Republic of Malawi

Syllabus for

Chemistry

Forms 3 and 4

Ministry of Education, Science and Technology

Syllabus for

Chemistry

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Ministry of Education, Science and Technology

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Contents

Foreword

Education is the vehicle through which every citizen can realise his or her potential and contribute to national development. The vision of the education sector in Malawi is to be a catalyst for socio-economic development, industrial growth and an instrument for empowering the poor, the weak and the voiceless. Its mission is to provide quality and relevant education to Malawians. As a catalyst for development of both the individual and the nation, education should equip learners with knowledge, skills, values and attitudes to enable them perform their roles effectively, in an attempt to promote and sustain the socio-economic development of the nation.

Ministry of Education, Science and Technology holds the view that primary education is not sufficient for achieving socio-economic development because the world at large is getting more complex and sophisticated. Therefore, secondary education is critical as it provides additional knowledge, skills, values and attitudes crucial for enabling Malawians to cope with the complex and sophisticated socio-economic and political environment of the global village to which Malawi belongs. Specifically, secondary education is: 1) a human right, and important for achieving gender equity; 2) important for improving health and quality of life for individuals, families and communities; 3) important for the socio-economic and political development of the nation; and 4) necessary for reaching the Millennium Development Goals (MDGs). Education For All (EFA) and maintaining Universal Primary Education (UPE).

Against this background, the Ministry of Education, Science and Technology has reviewed the secondary school curriculum with a view to improving its quality and relevance, and to align it with the primary school curriculum. It is hoped that the new curriculum will provide the basis for further education, gainful employment in the public or private sector, or self employment. The importance of this syllabus, therefore, cannot be over-emphasised.

I would like to thank all those who directly or indirectly contributed to the preparation of the syllabuses. Key among the stakeholders are the Directors and staff of the Directorates of Inspection and Advisory Services (DIAS) and Directorate of Secondary and Distance Education (DSDE) in the Ministry of Education, Science and Technology (MoEST), and the Malawi Institute of Education (MIE) for facilitating the development of the syllabuses. Gratitude is also extended to staff from public and private universities and colleges, teachers from public and private secondary schools, representatives of various faith groups and officers from the Malawi Revenue Authority (MRA), Reserve Bank of Malawi (RBM), Malawi Bureau of Standards (MBS), Anti-Corruption Bureau (ACB), Malawi Blood Transfusion Services (MBTS), National Commission for UNESCO and the Department of Disaster Risk Management for their valuable contributions to the preparation of these syllabuses.

Most of all, I would like to express my hope that teachers will implement this curriculum diligently and in the best interest of the students so that the goals for reviewing the curriculum are achieved.

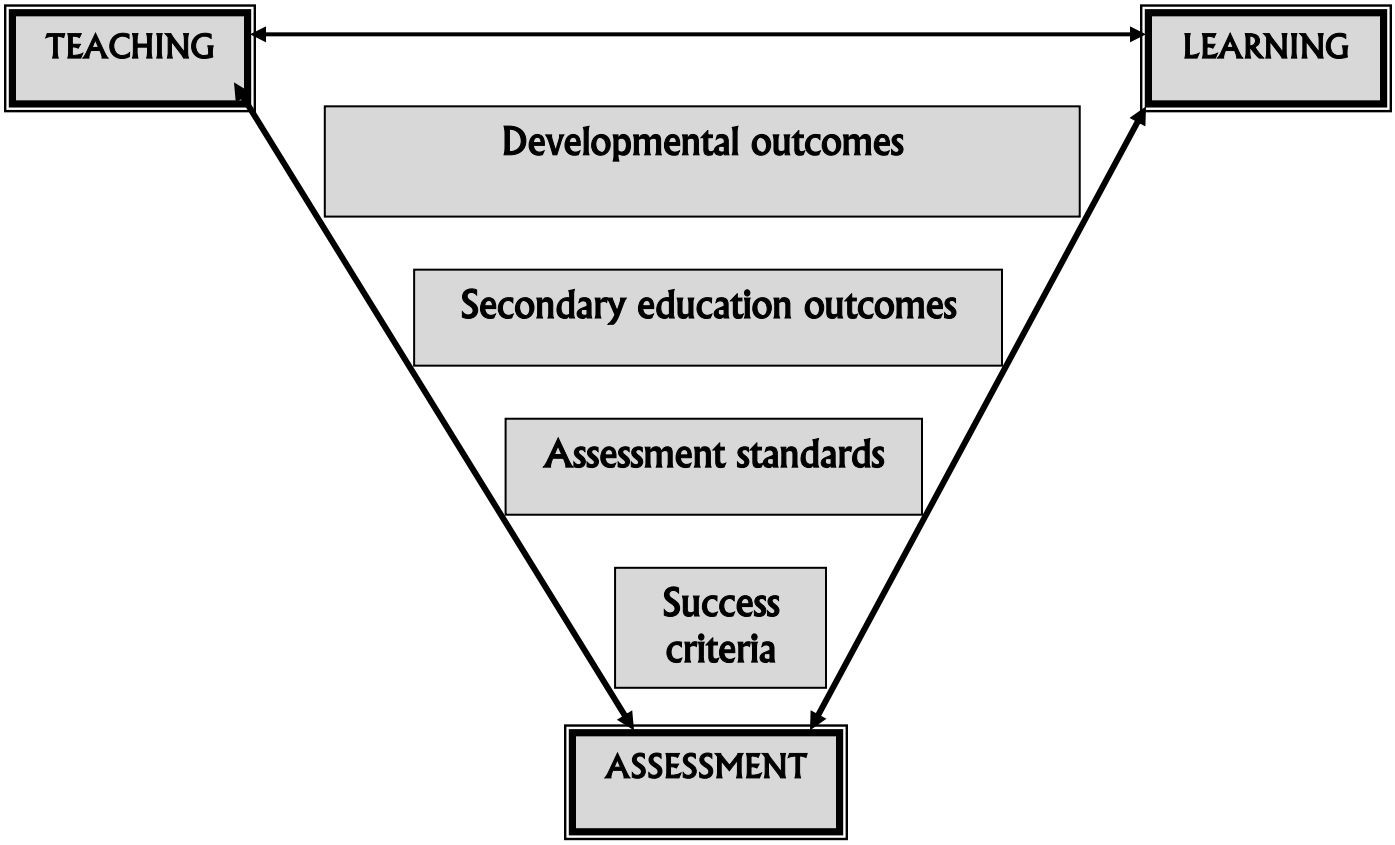
Principal Secretary Responsible for Basic and Secondary Education

The secondary school curriculum in Malawi

Among other reasons, the secondary school curriculum has been reviewed to align it with the primary school curriculum. This curriculum puts emphasis on student-centred teaching and learning approaches, including continuous assessment.

