Republic of Namibia

MINISTRY OF EDUCATION, ARTS AND CULTURE

JUNIOR SECONDARY PHASE

PHYSICAL SCIENCE SYLLABUS

GRADES 8 & 9

For implementation:

Grade 8 in 2017
and
Grade 9 in 2018

Ministry of Education
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Private Bag 2034
Okahandja
Namibia

Physical Science Syllabus Grades 8 & 9

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1. Introduction

This syllabus describes the intended learning and assessment for Physical Science in the Junior Secondary phase. As a subject, Physical Science is within the natural sciences area of learning in the curriculum, but has thematic links to other subjects across the curriculum.

The subject Physical Science places strong emphasis on the learners' understanding of the physical and biological world around them at the local, regional and international levels. It thus includes how societies use natural resources to satisfy their needs, and how the environment may be changed in ecologically sustainable ways. At this phase and subject area, the application of scientific knowledge and attitudes to health is of special relevance for the individual, the family, and society as a whole.

2. Rationale

The particular features of Physical Science at this phase are as follows:

Learning experiences in the natural science area are focused upon promoting the teaching and learning for understanding. Namibia, like most African countries, is rich in natural resources. The exploration of these resources requires scientific knowledge and relevant skills. The acquisition of scientific knowledge and skills presents itself as a prerequisite for a progressive national economy and the improved standard of life for our people. It is thus important for our learners to acquire knowledge and skills which will foster their understanding of the interaction of human beings and the environment in order to satisfy human needs. It must be understood that the physical and biological world around us is quite complex and therefore needs to be understood in a holistic manner by the society in order to sustain natural resources.

The sustainability of our natural resources, however, requires advanced technology through the efficient and effective usage of equipment, materials and processes. Modern technology is required in order to assist our learners and society to solve problems through planning, design, realisation, and evaluation of activities and goals.

3. Aims

The main aim of the syllabi in the natural sciences area is therefore to provide basic scientific background for our learners with the hope of producing the much-needed scientists for the country. The Namibian society needs to be scientifically literate if they are to cope with the challenges of appropriate global technology requirements.

The subject Physical Science, within the natural science area, promotes the following aims in the curriculum guide:

3.1 Knowledge with understanding

- develop knowledge, understanding, creativity, practical and experimental skills as a solid foundation for academic training to prepare learners for creative and meaningful adult life
- help learners develop self-confidence, self-knowledge and understanding of the world in which they live, through meaningful scientific activities

3.2 Values and attitudes

- develop a sense of responsibility towards the environment, relating scientific practices to sustainable use of natural resources
- demonstrate desirable behavioural patterns and frame of mind in interacting with the environment in a manner that is protective, preserving and nurturing
- develop attitudes and practices, further knowledge and activities that promote the physical and mental health of the society
- develop and enhance respect for, understanding of, and tolerance of other people's beliefs, cultures and way of life

3.3 Scientific skills

- develop a lively, questioning, appreciative and creative intellect to enable learners to discuss issues rationally, make careful observations and analysis, think scientifically, solve problems and apply them to tasks
- promote Information Communication Technology (ICT) as a tool to enhance understanding of the learning content

3.4 Democratic principles

- promote equality of opportunity for males and females, enabling both sexes to participate equally and fully in all spheres of society and fields of employment
- lay a foundation for informed and responsible attitudes and choices towards the balance of population growth, ecological sustainability, and the quality of life for all citizens of Namibia

4. Inclusive education

Inclusive education is the right of every learner and promotes access to and participation in the full range of educational programmes and services offered by the education system in mainstream schools. It is based on the principle of supporting and celebrating the diversity found among all learners and removing all barriers to learning. The Physical Science teacher in the Junior Secondary phase should therefore accommodate learners with special educational needs by adapting this syllabus to the needs of the learner through differentiation of teaching methods and material as indicated in the *Curriculum Framework for Inclusive Education: A Supplement to the National Curriculum for Basic Education (2014).* The adaptation for assessment of learners with special educational needs must be done as prescribed in the *Handbook for Centres (2014*) by the Directorate of National Examinations and Assessment (DNEA). The accommodations prescribed in this handbook are not only for external examinations, but apply to learners from Grade 1 to 12.

