

THE UNITED REPUBLIC OF TANZANIA
MINISTRY OF EDUCATION AND VOCATIONAL TRAINING



Field Support Programme for Diploma in Secondary Education
Second year Students

SELF STUDY MODULE

CHEMISTRY

NOVEMBER 2007

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ACKNOWLEDGEMENTS

The Ministry of Education and Vocational training (MoEVT) wishes to thank the following experts who participated in designing and developing this self-study module.

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INTRODUCTION

Dear student teacher, welcome to this module that aims at enhancing your professional competence as a teacher through performing different learning activities. You are to use it while doing your field work in your second year of study. So, you are required to demonstrate the richness of chemistry as a human activity, and hence its potential to provide meaningful content for you to learn during your field work; for the enrichment of the students whom you are going to teach; and indeed, to prepare you ready for your final examinations

The module has the following structure:

- Introduction
- Main competences
- How to use the module
- Topics
- Competences
- Learning activities; and
- Self -assessment

Main competences

In this module you are expected to develop the following academic and pedagogical competences

- Solving daily life problems using chemistry knowledge, principles and skills;
- Designing and carrying out basic Chemistry experiment to verify phenomena which can be explained scientifically.
- Applying participatory teaching and learning techniques in promoting active learning of chemistry.
- Using and managing chemistry laboratory.
- Using modern technology in teaching and learning process; and
- Assessing learner's achievements objectively.

How to use the module

You are required to go through each topic in the module and read its competences and content. Then, attempt the given activities and keep the work in your chemistry portfolio or diary for evaluation purposes. These records may enable you to write a report if required to do so.

For every academic topic you will find the tasks that focus at developing your academic competences and how to treat ordinary level chemistry content and competences. But in many cases, this information in the module is not enough. So, find other sources on the same topic and read as much as you can to get a deep understanding of the topic. For every topic there is brief explanation, expected competences and activities. You are required to go through the work, understand it clearly and do the activities as instructed.

Furthermore you are required to do self assessment questions in each topic to evaluate yourself if you have achieved the given competences. In addition, the questions are provided to assist you in making preparation for the final examination in both academics and pedagogy.

TOPIC ONE:
FUNDAMENTALS OF TEACHING CHEMISTRY

Brief Explanation

This topic introduces you to the principles used in the teaching and learning of chemistry and their applications.

The topic further explains the importance of chemistry and its application in real life situation.

Competences:

After completing this topic you will develop the ability to:

- Use correctly principles of teaching and learning chemistry.
- Apply chemistry knowledge, principles and skills in solving daily life problems.

Activity 1.1

Explain the following principles used in teaching and learning chemistry.

1. Students learn better when teaching and learning is in inquiry oriented.
2. Students learn better when they learn from concrete to abstract.
3. Students construct their own chemistry meaning from prior ideas or experiences.
4. Practice makes teaching and learning more meaningful.
5. Cooperative learning and teaching facilitate understanding of concepts.
6. Students learning is enhanced in the safe and supportive learning environment.

Activity 1.2

As a chemistry teacher suppose you have realized that most students do not want to participate in chemistry practicals due to fear of handling laboratory apparatus and equipment. How can you assist them and foster their participation in practical lessons?

Activity 1.3

Prepare a lesson plan and conduct a lesson to form 1 students on “the importance of chemistry”. After conducting the lesson explain the challenges that you have encountered and suggest ways to make improvements.

Self assessment

1. Discuss how the principles of teaching and learning chemistry can be applied in real class room situations.

TOPIC TWO: CHEMICAL KINETICS AND EQUILIBRIUM

Brief explanation

In this topic you will deal with the concepts of order of chemical reaction, factor affecting the rate of chemical reaction and reversible reactions.

Competences

In this topic you are required to develop competences in:

- Applying the knowledge of rate of chemical reactions and equilibrium in solving daily life problems.
- Preparing and conducting interactive lessons on the effects of concentration, temperature, catalyst and pressure on rate of reaction

Activity 2.1

1. Identify a phenomenon which keeps on changing.
2. Design an experiment to find average rate of its change.
3. Identify the indicators which show rate of change in the phenomenon?

Activity 2.2

Choose a desirable strategy and use it to conduct a lesson on the effects of concentration on rate of reaction. What are the strengths and challenges that you met in implementing the lesson? Suggest ways to improve the lesson.