This curriculum focuses on student achievement. To achieve the outcomes, students must be introduced to new knowledge, skills, attitudes and values in the context of their existing knowledge, skills, attitudes and values so that they develop a deeper understanding as they learn and apply the knowledge. In this way, the process of learning is integral to the final product. The final products are the outcomes, that is, what students are expected to achieve in terms of knowledge, skills, attitudes and values, which must be clearly stated before teaching and learning begin. The achievements made at school, however, are only truly beneficial when the students transfer them to life beyond the school and view learning as a lifelong process. This is essential to keep pace with the changing social environment of home and work.

The figure below illustrates the structure and major elements of Malawi's secondary school curriculum, which are elaborated in the text below.



The developmental structure of the secondary school curriculum in Malawi

Developmental outcomes

The developmental outcomes are over-arching; they are what the student is expected to achieve by the end of the secondary school cycle both in and out of school. These outcomes apply to subject areas and they have been derived from the Constitution of the Republic of Malawi, Malawi Growth and Development Strategy (MGDS), National Education Sector Plan (NESP), Education Act and other education policy documents, including global policies and multilateral agreements to which Malawi is a signatory, as well as from the Secondary School Curriculum and Assessment Review (SSCAR). That is, students should be able to:

1 demonstrate appropriate moral and ethical behaviour in accordance with the accepted norms and values of the society
2 demonstrate local, regional, and international understanding
3 communicate competently, effectively, and relevantly in a variety of contexts, in an appropriate local or international language
4 apply mathematical concepts in socio-cultural, political, economic, environmental, scientific, and technological contexts to solve problems
5 apply scientific, technological, vocational, and managerial skills in a creative and innovative way to identify problems and develop appropriate solutions, so as to participate productively in society
6 demonstrate health-promoting behaviour in their personal lives as well as in their communities and the wider environment, with particular attention to prevalent diseases
7 appreciate and interact with the environment in a responsible and sustainable manner
8 apply the indigenous and non-indigenous knowledge and skills necessary for lifelong learning, personal advancement, employment, and the development of society
9 use Information and Communication Technology (ICT) responsibly and productively
10 demonstrate an understanding of the functioning of the economy and the contribution of agriculture and other sectors to national development
11 make use of entrepreneurial and vocational skills for personal and national development
12 apply research skills for problem-solving
13 demonstrate an understanding and appreciation of issues of human rights, democracy, gender, governance, and other emerging issues

Secondary education outcomes

The secondary education outcomes are categorised into seven sets of essential skills to be acquired by a secondary school graduate. The skills are:

1 citizenship skills
2 ethical and socio-cultural skills
3 economic development and environmental management skills
4 occupational and entrepreneurial skills
5 practical skills
6 creativity and resourcefulness
7 scientific and technological skills

Citizenship skills

1 demonstrate an understanding and appreciation of the symbols of nationhood

2 demonstrate a spirit of patriotism and national unity

3 apply decision-making skills necessary for participation in civic affairs

4 demonstrate a spirit of leadership and service

5 show respect for one's own and other people's rights and responsibilities

6 tolerate other people's attitudes and beliefs

7 demonstrate respect for the rule of law

8 understand characteristics of good governance

9 initiate and implement community development projects

10 demonstrate a sense of good neighbourliness

11 demonstrate a sense of national, regional and international understanding

12 demonstrate cooperative behaviour

13 demonstrate personal and social responsibility

Ethical and socio-cultural skills

14 demonstrate moral, spiritual and ethical attitudes and values

15 appreciate Malawi's diverse cultures and their respective practices

16 appreciate existing national institutions and cultural heritage

17 appreciate the value of the relationship between the individual and society

18 respect one's own and other people's cultures

19 identify beliefs which promote or retard national development

20 evaluate beliefs, taboos and superstitions in relation to national development

21 uphold beliefs which promote national development

Economic development and environmental management skills

22 understand Malawi's economy and economic structure

23 demonstrate entrepreneurial and/or vocational skills for formal or informal employment

24 exploit economic opportunities stemming from agriculture

25 demonstrate an interest in land husbandry, animal husbandry and aquaculture

26 apply appropriate agricultural practices and methods

27 acquire positive attitudes and skills, and apply them to the sustainable development of the natural and physical environment

28 understand the importance of diversified agriculture for Malawi's economy

29 understand the impact of technologies on economic productivity

30 apply relevant technologies to various economic activities

31 apply value addition practices to agricultural and environmental resource utilisation and management

32 appreciate Malawi's environmental resources

33 understand the impact of rapid population growth on natural resources and the delivery of social services

34 apply a variety of measures to conserve Malawi's natural resources

35 apply ICT skills to improve intellectual growth, personal enhancement and communication

36 demonstrate the ability to adapt to climate change and mitigate its impact on the economy and environment

37 appreciate the importance of energy in economic development

38 understand the importance of diversifying the economy through sectors such as tourism, mining and manufacturing

Occupational and entrepreneurial skills

39 demonstrate the spirit of self-reliance through vocational and entrepreneurial activities

40 apply appropriate vocational, occupational and entrepreneurial skills to individual and national advancement

41 demonstrate effective communication skills for the transfer of occupational and entrepreneurial knowledge, skills, attitudes and values

42 apply the principles of science and technology, entrepreneurship and management to promote active and productive participation in the society

43 demonstrate creativity and innovation for the benefit of the individual, community and the nation as a whole

44 demonstrate an understanding of indigenous and non-indigenous knowledge, skills, attitudes and values, and apply them to personal intellectual growth and national development

45 use vocational, occupational and entrepreneurial skills for the creation of economic opportunities in agriculture and other sectors

Practical skills

46 acquire entrepreneurial skills related to agriculture, commerce and industry

47 apply appropriate skills to agricultural, commercial and industrial production

48 demonstrate positive attitudes to manual work

49 demonstrate excellence in any kind of workmanship

50 demonstrate sporting ability and sportsmanship

51 demonstrate the ability to use creative and innovative artistic talents for self-employment

Creativity and resourcefulness

52 demonstrate a spirit of inquiry and creative, critical and lateral thinking

53 use problem-solving techniques to solve practical problems

54 demonstrate an imaginative and creative mind

55 exploit creative potential

56 understand personal strengths and weaknesses and use strengths to promote healthy self-esteem

57 maximise the use of available resources

Scientific and technological skills

58 apply appropriate scientific, technological and vocational skills to improve economic productivity

59 apply relevant innovations in science and technology

60 demonstrate a capacity to utilise appropriate technology

61 demonstrate basic research skills

Rationale for chemistry

Chemistry enables students to acquire knowledge of fundamental theoretical and practical principles of science, which are useful in the understanding of the technological world and development of a positive attitude towards science and scientific developments.