Learners who are so severely impaired that they cannot benefit from attending mainstream schools will be provided for according to their needs in learning support units, resource units or resource schools until such time that they can join a mainstream school structure, if possible.

The subjects in the natural sciences and Mathematics area are basic to foster logical thinking skills and form part of the foundation needed for pursuing most careers. Therefore including gender perspectives is important for the science curriculum in order to raise awareness of

gender stereotyping (e.g. gender roles we previously associated with doctors, nurses, farmers, artisans, mechanics, lawyers etc.). Teachers are obliged to promote gender equity in all spheres of life. In all activities carried out within the scientific area of study, female learners should experience the confidence, which will motivate them to continue in the natural science stream throughout their school career and beyond.

5. Links to other subjects and cross-curricular issues

The cross-curricular issues include environmental education, HIV and AIDS, population education, education for human rights and democracy, information and communication technology (ICT) and road safety. These issues have been introduced to the formal curriculum, because each of the issues deals with particular risks and challenges in our Namibian society. They should be dealt with across all phases and in every subject where the topics overlap with the content of that subject.

All of our learners need to:

- understand the nature of these risks and challenges;
- know how they will impact our society and the quality of life of our people now and in the future;
- understand how these risks and challenges can be addressed on a national and global level; and
- understand how they can play a part in addressing these risks and challenges in their own school and local community.

The main risks and challenges have been identified as the challenges and risks:

- we face if we do not care for and manage our natural resources;
- caused by HIV and AIDS;
- to health caused by pollution, poor sanitation and waste;
- to democracy and social stability caused by inequity and governance that ignores rights and responsibilities;
- we face if we do not adhere to road safety measures;
- we face because of globalisation.

Since some subjects are more suitable to address specific cross-curricular issues, those issues will receive more emphasis in the particular syllabuses.

In this syllabus the following cross-curricular issues can be dealt with in the topics as indicated:

Cross-curricular issues	Grade 8	Grade 9
Environmental Learning	**Matter and materials** Topic 2 Matter **Environmental chemistry** Topic 3 The Gases of the air **Mechanics** Topic 4 Forces	**Matter and materials** Topic 2 Matter **Environmental chemistry** Topic 3 Acids, alkalis (bases), metals and non-metals **Mechanics** Topic 4 Mechanics
ICT	**Scientific processes and experimental techniques** Topic 1 Scientific processes	**Scientific processes and experimental techniques** Topic 1 Scientific processes
EHRD	**Environmental chemistry** Topic 3 The Gases of the air	**Environmental chemistry** Topic 3 Acids, alkalis (bases), metals and non-metals

6. Approach to teaching and learning

The approach to teaching and learning is based on a paradigm of learner-centred education (LCE) described in ministerial policy documents and the learner-centred education conceptual framework. This approach ensures optimal quality of learning when the principles are put into practice.

The aim of learner-centred education is to develop learning with understanding, and to impart the knowledge, skills and attitudes that contribute to the development of society. The starting point for teaching and learning is the fact that the learner brings to the school a wealth of knowledge and experience gained continually from the family, the community, and through interaction with the environment. Learning in school must involve, build on, extend and challenge the learner's prior knowledge and experience.

Learners learn best when they are actively involved in the learning process through a high degree of participation, contribution and production. At the same time, each learner is an individual with his/her own needs, pace of learning, experiences and abilities. The teacher must be able to identify the needs of the learners and the learning that still needs to take place, and know how to shape learning experiences accordingly. Teaching strategies must therefore be varied and flexible within well-structured sequences of lessons.

The teacher must decide, in relation to the general and specific objectives to be achieved, when it is best to convey content directly; when it is best to let learners discover or explore information for themselves; when they need directed learning; when they need reinforcement or enrichment learning; when there is a particular progression of skills or information that needs to be followed; or when the learners can be allowed to find their own way through a topic or area of content.