Self assessment

You have found that the rate constant of a first-order reaction is $2.0 \times 10^{-6} \text{ s}^{-1}$. The initial concentration of the reactant is 0.10 mol dm^{-3} . Determine the value of the initial rate in $\text{mol dm}^{-3} \text{ s}^{-1}$?

What experiences have you learnt after conducting the lesson on the effects of concentration on rate of reaction? How do you use this experience in conducting other lessons on the effects of temperature, catalyst and pressure on rate of reaction?

The half - life of a certain first – order reaction is 86. What percentage of the initial concentration of reactant will remain after 60s?

TOPIC THREE: ELECTROLYSIS

Briefly explanation

In this topic you will learn about:

Electrolysis cells of different electrolytes, e.g. dilute sulphuric acid, aqueous solution of copper (ii) sulphate and molten potassium bromide.

Migration of ions during electrolysis and preferential discharge at the electrodes.

Faraday's first and second laws of electrolysis

Purification and production of various substances by electrolysis.

Competences

You are expected to have the ability to:

Carry out experiments on electrolysis.

Plan and organize teacher's and students' activities in conducting electrolysis experiments.

Activity 3.1

Construct an electrolysis cell by using scrape materials and carry out the electrolysis of an electrolyte of your choice. By the aid of a well labeled diagram explain the migration of ions during the electrolysis and write the electrode reactions.

Activity 3.2

1. Prepare a lesson plan and conduct a lesson on Faraday's first law of electrolysis.
2. After the lesson explain the challenges you faced in conducting the lesson and suggest how to improve.

Activity 3.3

Having completed the teaching and learning of this topic fill in the chemistry log book. Describe the format of a log book.

Self- assessment

Am I able to attempt the following tasks accurately?

1. Write electrode reactions for the electrolysis of the following electrolytes:
 - (a) An aqueous solution of sulphuric acid.
 - (b) An aqueous solution of copper(ii) sulphate using platinum or graphite electrodes
 - (c) Molten potassium bromide using unreactive electrodes.
2. Determine the mass of copper deposited when copper(ii) sulphate solution is electrolysed by a current of 0.25 amperes passing through the electrolyte for 40 minutes.

(1 Faraday = 96,500 coulombs, 1mole of copper = 64g).

3.
 - (a) Draw diagrams of three voltmeters (electrolytic cells) containing Ag^+ , Cu^{2+} and Zn^{2+} ions connected in series..
 - (b) Calculate the weights of silver and aluminium deposited at the same time as 16g of copper in a copper voltmeter if the three voltmeters are connected in series.
4. State the names and calculate the volumes of gases at the cathode and anode at s.t.p. when 0.50 A of current are passed for 3.50 hours through an aqueous solution of sulphuric acid.
5. With the aid of an appropriate electrolysis cell briefly explain the application of electrolysis in the following industrial activities:
 - Electroplating of iron by a thin layer of copper metal.
 - Extraction of aluminium metal.
 - Purification of copper metal.

TOPIC FOUR: VOLUMETRIC ANALYSIS

Briefly explanation

The topic addresses the essential apparatus needed for volumetric analysis, preparation of standard solutions of common acids and bases used in the chemistry practicals. Also the topic focuses on choosing a suitable indicator to be used in different acid – base titrations,

converting known masses of substances into moles; performing calculations based on the mole concept. Further more you will learn about oxidation and reduction reactions.

Competences:

You are expected to use the knowledge, principles and skills of volumetric analysis in:

- Planning practical work and carrying out standardization of solutions.
- Analyzing molar quantities of different solutions.
- Performing calculations based on the mole concept.
- Balance chemical equations.

Activities 4.1

Demonstrate to your students the preparation of a standard solution of sulphuric acid and sodium carbonate to be used in school chemistry practicals.

Then allow your students to practice the demonstration.

Explain the procedure you used in preparing the standard solutions.

Activity 4.2

Identify a kind of first Aid you will provide to a student who has been involved in the following accidents?

- a) Has a Splash of an alkali into his/her eyes.
- b) Has swallowed an acid.
- c) Has a sharp particle in his/her eye.