Through the investigative approach, chemistry equips students with essential skills for effective communication of scientific information, problem-solving and pursuit of further education.

Chemistry provides students with awareness and understanding of environmental and natural resource management that leads to safe and efficient management of local resources for sustainable national development.

Core elements and their outcomes

Analytical skills in Chemistry
The students will be able to demonstrate an understanding of the appropriate use of scientific methods, techniques and materials to solve problems in their daily lives.

Inorganic compounds
The students will be able to appreciate properties of various inorganic substances, their uses in the manufacturing industry and the dangers they pose on the environment.

Chemical composition of matter
The students will be able to appreciate the composition and properties of various natural and synthetic substances, which form their environment.

Chemical reactions
The students will be able to demonstrate an understanding reaction of dynamics and chemical energetics essential for the advancement of the chemical and manufacturing industry.

Organic chemistry
The students will be able to demonstrate creative use of knowledge and skills on the composition and reactivity of organic compounds for safe and efficient utilization of resources around them.

Environmental chemistry
The students will be able to demonstrate an understanding of the applications of chemistry in solving real life problems and the potential harmful effects of chemicals and chemical processes on the environment and human health

Scope and sequence chart for Forms 1 to 4

Core element	Form 1	Form 2	Form 3	Form 4
Analytical skills in chemistry	**Introduction to chemistry (**15 periods) • chemistry and society • laboratory safety measures • units of measurements • basic scientific instruments and apparatus • scientific method of investigations **Essential mathematical skills for chemistry (**9 periods**)** • handling numbers – scientific notation – significant figures • accuracy and precision • presentation and manipulation of numerical data		**Experimental techniques** (12 periods) • ways of disposing off chemical wastes in the laboratory • designing experiments for scientific investigations • determining the purity of substances • simple tests for water, ions and gases	

Core element	Form 1	Form 2	Form 3	Form 4
Chemical composition of matter	**Composition and classification of matter** (24 periods) • particulate nature of matter • atoms, elements and compounds • chemical symbols and formulae • pure substances and mixtures • solutions • separating mixtures – chromatography – filtration – distillation – sedimentation – decantation – centrifuge – crystallization	**Chemical bonding** (15 periods) • types of bonding – covalent – ionic – metallic • chemical formulae for ionic and covalent compounds • cross and dot diagrams	**Chemical bonding and properties of matter** (20 periods) • properties of ionic and covalent compounds • bond polarity • effects of intermolecular forces • allotropy and allotropes • properties and uses of allotropes of carbon • properties and uses of metallic substances • properties and uses of alloys	

Core element	Form 1	Form 2	Form 3	Form 4
Inorganic chemistry	**Atomic structure** (12 periods) • atomic structure • electron configuration • atomic numbers (A) and mass numbers (Z) • isotopes • average atomic masses **The periodic table** (9 periods) • definition of periodic table • arrangement of the first twenty elements in the periodic table • family of elements	**Elements and the periodic Table** (15 periods) • trends in the periodic table • properties of groups I,II,VII and VIII • uses of group I,II,VII and VIII elements	**Nitrogen, sulphur and phosphorus** (16 periods) • properties and uses of nitrogen, sulphur, phosphorus and their compounds	

Core element	Form 1	Form 2	Form 3	Form 4
Chemical reactions	**Physical and chemical changes** (12 periods) • introduction to physical and chemical changes • chemical reactions • balancing chemical equations • reacting masses • percentage composition by mass	**Acids and bases** (15 periods) • properties of acids and bases • acid – base indicators • strength of acids and bases in terms of pH value • uses of acids and bases • neutralisation reactions and their applications	**Chemical reactions I:stoichiometry** (28 periods) • balancing chemical equations • relative formula masses • the mole concept • the percentage of water in molecular and hydrated ionic compounds • empirical and molecular formula • concentration of solutions • preparation of standard solutions • titrations • percentage yield	**Chemical reactions II**: **rates of reactions** (8 periods) • definition of rate of reaction • factors affecting rate of reaction • measuring rates of reactions • interpreting graphs on rates of reactions • reversible and irreversible reactions • chemical equilibrium

Core element	Form 1	Form 2	Form 3	Form 4
Chemical reactions			**Heats of reactions** (10 periods) • endothermic and exothermic reactions • temperature change in chemical reactions • energy level diagrams • bond energies • preparation of soluble and insoluble salts • separation and purification of salts • applications of precipitation reactions	**Acids and bases** (16 periods) • definition of acids and bases according to Bronsted-Lowry theory conjugate acid- base pairs • strength of acids and base in terms of ionisation • concentration versus strength of acids and bases • ways of controlling pH in different environments • classification of metal oxides and non-metal oxides as acidic and basic

Core element	Form 1	Form 2	Form 3	Form 4
Chemical reactions				**Reduction and oxidation reactions (16 periods)** • definition of oxidation and reduction oxidation states/numbers • half and overall equations • oxidizing and reducing agents • displacement reactions • activity series • voltage series • corrosion and its prevention **Electrolysis** (12 periods) • definition of electrolysis • uses of electrolysis • purification of copper • electroplating and its uses

Core element	Form 1	Form 2	Form 3	Form 4
Organic chemistry	**Introduction to organic compounds** (9 periods) • historical background of organic compounds • uses of organic compounds • fractions of petroleum and their uses	**Organic families I: hydrocarbons** (15 periods) (alkanes, alkenes) • nomenclature of alkanes and alkenes • molecular, condensed, structural and skeletal formulae of alkanes and alkenes • saturated and unsaturated hydrocarbons • physical and chemical properties of alkanes and alkenes • uses of alkanes and alkenes	**Organic families II:** Alkanols(12 periods) • functional group • structure and nomenclature • molecular and general formulae • classification • preparation • physical, and chemical properties • uses **Alkanals and alkanones (aldehydes and ketones)** (8 periods) • functional group • structure and nomenclature • sources • tests • uses	**Isomerism** (8 periods) • definition of isomers • structures and nomenclature of isomers (alkanes, alkenes, alkanolsalkanals, alkanones and alkanoic acids) • effects of branching on physical properties of organic compounds

Core element	Form 1	Form 2	Form 3	Form 4
Organic chemistry			**Alkanoic (carboxylic) acids** (12 periods) • functional group • structure and nomenclature • molecular and general formulae • sources • physical, and chemical properties • uses	**Polymerisation** (8 periods) • definition of polymers • types of polymers • types of polymerisation • properties and uses of polymers • thermosoftening and thermosetting plastics • ways of moulding plastics