Work in groups, in pairs, individually, or as a whole class must therefore be organised as appropriate to the task in hand. Co-operative and collaborative learning should be encouraged wherever possible. In such cases, tasks must be designed so that pair or group work is needed to complete it, otherwise the learners will not see any relevance in carrying out tasks together. As the learners develop personal, social and communication skills, they

can gradually be given increasing responsibility to participate in planning and evaluating their work, under the teacher's guidance.

7. End-of-phase competencies

A few learners might not be able to achieve all the specific objectives satisfactorily and must receive learning support through adapted teaching approaches, adapted materials, and assistance from peers. A small number of learners have special educational needs to a degree which requires greater individual attention, resources or assessment. Others will have impairments which do not necessarily limit cognitive and affective learning and development, e.g. the visually impaired, hearing impaired and physically challenged.

On completing of the Junior Secondary phase, learners are expected to be able to:

Scientific processes

- use methods and skills to follow a sequence of instructions; use appropriate techniques; handle apparatus/material competently and have due regard to safety; make, record and convert units of estimates and measurements of length, volume, time, temperature, mass, electrical quantities, area, volume, amount of substance and use SI units;
- start observations and classification determining dependent, independent and control variables in existing scientific models in order for models to reflect real-life situations. Understand the importance of recording and communicating results from experimental investigations;
- use methods, skills of simple scientific models and where possible ICT on the basis of existing and new information to communicate to other people, both scientists and non-scientists, their investigations, analyses and conclusions using basic scientific and mathematical language.

Matter & materials

- investigate and differentiate chemical combustion, decomposition, synthesis and neutralization reactions and be able to formulate word equations for these reactions;
- know the three states of matter to communicate nature and characteristics of physical change and chemical change, observations and conclusions using the kinetic particle theory of matter and the atomic model leading to the understanding of the physical properties and reactions of gases as well as their advantages, uses and disadvantages in everyday life;
- understand that the world around us is made up from the elements on the Periodic Table and that the Periodic Table is a specific arrangement of the elements, in periods and groups, according to their atomic numbers and atomic structures;
- understand that atoms combine to form the building blocks of all material, ionic and covalent bonding, properties and reactions within the Periodic Table. Understand covalent bonding and know how to illustrate covalent bonding as the sharing of electrons when atoms bind (restricted to H_2O, H_2, O_2, CO_2, CH_4 , diatomic molecules of group 7 & N_2). Know how to illustrate ionic bonding as the transfer of electrons to form oppositely charged ions which attract electrostatically.

Environmental chemistry

- know the composition, occurrence, reaction, uses and production of gasses in air and realise that the properties of the gases in air have certain consequences in nature and in industry;
- know acids and bases in everyday life, their properties and reactions that they can undergo. Relate acids' chemical composition to hydrogen ions and negative anions and the pH scale from 0 to less than 7 to measure acid strength and from more than 7 to 14 to measure the strength of an alkali;
- know the nature, the effect on indicators and the reactions of acids and alkalis (bases). Understand neutralisation as a reaction between bases and acids. Know the pH scale and be able to relate the pH of strong and weak acids and alkalis and the pH of pure water;
- know metal and non-metal properties and how to arrange them in order of reactivity. Understand the reactions and write word equations between metals (Group I and II) oxides and acids; metal (Group I and II) hydroxides and acids and carbonates and acids. Outline the important metals mined in Namibia and be able to write word equations of metal and non-metal reactions.