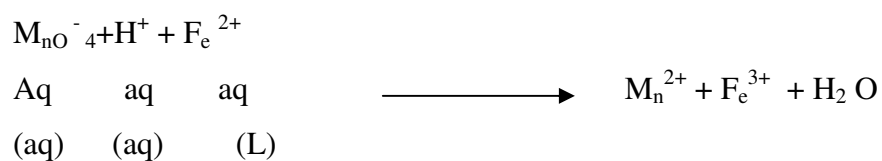
Activity 4.3

Prepare a lesson plan and conduct a practical lesson on acid - base titration.

After the lesson describe the successes and failures of the lesson and suggest ways of improvement.

Self assessment.

1. Do I managed to;
 - Follow steps in preparing standard solutions for practical Lessons?
 - Do calculations based on the mole concept and balanced chemical equations?
 - Supervise students in performing titration work?
2. Use the oxidation number method to balance the following equation



TOPIC FIVE: ORGANIC CHEMISTRY

Brief Explanation

Organic chemistry is a branch of chemistry which deals with the chemistry of carbon compounds (except carbon dioxide and the carbonates which are inorganic compounds).

In this topic you will study about:

3. The sources of organic compounds
4. Classification of hydrocarbons
5. Alkenes
6. Alkenes and alkynes
7. Benzene and methylbenzene.
8. Hydroxyl compounds
9. Carbonyl compounds.

Competencies

After studying the concepts in this topic you should have the ability in:

- (a) Describing various sources of organic compounds.
- (b) Classifying aliphatic and aromatic hydrocarbons.
- (c) Explaining the preparation, physical and chemical properties of Alkanes, Alkenes, alkynes, Benzene, methylbenzene, alcohols and Carbonyl compounds.

Activity 5.1

With the aid of a precise lesson plan conduct a lesson on classification of hydrocarbons to form iv students.

Explain the challenges you have encountered in conducting the lesson and suggest ways of improvement.

Activity 5.2

1. Prepare a one month scheme of work which you can use for teaching organic chemistry to form IV students.
2. Choose one subtopic from the scheme of work and conduct a lesson on it.
3. Explain how you make use of the prior knowledge of students in introducing the lesson.

Self – assessment.

1. Write a summary of each of the following groups of organic compounds: alkanes, alkenes, alkynes, alcohols, aldehydes and ketones?
2. Ozonolysis of compound A (C_6H_{12}) gave compounds B (C_3H_6O) and C (C_3H_6O). B did not reduce Fehlings solution but C did. Reduction of C with hydrogen and a catalyst gave D (C_3H_8O) which when heated with concentrated hydrobromic acid gave E (C_3H_7Br). E was heated with concentrated solution of potassium hydroxide in ethanol and gave F (C_3H_6). Identify the compounds A – F, explaining your reasoning.

TOPIC SIX: FORMULA AND BONDING

This topic deals with the following concepts:

Types of chemical bonds

Properties of covalent and electrovalent compounds

Hybridization of atomic orbitals (sp , sp^2 and sp^3).

Competencies

Upon studying this topic you should develop the ability in:

- (a) Describing different types of chemical bonds
- (b) Analyzing the concept of atomic structure and bonding.
- (c) Explaining the concept of hybridization of atomic orbitals (sp , sp^2 and sp^3).

Activity 6.1

By the aid of electronic diagrams of two pairs of any named elements of your choice show how covalent and electrovalent bonds are formed.

Activity 6.2

1. Prepare a lesson plan and conduct a lesson on the properties of covalent and electrovalent compounds.
2. After the lesson explain the challenges that you encountered in conducting the lesson and suggest ways of improvement.

Self- assessment questions

1. Use the concept of hybridization of atomic orbitals to explain the bonding of atoms in methane, ethane and ethyne molecules.

TOPIC SEVEN: PERIODIC CLASSIFICATIONS

Brief Explanation

In this topic you will learn about:

- Classification of elements on the basis of their chemical properties.
- Periodic law and general periodic trends in physical and chemical properties of elements across period 3 and down group IIA and VII.
- Preparation of oxygen and hydrogen and description of their physical and chemical properties and their uses.

Competences

Upon studying the concepts in this topic you should develop the ability to:

- Classify elements on the basis of their chemical properties and
- Describe the general trends in physical and chemical properties across the periods and down the groups in the periodic table.
- Prepare oxygen and hydrogen and describe their properties and uses.