Core element	Form 1	Form 2	Form 3	Form 4
Organic chemistry			**Alkanoates (esters)** (8 periods) • functional group • structure and nomenclature • sources • properties • uses • saponification **Identification of unknown organic compounds** (4 periods) • deducing class and formulae of unknown organic compounds • construction of flow diagrams	

Core element	Form 1	Form 2	Form 3	Form 4
Environmental chemistry		**Air** (12 periods) • composition of dry air • separation of air into its components • properties and uses of gases in air • common pollutants of air • sources of air pollutants **Soil** (9 periods) • chemical composition of soil • chemical properties of soil • sources and effects of soil pollution • ways of controlling soil pollution		**Water** (18 periods) • natural sources • water cycle • properties of water • importance of water • hard and soft water • water pollutants • dangers of polluted water • purification and treatment of water • prevention of water pollution • international and national standards on water quality • impact of human activities on the atmosphere

Core element	Form 1	**Form 2**	Form 3	**Form 4**
Environmental chemistry				**Greenhouse gases and the ozone layer** (8 periods) • greenhouse gases • ozone layer • standards on air quality **Waste management** (8 periods) • types of wastes • sources • treatment and disposal of wastes • minimization of wastes • social and economic importance of recycling wastes

Teaching syllabus for Forms 3 and 4

Form 3

Core element Analytical skills in chemistry

Outcome The students will be able to show an understanding of appropriate use of scientific methods, techniques and materials to solve problems in their daily lives.

Assessment standard	Success criteria	Topic/theme	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of techniques for the purification and analysis of different substances	Students must be able to: 1 describe safe ways of disposing chemical wastes in the laboratory	**Experimental techniques**	• identifying examples of waste products from chemical reactions • discussing ways of disposing chemical wastes in the laboratory • demonstrating safe ways of disposing chemical wastes in the laboratory	• group discussions • written exercises • written reports • observations • demonstrations • tests • experimentations • question and answer • field/industrial visits • reading assignments • projects	• textbooks • laboratory manuals • activity sheets • charts • computer simulations • videos • laboratory safety kits (gloves, laboratory coats, goggles) • glassware • anhydrous copper sulphate • sodium hydroxide • aqueous ammonia • funnels

Assessment standard	Success criteria	Topic/theme	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	2 design scientific investigation 3 carry out an investigation to determine the purity of substance		• identifying techniques and suitable apparatus for a variety of simple experiments • presenting experimental data from observations and measurements • determining the purity of substances using melting and boiling points or paper chromatography • interpreting paper chromatograms using known samples and relative flow values • identifying aqueous cationsusing aqueous sodium hydroxide and aqueous ammonia		• anhydrous cobalt chloride • gas syringes • thermometers • ink • filter paper/cloth • distilled or deionised water • ethanol • mortars • pestles • sources of heat • centrifuges • computers • scientific calculators

Assessment standard	Success criteria	Topic/theme	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	4 describe simple tests for water, ions and gases		• discussing tests for identifying aqueous anions (sulphates, halides and nitrates) • discussing simple tests for identifying common gases such as ammonia, carbon dioxide, hydrogen, chlorine, oxygen, and sulphur dioxide • testing for the presence of water using anhydrous copper sulphate or anhydrous cobalt chloride		

Core element Inorganic compounds

Outcome The students will be able to appreciate properties of various inorganic substances, their uses in the manufacturing industry and the dangers they pose on the environment.

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of properties and uses of some selected elements and their compounds	Students must be able to: 1 describe sources of nitrogen 2 describe properties of nitrogen 3 explain uses of nitrogen and its compounds	**Nitrogen, sulphur and phosphorus**	• discussing sources of nitrogen • explaining the inert character of nitrogen and its reactivity under specific conditions • discussing properties of nitrogen gas • discussing uses of nitrogen in providing an inert atmosphere, as a coolant and food packaging • describing the preparation of ammonia and nitric acid	• group discussions • written exercises • written reports • observations • demonstrations • tests • question and answer • field/industrial visits • reading assignments	• charts • pictures • posters • matches • ammonia • nitric acid • textbooks • molecular models • tooth paste • activity sheets • samples of fertilizers • sulphur • fire works • used tyres • sulphuric acid • sugar • students' experiences

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
			• discussing uses of ammonia and nitric acid in the manufacture of ammonium nitrate fertilisers		
	4 describe sources and properties of sulphur		• discussing sources of sulphur • explaining the properties of sulphur		
	5 explain the uses of sulphur and its compounds		• Discussing the uses of sulphur including the manufacture of rubber tyres, dyes and matches • discussing the preparation of sulphuric acid • discussing use of sulphuric acid in the manufacture of inorganic fertilizers		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	6 describe sources and properties of phosphorus 7 describe uses of phosphorus and its compounds		• discussing sources of phosphorous • discussing properties of phosphorous • discussing uses of phosphorous in manufacturing of products such as toothpaste, matches baking soda and detergents • discussing uses of phosphoric acid in the manufacture of inorganic fertilizers and food additives		

Core element Chemical composition of matter

Outcome The students will be able to appreciate the composition and properties of various natural and synthetic substances which form their environment.

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of how bonding relates to properties of chemical substances	Students must be able to: 1 describe properties of ionic and covalent compounds	**Chemical bonding and properties of matter**	• investigating the physical properties of ionic and covalent compounds based on - solubility - melting and boiling points - volatility - electrical conductivity in solid and molten states	• role plays • practical work • group discussions • question and answer • written exercises • experimentation • demonstrations • reading assignments • observations • tests	• textbooks • activity sheets • charts • posters • molecular models • bottle tops • circuit boards • bulbs • ammeters • carbon rods • thermometer • tripod stand • NaCl • $MgCl_2$, • glassware • CaO

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	2 explain structural differences between ionic and covalent compounds 3 differentiate between polar and non-polar covalent bonds		• comparing strength of electrostatic forces in covalent and ionic compounds by heating sugar and common salt • relating the physical properties such as melting point and conductivity of ionic and covalent compounds to their structure (lattice) and bonding • explaining the difference between pure covalent bond and dative covalent bond in terms of electron sharing		• sugar • water • alcohol • dry cells • spatulas • gas burners • crucibles • metals eg Al and Cu • diamond and graphite • heating blocks (hot plates) • pieces of cutlery

