation is the process by which a teacher reflects on and judges the effectiveness of a lesson after it has been taught. It helps to determine whether the objectives were achieved and what can be improved in the future.

(b) One aspect to reflect on is whether the students achieved the intended learning objectives. This includes assessing whether they could understand, recall, and apply the taught concepts.

Another aspect is the effectiveness of the teaching methods used. The teacher must consider whether the strategies, such as group discussion or demonstration, engaged students and suited the topic.

The teacher should reflect on student participation. If few students contributed or asked questions, it may indicate low engagement or that the lesson was not clearly delivered.

Time management is also important. The teacher should evaluate whether the lesson activities were completed within the allocated time and whether time was effectively used.

(c) To improve lesson delivery, the teacher can vary teaching methods to include more interactive strategies like practicals, visuals, or digital tools that better match students' learning styles.

The teacher can also use student feedback, such as exit slips or questionnaires, to adjust future lessons based on learner preferences, needs, or confusion points.

14. With the use of chemical equations and examples, differentiate between:
    (a) Endothermic and exothermic reactions
    (b) Ionic and covalent compounds
    (c) Physical and chemical changes
    (d) Oxidation and reduction in terms of electron transfer

(a) Endothermic reactions absorb heat from the surroundings. An example is photosynthesis:
$6CO_2 + 6H_2O + \text{energy} \rightarrow C_6H_{12}O_6 + 6O_2$
Exothermic reactions release heat. For example, combustion:
$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + \text{heat}$

(b) Ionic compounds are formed when electrons are transferred from metals to non-metals, creating charged ions. Example:

$Na + Cl \rightarrow Na^+ + Cl^- \rightarrow NaCl$
Covalent compounds form when non-metals share electrons. Example:
$H + H \rightarrow H_2$ (a molecule with shared electrons)

(c) A physical change does not produce a new substance and is often reversible. For example, melting ice to water.
A chemical change results in new substances being formed and is usually irreversible. For example, burning wood produces carbon dioxide, ash, and water vapor.

(d) Oxidation is the loss of electrons, while reduction is the gain of electrons.
Example:
$Zn \rightarrow Zn^{2+} + 2e^-$ (oxidation)
$Cu^{2+} + 2e^- \rightarrow Cu$ (reduction)

15. A Chemistry teacher is planning to prepare a scheme of work for Form Three students.
    (a) Describe five (5) components of a good Chemistry scheme of work.
    (b) Explain the relationship between the scheme of work and the lesson plan.
    (c) Outline four (4) challenges a teacher may face when preparing a Chemistry scheme of work.

(a) One component is the topic or sub-topic to be covered. This is based on the syllabus and outlines the specific areas of focus for each lesson.

Another component is the instructional objectives. These describe what students should be able to know or do by the end of the lesson.

Content or subject matter is also included. It summarizes the key concepts and facts that will be taught in that particular lesson.

Teaching and learning methods describe how the content will be delivered — through lectures, experiments, discussions, etc.

Time allocation is also critical. Each topic is assigned a specific number of periods to ensure coverage within the term or academic year.

(b) The scheme of work outlines the broader plan for the term, including what will be taught and when. The lesson plan is a detailed breakdown of how a single lesson within that scheme will be taught, including activities, materials, and assessments. The lesson plan is therefore derived directly from the scheme of work.

(c) One challenge is limited time. Teachers may struggle to distribute all syllabus content evenly across available periods, especially when school calendars are tight.

Another challenge is lack of resources. Teachers may hesitate to include practicals in the scheme if the school lacks chemicals or apparatus.

Unexpected events such as public holidays or school closures can disrupt planned timelines, making the scheme difficult to follow strictly.

Finally, varying student ability levels may make it difficult to plan uniformly. Teachers may need to adjust content pacing, which complicates strict adherence to the initial scheme.