Activity 7.1

Prepare a lesson plan and conduct a lesson on classification of elements in the periodic table and the periodic law. After the lesson explain the challenges that you faced in conducting the lesson and ways to improve.

Activity 7.2

Involve your students to design and carry out experiments on the preparation of hydrogen from locally available materials. Test the gas and lead the students to discuss the physical and chemical properties of hydrogen.

Self-assessment

Do the following questions to assess yourself on the extent you have mastered the concepts in this topic.

1. Explain how the modern periodic table was developed.
2. Describe the trends in physical and chemical properties of elements across period 3 and down groups IIA and VII of the modern periodic table.

TOPIC EIGHT: LABORATORY MANAGEMENT

Brief explanation

A chemistry laboratory is a place where properties of matter are investigated.

Good management of the laboratory should be maintained to ensure effective and safe use of the laboratory.

In this topic you will learn about:

- Features of a good chemistry laboratory
- Laboratory safety rules
- Sources of dangers in a chemistry laboratory
- Classes of fires and their appropriate fire extinguishers.
- First aid and the first aid kit.

Competencies.

After learning the concepts in this topic you will have the ability to:

- Describe the features of a good chemistry laboratory and how to maintain its safety.
- Provide first aid to accident victims.

Activity 8: 1

Visit a chemistry laboratory with your students and guide them to identify its main features.

Activity 8.2

Prepare lesson plans and conduct lessons on:-

- a) Source of dangers in the laboratory and safety rules.
- b) Classes of fires and their appropriate extinguishers.
- c) The first aid kit and its use.

Self assessment.

Assess yourself on the extent you have mastered the concepts in this topic by answering the following questions.

1. Describe the features of a modern chemistry laboratory.
2. What precautions should you take to maintain safety in a chemistry laboratory?
3. Describe the various classes of fire and their appropriate extinguishers.
4. Explain how you will provide first aid to a student who has been involved in the following accidents.
 - a) Has a severe bleeding wound.
 - b) Has alkali splashes in his/her eyes
 - c) Has swallowed a base.

TOPIC NINE: CURRICULUM MATERIALS

Brief explanation

Teaching and learning of chemistry involves the use of curriculum materials.

There are two main categories of curriculum materials namely textual (printed) and non-textual (non-printed) materials.

Textual curriculum materials include the syllabus, textbooks teachers guide and journals.

Non-textual curriculum materials include the glass wares and non-glassware equipments used in chemistry practicals. In this topic you will study the following concepts:

- Analysis of the structure and components of the chemistry syllabus, textbooks and teacher guide to evaluate their quality.
- Relationship between chemistry syllabus, textbook and teacher's guide.

Competences.

After studying this topic you should develop the ability to:-

Evaluate the quality of chemistry curriculum materials used in Chemistry O – level course.

Establish the relationship between O – level chemistry syllabus textbooks and teacher's guide.

Activity9.1

Analyse the O – level chemistry syllabus and comment on the quality of its cover, printed pages and nature of the binding.

Activity 9.2

Collect various chemistry text books used in O – level chemistry course and check if they meet the needs of the chemistry syllabus.

Self – assessment

Answer the following questions which are designed to enable you assess yourself on the extent you have mastered the concepts in this topic.

1. Go through the various textbooks used in O-Level chemistry course comment on their relationship with the course syllabus.
2. Explain the importance of analysing chemistry curriculum materials.
3. Describe the qualities of a good chemistry syllabus and text book.

**TOPIC TEN:
ASSESSMENT IN CHEMISTRY**

Assessment is a process which involves various activities designed to measure learners achievements in learning.

These activities include construction, moderation, administration marking and record keeping of a test or examination.

Competencies.

After studying this topic you should have the ability to:-

- Evaluate the learning achievements of your students.

Activity 10.1:

After facilitating a good number of lessons to your chemistry students, do the following:

1. Construct a test and give it to your fellow teacher for moderation. Then administer it.
2. Prepare a marking scheme and mark the test.
3. Standardize and rank the scores.
4. Explain why it is important to standardize test scores?

Self assessment

1. Describe the steps involved in planning a test.
2. (a) Standardize the following set of scores which were obtained by form II students in a chemistry test.
(b) Determine the mean, mode and median of the set of scores.

70	48,	64	91,	36,	42,	54	60
62	30	42	50	66	70	62	48
45	75	63	40	42	83	75	70