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
			• discussing polarity of covalent bonds based on eletronegativity differences between the bonded atoms		
	4 relate intermolecular forces to properties of covalent compounds		• discussing types of intermolecular forces: hydrogen bonding and Van der Waal's forces • discussing the effect of intermolecular forces on physical properties of covalent compounds		
	5 define the term *allotropy*		• explaining the meaning of allotropy • discussing allotropy using examples of oxygen, carbon and sulphur		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	6 relate the properties of allotropes of carbon to their uses 7 explain similarities between diamond and silicon dioxide		• discussing the structure and physical properties of graphite and diamond • discussing the uses of graphite and diamond in relation to their structure • explaining the structure of silicon dioxide • comparing properties of diamond and silicon dioxide - hardness - conductivity - melting and boiling points		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	8 describe the uses of metals in relation to their properties		• discussing and demonstrating the properties of metals such as conductivity of heat and electricity, hardness, ductility, malleability and lustre • relating the properties of metals to their uses		
	9 explain the physical properties of alloys		• brainstorming the meaning of the term*alloy* • listing examples of alloys such as brass and stainless steel • discussing the properties of alloys • comparing the physical properties of alloys to those of their constituent elements		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	10 state the uses of alloys		• discussing some of the uses of alloys eg in the manufacture of food cans, electric cables, aircraft bodies, surgical instruments, cutlery, and car bodies		

Core element Chemical reactions

Outcome: The students will be able to demonstrate an understanding of aspects of reaction dynamics and chemical energetics essential for the advancement of the chemical and manufacturing industry.

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of the quantitative relationships between reacting species in a chemical reaction	Students must be able to: 1 write balanced chemical equations 2 work out the relative formula mass of a compound	**Stoichiometry**	• writing chemical formulae of compounds • writing chemicalequations • balancing chemical equations • discussing the term relative formula mass • calculating relative formula mass (M_r) using relative atomic masses (A_r)	• role plays • demonstrations • group discussions • brainstorming • question and answer • written exercises • experimentation • reading assignments • tests • observations	• charts • posters • molecular models • balances • textbooks • scientific calculators • activity sheets • spatulas • stirring rods • sodium hydroxide • hydrochloric acid/acetic acid • glass ware • syringes • distilled water

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	3 define the mole of a substance 4 convert moles into other units of measurements		• discussing the term mole(Avogadro's constant) • calculating the number of moles and mass of compounds given relevant information • discussing molar volume of gases at s.t.p and r.t.p • use Avogadro's constant to find the number of particles of a substance given relevant information	• role plays • demonstrations • group discussions • brainstorming • question and answer • written exercises • experimentation • reading assignments • tests • observations	• white tiles • phenolphthalein indicator • clamps and stands • magnesium ribbon • wash bottles • hydrous copper sulphate • sugar • sources of heat • mutton cloth (waster) • protective wear

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	5 determine the percentage of water in molecular and hydrated ionic compounds		• heating sugar to investigate loss of water • heating hydrous copper sulphate to investigate loss of water of crystallisation • discussing water of crystallisation		
	6 deduce empirical and molecular formulae from relevant data		• defining empirical formulae • working out empirical and molecular formulae from relevant data such as the mass of a compound or percentage composition by mass		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	7 calculate concentration of solutions 8 prepare standard solutions		• discussing ways of expressing concentration of a solution (moles/dm^3, g/ cm^3 and percentage) • discussing the meaning of molarity (M) • calculating concentration of solutions given relevant information • defining the term*standard solution* • discussing steps for preparing a standard solution • preparing solutions of known concentration by dissolution and dilution		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	9 determine the concentration of a solution using titration 10 determine the yield in a chemical reaction		• defining the terms *titration* • determining the concentration of a solution by titration • determining the limiting and excess reagents in a given chemical reaction • calculating the theoretical yield and percentage yield of a given chemical reaction		

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of energy changes that occur in chemical reactions and processes	Students must be able to: 1 define the terms *exothermic* and *endothermic* in relation to heat changes 2 describe temperature changes in exothermic and endothermic reactions and processes	**Heats of reactions**	• discussing the terms*exothermic* and *endothermic* in relation to heat changes in chemical reactions and processes • discussing examples of exothermic and endothermic processes in everyday life • investigating temperature changes in the dissolution of silver nitrate or ammonium nitrate and sodium hydroxide • investigating temperature changes in neutralization reactions	• question and answer • written exercises • experimentations • demonstrations • observations • group discussions • tests • brainstorming • reading assessments	• activity sheets • textbooks • charts • dilute hydrochloric acid • silver nitrate • barium hydroxide • ammonium chloride • ammonium nitrate • sodium hydroxide • glass ware • posters • thermometers • calorimeters • computer simulations • scientific calculators • protective wear

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	3 draw energy level diagrams for exothermic and endothermic reactions 4 describe energy changes involved in bond breaking and bond formation processes		• identifying exothermic and endothermic reactions from thermo-chemical equations • drawing energy level diagrams for exothermic and endothermic reactions showing enthalpy change (ΔH) • defining bond energy • explaining the energy changes involved in bond breaking and bond formation		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	5 determine whether the reaction is exothermic or endothermic using bond energies		• calculating the overall energy change of reactions using bond energies • analysing energy level diagrams		

Core element Organic chemistry

Outcome The students will be able to demonstrate creative use of knowledge and skills on the composition and reactivity of organic compounds for safe and efficient utilization of resources around them.

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of the structure, properties, sources and uses of alkanols	Students must be able to: 1 identify the functional group of alkanols 2 draw and name the structures of the first ten unbranchedalkanols 3 write the molecular formula of alkanolsgiven the number of carbon atoms	**Alkanols**	• discussing the functional group of alkanols • writing functional groups of alkanols • drawing the structural and skeletal formulae of the first ten alkanols • naming the first ten alkanols using IUPAC rules • writing the molecular and condensed formulae of the first ten alkanols • deducing the general formulae of alkanols	• written exercises • reading assignments • written reports • brainstorming • demonstrations • experimentation • tests • field trips • question and answer • group discussions • observations • role playing	• charts • posters • molecular models • textbooks • activity sheets • distilled or deionised water • glassware • sugar • yeast • distillation apparatus • sodium metal

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	4 classify alkanols as primary, secondary and tertiary		• discussing how to use the general formulae to come up with a molecular formula of any alkanol given the number of carbon atoms • writing and naming branched chain alkanols • discussing types of alkanols (primary, secondary and tertiary) • identifying primary, secondary and tertiary alkanols given different structures		• ethanol • methylated spirits • butanol • propanol • octanol • pictures • computer simulations • resource persons

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	5 describe methods of preparing alkanols		• discussing indigenous waysof preparing ethanol • investigating preparation of ethanol through fermentation of sugar by yeast • discussing the formation of ethanol by hydration of ethene (consider the exothermic nature and reversibility of the reaction)		
	6 explain the physical properties of alkanols		• discussing the polarity of alkanol • investigating the trends in solubility, melting points and boiling points, densities, volatility and viscosity of alkanols		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	7 describe the chemical reactions of alkanols 8 explain uses of ethanol		• discussing reactions of alkanols with alkali metals • discussing the dehydration of ethanol to form ethene • discussing the oxidation of alkanols to alkanals, alkanones and alkanoic acids • discussing uses of ethanol as a solvent, as constituent of alcoholic beverages and medicine, as an antiseptic, as a raw material in industry and as fuel for vehicles • discussing dangers of excessive consumption of alcoholic drinks and medicines on human health		

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of the structure, sources, importance, and properties of alkanals and alkanones	Students must be able to: 1 identify the functional groups of alkanals and alkanones 2 draw and name the structures of the first five alkanals and alkanones	**Alkanals and alkanones**	• discussing the functional group of alkanals and alkanones • discussing the structural difference between alkanals and alkanones • drawing the structures of the first five alkanals and alkanones • writing the molecular formulae for the first five alkanals and alkanones • naming the first five straight chain alkanals and alkanonesusing IUPAC rules (including position of functional group)	• brainstorming • demonstrations • experimentations • tests • group discussions • question and answer • written exercises • reading assignments • observations	• textbooks • charts • molecular models • activity sheets • propanone • butanone • distilled water • Fehling's solution • Benedict's solution • glassware • source of heat • 2,4-DNPH • propanal • butanal • protective wear • Tollen's reagents

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	3 describe the sources and properties of alkanals and alkanones		• discussing the oxidation of alkanols to alkanals and alkanones • discussing the trends in physical properties of alkanals and alkanones such as solubility, melting and boiling points • discussing the chemical properties of alkanals and alkanones		
	4 carry out a test to distinguish alkanals from alkanones		• distinguishing alkanals from alkanones using the oxidation reaction • carrying out Fehling's, Brady's and Tollen's (silver mirror) tests		
	5 describe the uses of alkanals and alkanones		discussing the uses ofalkanals and alkanones as solvents and preservatives		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of the structure, sources, properties and importance of alkanoic acids	Students must be able to: 1 identify the functional group of alkanoic acids 2 name the first tenunbranched alkanoic acids 3 draw the structures of first ten unbranchedalkanoicacids	**Alkanoic acids**	• discussing the functional group of alkanoic acids • discussing the nomenclature of alkonoic acids • naming the first ten alkanoic acids using IUPAC rules • drawing the structural formulae of the first ten alkanoic acids • draw skeletal formulae of the first ten alkanoic acids	• question and answer • written exercises • reading assignments • brainstorming • demonstrations • experimentations • tests • field trips • group discussions • observations • written reports	• textbooks • charts • distilled water • ethanoic acid (vinegar) • activity sheets • acid-base indicators • conductivity apparatus • bulbs/ammeters • sodium metal • sodium hydroxide • sodium hydrogen carbonate • sulphuric acid • ethanol

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
•	4 write the molecular formula of alkanoic acids given the number of carbon atoms 5 describe the sources of alkanoic acids		• writing the molecular and condensed formulae of the first ten alkanoic acids • deducing the general formulae • discussing how to use general formulae to come up with the molecular formula of any alkanoic acid given the number of carbon atoms • discussing the natural sources of alkanoic acids such as citrus fruits, sour milk and vinegar • discussing the preparation of alkanoic acids from oxidation of alkanols and alkanals • investigating the formation of ethanoic acid using reaction of ethanol with oxygen		• glassware • burners • orange juice • lemon juice • grape juice • carbon electrodes • nails • natural dyes • sodium chloride • molecular models • protective wear

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	6 explain the physical properties of alkanoic acids 7 explain the chemical properties of alkanoic acids 8 describe the uses of alkanoic acids		• discussing the physical properties of alkanoic acids • investigating the trends in solubility, melting points, boiling points, densities and viscosity of alkanoic acids • investigating conductivity of aqueous ethanoic acid • investigating the effect of alkanoic acids on different acid base indicators • investigating the reactions of alkanoic acids with – alkali metals – hydroxides – carbonates – alkanols • discussing the uses of alkanoic acids as solvents and food preservatives		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of the structure, sources, properties and importance of alkanoates	Students must be able to: 1 identify the functional group of alkanoates (esters) 2 name and draw the structures of alkanoates	**Alkanoates**	• discussing the functional group of alkanoates • representing functional groups of alkanoates • discussing the nomenclature of alkanoates • drawing the structure of alkanoates formed from a given alkanoic acid and alkanol • deducing the reactants of esterification given the structure of the product of the reaction	• question and answer • written exercises • reading assignments • brainstorming • demonstrations • experimentations • tests • field trips • group discussions • observations • written reports • reporting in plenary	• sulphuric acid • ethanol • glass ware • sodium hydroxide • potassium hydroxide • molecular models • vegetable oil/animal fat • sweet smelling fruits such as bananas and pine apples • night queen flowers • rose flowers • perfumes

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	3 describe the sources of alkanoates		• discussing the sources of alkanoates as - natural such as fruits and flowers - synthetic through condensation reaction of alkanoic acids and alkanols • investigating the formation of an ester (ethyl ethanoate) using the reaction of ethanol with ethanoic acid		• activity sheets • sodium hydroxide • computer simulations
	4 describe the properties of alkanoates		• discussing the properties of alkanoates - solubility - sweet smell - melting and boiling points - hydrolysis with sodium hydroxide		
	5 state uses of alkanoates		• discussing the uses of esters as solvents, flavourings and fragrances		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	6 describe the process of soap making (saponification)		• discussing fats and oils as esters • explaining the process of soap making • investigating the reaction of fats or oils withalcalihydroxides such as NaOH and KOH		

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of aspects of organic chemistry by solving problems associated with properties of organic compounds	Students must be able to: 1 deduce the family and structural formula of an unknown organic compound 2 distinguish organic compounds basing on their properties	**Identification of unknown organic compounds**	• discussing how to deduce the family and structural formula of an unknown organic compound given relevant information - structural formula, - general formulae - products of chemical reactions - physical and chemical properties, • discussing tests that can be used to classify organic compounds • constructing flow diagrams and using them to identify alkanes, alkenes, alkanols, alkanals, alkanones and alkanoic acids	• question and answer • written exercises • tests • group discussions • demonstrations • experimentations • observations • written reports	• molecular models • activity sheets • textbooks • charts • chemicals and reagents • glassware • plastic containers • scientific calculators • protective wear

Form 4
Core element Chemical reactions
Outcome The students will be able to demonstrate an understanding of reaction dynamics and chemical energetics essential for the advancement of the chemical and manufacturing industry.

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an under-standing that rates of reactions are determined by conditions under which reactions take place	Students must be able to: 1 describe factors that affect rates of reactions	**Rates of reactions**	• defining the term*rate of reaction* • discussing factors that affect rates of reactions • investigating the effects of temperature, surface area, catalysts, and concentration on rates of reactions	• group discussions • written exercises • tests • demonstrations • experimentations • quizzes • observations • question and answer • role plays	• activity sheets • textbooks • charts • posters • graph paper • gas syringes • digital balances • glassware • computer simulations • source s of heat • stop watches • hydrochloric acid • marble chips (calcium carbonate) • markers • clamp stand

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	2 describe methods for measuring rates of reactions 3 explain reversible and irreversible reactions		• discussing how to measure the rate of reaction by monitoring changes of mass of reactants or volume of gas produced per unit time • plotting and interpreting volume or mass against time graphs • discussing reversible and irreversible reactions • investigating reversible reactions by hydration and dehydration of copper sulphate • investigating irreversible reaction by decomposing $CaCO_3$		• anhydrous copper (II) sulphate • hydrated copper (II) sulphate • videos • protective wear

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessmentmethods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate appropriate knowledge and skills in interpreting observations from acid-base reactions and their applications in everyday life	Students must be able to: 1 define acids and bases 2 identify conjugate acid-base pairs from given equations	**Acids and bases**	• discussing the ionisation of acids and bases in water • discussing acids and bases according to the Bronsted-Lowry theory • discussing conjugate acid-base pairs from given equations • isolating acid-base pairs from given reactions	• brainstorming • question and answer • written exercises • group discussions • experimentation • reading assignments • demonstrations • tests • observations • written reports • role play	• charts • textbooks • activity sheets • universal indicator • litmus paper • pH scale charts • pH meters • acids and bases • phenolphthalein indicator

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessmentmethods	Suggested teaching and learning resources
	3 explain the difference between strength and concentration of an acid or a base 4 explain ways of regulating pH in different environments		• investigating the relative strengths of acids and bases using conductivity and pH • discussing the strength of acids and bases in terms of extent of ionisation • discussing the difference between concentration and strength of acids and bases • discussing the use of lime in treating soil and water acidity • discussing the use of magnesium hydroxide (milk of magnesia) in treating stomach upsets • discussing the importance of maintaining suitable pH in the human digestive system, soils and water		• conductivity apparatus • metal oxides • metal hydroxides • non-metal oxides • filter paper/cloth • filter funnel • crucibles • tripod stand • source of heat • glassware • stirring rods • pipettes • protective wear

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessmentmethods	Suggested teaching and learning resources
	5 classify oxides as acidic, basic or amphoteric		• discussing acidic, basic and amphoteric characteristics of metallic and non-metallic oxides • carrying out experiments on the reaction of oxides with acids and bases		
	6 describe different ways of preparing salts		• discussing salts formationin a neutralisation reaction • discussing other ways of preparing salts such as - precipitation - reaction of acids with metals, insoluble bases and carbonates • discussing solubility rules		
	7 design an experiment to prepare and purify a salt		• discussing different ways of obtaining and purifying soluble and insoluble salts • carrying out an experiment to prepare and purify a salts		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessmentmethods	Suggested teaching and learning resources
	8 state applications of precipitation		• discussing the applications of precipitation reactions such as treating effluents and water for domestic use		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of oxidation-reduction reactions and their applications	Students must be able to: 1 define the terms of*oxidation* and *reduction*	**Oxidation - reduction reactions**	• defining oxidation and reduction in terms of: - removal/addition of oxygen - removal/addition of hydrogen - loss/gain of electrons - increase or decrease of oxidation number/state	• brainstorming • question and answers • quizzes • demonstrations • group discussions • experimentation • tests • role play • written reports • observations • reading assignments	• activity sheets • textbooks • charts • copper sulphate solutions • zinc sulphate solutions • zinc metal • copper metal • iron metal • magnesium • iron sulphate solutions • magnesium sulphate solutions

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	2 assign an oxidation number to an atom in an element, ion or compound		• brainstorming the meaning of the term*oxidationnumber* • discussing rules for assigning oxidation numbers • working out the oxidation number of an atom present in an element, ion or compound • discussing the significance of oxidation numbers in - naming of inorganic compounds - writing formulae of inorganic compounds		• table of reactivity series • stoppers • glass ware • distilled water • silver nitrate • iron oxide • computer simulations • scientific calculators • protective wear
	3 identify reducing and oxidizing agents		• defining reducing and oxidizing agents • identifying oxidizing and reducing agents from a given equation		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
			• identifying reduced and oxidised species based on changes in oxidation numbers		
	4 write half and overall redox equations		• discussing half equations for reduction and oxidation reactions • writing and balancing overall redox equations		
	5 deduce the order of reactivity of metals		• conducting an experiment on the reaction of metals with water and hydrochloric acid • arranging metals in order of their reactivity		
	6 predict the spontaneity of a reaction		• explaining displacement reaction using reactions of metals with metal ions in solution		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	7 describe corrosion		• discussing the reactivity of metals in terms of the ease with which they lose electrons • using the activity series to predict whether a reaction will take place or not for given reactants • explaining the potential difference between different metals using voltage series • Calculating the potential difference between different metals using voltage series		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	8 state conditions necessary for corrosion and methods of prevention		• explaining the process of corrosion as a reduction-oxidation reaction of metals • discussing corrosion of iron (rusting) in terms of half reaction equations • conducting an experiment on conditions necessary for rusting to take place • discussing methods of preventing corrosion		

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of the process and applications of electrolysis	Students must be able to: 1 describe electrolysis 2 write electrolytic half and overall equations	**Electrolysis**	• defining electrolysis • discussing the process of electrolysis and components of an electrolytic cell (voltmeter) • writing and balancing half equations at the cathode and the anode • adding cathode and anode half equations to form overall equations	• brainstorming • question and answer • written exercises • experimentation • group discussions • demonstrations • observations • tests • reading assignments • role play	• activity sheets • computer simulations • text books • charts • lead bromide • copper(II) sulphate • sodium iodide • graphite electrodes • copper electrodes • sources of heat • glassware

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	3 predict of products of the electrolysis of molten and aqueous ionic compounds		• discussing the ions present in the molten state of an electrolyte and products that are formed at the electrodes • discussing the ions present in aqueous solution and the products formed at the electrodes • demonstrating preferential discharge using very reactive metals and non-metals • conducting an experiment on the electrolysis of molten lead bromide and aqueous sodium iodide		• conductivity apparatus • cotton wool • nails • cooking oil • water • anhydrous calcium chloride • bulbs/ammeter • protective wear

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	4 explain some uses of electrolysis		• investigating the electrolysis of copper (II) sulphate using inert (graphite) and copper electrodes • discussing the uses of electrolysis such as extraction and purification of metals, electroplating, production of chemicals and lead batteries • Describing the process of the purification of copper		
	5 explain the applications of electroplating		• discussing applications of electroplating and its benefits to society • designing and conducting an experiment to exemplify electroplating		

Core element Organic chemistry

Outcome The students will be able to demonstrate creative use of knowledge and skills on the composition and reactivity of organic compounds for safe and efficient utilization of resources around them.

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of isomerism of organic compounds	Students must be able to: 1 define isomers	**Isomerism**	• discussing isomers as compounds with the same molecular formula but different structures • discussing structural and position of functional group isomerism • discussing and illustrating the difference between isomers and conformers	• written exercises • reading assignments • group discussions • brainstorming • tests • observations • question and answer • written reports • role plays	• charts • textbooks • activity sheets • molecular models • computers animations • samples of different organic compounds

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	2 draw the structures of isomers of alkanes, alkenes alkanols, alkanals, alkanones and alkanoic acids		• drawing isomers of molecules (of up to five carbon atoms) from the specified families of organic compounds • discussing and naming constituent branches of alkanes using IUPAC naming system • naming isomers given their structures		
	3 describe the effect of branching on physical properties in different organic families		• discussing the polarity of different organic compounds • relating the differences in structure of isomers to boiling and melting points and densities		

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of polymers and their social and environmental effects	Students must be able to: 1 define a polymer 2 state types of polymerisation 3 describe properties and uses of synthetic polymers	**Polymerisation**	• defining the terms*monomers* and *polymers* • listing examples of – natural polymers such as proteins, DNA and carbohydrates – synthetic polymers such as PVC, nylon and terlyene • discussing addition and condensation polymerisation • listing examples of addition and condensation polymerisation • discussing properties of synthetic polymers • discussing the uses of	• written exercises • reading assignments • group discussions • brainstorming • tests • field trips • role play • question and answer • demonstrations • observations • written reports • experimentations	• textbooks • charts • activity sheets • videos • plastic materials • hair mesh • molecular models • pictures • sources of heat • posters • computer simulations • protective wear

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	4 explain the difference between thermosoftening and thermosetting plastics		synthetic polymers • discussing the differences between thermosoftening and thermosetting plastics • investigating differences between thermosoftening and thermosetting plastics		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources

Core element Environmental chemistry

Outcome The students will be able to demonstrate an understanding of the applications of chemistry in solving real life problems and the potential harmful effects of chemicals and chemical processes on the environment and human health.

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of sources, properties, uses and pollution of water	Students must be able to: 1 identify natural sources of water 2 explain the water cycle	**Water**	• brainstorming natural sources of water • discussing different natural sources of water (underground, surface and atmospheric) • discussing the water cycle • drawing the water cycle	• question and answer • written exercises • reading assignments • written reports • brainstorming • demonstrations • experimentation • group discussion • tests • observations	• resource persons • rain water • river water • tap water • bore hole water • pond water • calcium hydroxide • aqueous ammonia • charts

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
				• field trips	• sources of heat • distillation apparatus • sodium carbonate
Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
	3 describe the physical properties of water 4 explain the importance of water		• investigating the physical properties of water (boiling point, density, surface tension) • discussing the importance of water as a - reactant - coolant - solvent • brainstorming the meaning of hard and soft water • investigating the		• posters • textbooks • thermometers • glass ware • balances • needles • soap • pictures • internet • activity sheets • video • mathematical instruments • scientific

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
			hardness and softness of water using soap		calculators • radio jingles • bottled water
	5 describe water hardness and its effects		• describing the process that results in hard water and naming salts that cause hard water • discussing the difference between temporary and permanent hardness of water • discussing the effects of water hardness		
	6 describe methods used to remove water hardness		• discussing physical and chemical processes of softening hard water • conducting experiments on moving water hardness		
	7 describe sources,		• defining water pollution • discussing the sources of		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	effects and prevention of water pollution		water pollution; domestic, industrial and agricultural wastes • discussing the effects of water pollution • discussing ways of preventing water pollution		

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate understanding of the causes and effects of changes in the atmosphere and how to manage them to make the world a better living place for all	Students must be able to: 1 explain the effects of natural disasters and human activities on the atmosphere 2 explain the effects greenhouse gases	**Greenhouse gases and ozone layer**	• discussing effects of natural disasters such as volcanoes and bush fires • discussing the effects of extensive burning of organic fuels and deforestation • discussing the effects of using CFCs • discussing the meaning of greenhouse gases • discussing the greenhouse gases and their sources • discussing the contribution of carbon dioxide and methane to global warming	• written exercises • written reports • observations • demonstrations • field trips • group discussion • reading assignments • brainstorming • question and answer • tests	• computer simulations • resource persons • videos • posters • news papers • charts • textbooks • activity sheets • pictures • internet • MBS brochures/ booklets • World Health Organisation (WHO) booklets • WHO website • MBS website

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	3 describe ways of mitigating the effects of global warming		• brainstorming on ways of mitigating global warming • discussing the role of disaster risk management institutions in mitigating the effects of global warming • discussing standards on air quality		
	4 describe the importance of ozone layer		• describing the position of ozone layer in the atmosphere • explaining the importance of ozone layer		
	5 explain the depletion of ozone layer and its associated problems		• discussing the depletion of ozone layer by action of chlorofluorocarbons (CFCs) • discussing problems associated with depletion of ozone layer		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of sources and management of wastes as well as their social and environmental effects	Students must be able to: 1 classify different types of wastes 2 state major sources of wastes	**Waste management**	• identifying different types of wastes and classifying different types of waste based on: - physical state - degradability • discussing the major sources of wastes: - domestic - industrial - agricultural - medical - laboratory • displaying pictures of wastes at source	• written exercises • written reports • observations • demonstrations • field trips • group discussion • reading assignments • brainstorming • question and answer • tests	• resource persons • videos • charts • textbooks • activity sheets • pictures • computer simulations • samples of plastics • scrap metals

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	3 describe environmentally friendly ways of treating and disposing wastes		• discussing the physical and chemical characterisation of wastes • discussing ways of treating wastes - physical - chemical - biological - thermal eg incineration • describing the different ways of waste disposal such as landfills and damp-site • discussing the advantages and disadvantages of the different ways of waste treatment and disposal such as landfills, incineration and recycling		

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	4 state ways of minimising wastes		• describing ways of waste minimization such as reusing, recycling and reduction at source • summarising waste minimisation reports from print media		
	5 describe the social and economic importance of recycling metals and plastics		• explaining the process of recycling metals and plastics • discussing the benefits of recycling metals and plastics		

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