Mechanics

- communicate their physical observations and conclusions using scientific and mathematical language and theories to explain the source, nature, transmission, properties and effects of forces, energy and magnetism, light and waves, static and moving charge electrical energy in the day to day living and have a due regard for safety and conservation of resources. Formulate scientific formulae and do complete calculations of force, friction, work, power, pressure, weight, mass and density and know the apparatus used to measure these quantities (In Grade 8 and 9 only calculations are required where the force and the distance are in the same direction e.g. ether both vertically or both horizontally);
- know various forms, sources and characteristics of energy, the law of conservation of energy and energy transfer and recognise that energy takes various forms that can be classify based on their interaction with matter. Understand the properties of light, in particular that light travels in a straight line and demonstrate an understanding that the sun is the principal source of energy;
- know how to measure and understand from the kinetic particle theory of matter the behaviour of gases and liquids for phenomena such as gas pressure (including atmospheric pressure) and pressure in liquids (under the surface of the liquid);
- understand the forces of flotation (without defining Archimedes principle)and use density to determine whether an object will float or sink in a liquid.

Electricity and magnetism

- know the existence of charge, current, resistance and voltage. Know how to construct simple circuits and draw the circuit symbols and use multi meters or analogues meters to measure current, resistance and potential difference at any place in a circuit;
- know effects on current and potential difference when bulbs, resistors and cells are connected in series and parallel;
- understand magnetism and magnetic properties and uses of magnets.

8. Summary of the learning content

Teachers should realise that there are certain aspects of the syllabus that should not be taught as separate entities and at fixed times during the school year. These include incidental topics such as general knowledge, field trips, project work, investigations and observations including social events.

Table: Summary of learning content for Grade 8 - 9 Physical Science

Grade 8	Grade 9
Scientific Processes and Experimental Techniques	
Topic 1 Scientific processes	Topic 1 Scientific processes
Matter and Materials	
Topic 2 Matter	Topic 2 Matter
Environmental Chemistry	
Topic 3 The Gases of the air	Topic 3 Acids, alkalis (bases), metals and non-metals
Mechanics	
Topic 4 Forces	Topic 4 Mechanics
Electricity and Magnetism	
Topic 5 Electricity	Topic 5 Electricity and magnetism

9. Learning content

9.1 Introduction to learning content

1. The learning content outlined below is designed to provide guidance to teachers as to what will be assessed in the overall evaluation of learners. It is not meant to limit, in any way, the teaching programme of any particular school.

2. **Topics** and **Sub-topics** refer to those components of the subject which learners are required to master.
   The **General objectives** are derived from the topic/skill and are the general knowledge, understanding and demonstration of skills on which learners will be assessed.
   The **Specific objectives** are the detailed and specified content of the syllabus, which learners need to master to achieve the general objectives, and on which they will be assessed.

3. Suggestions for practical activities **or** demonstrations are included at the end of each topic. These suggestions for practical activities **or** demonstrations **are considered essential** and all learners should be exposed to them, both during teaching and as preparation for assessment.

9.2 Learning content

9.2.1 Grade 8 learning content

TOPIC 1 SCIENTIFIC PROCESSES

This topic is an introduction to some of the basic scientific skills. The skills in this topic should not be taught in isolation, as they form an integral part of the other topics

GENERAL OBJECTIVES *Learners will:*	**GRADE 8 SPECIFIC OBJECTIVES** *Learners should be able to:*
1.1 Estimating and measuring	
• know how to estimate and measure volume, length, mass, time and temperature	• find a measurement by following a sequence of instructions; use appropriate techniques; handle apparatus/material competently and have due regard to safety • estimate or measure and record area, volume, length, mass, time and temperature • convert units of length, mass, time, area and volume
1.2 Stating the aim (question) of an investigation	
• realise the value of investigations to understand the world around us and to check the results of other scientists	• outline that investigations are a way to find out new information, explore the world around us, develop new ideas to explain the world around us and to check the results of other scientists • explain the first steps to an investigation as: - choosing the right question or aim of the investigation - planning how to collect information or data • explain how to make a test fair by identifying an appropriate control • explain the importance of a zero reading or the use of a control • identify dependent (what you measure) and independent variable (what you are changing) • explain direct proportionality and inverse proportion

GENERAL OBJECTIVES *Learners will:*	**GRADE 8 SPECIFIC OBJECTIVES** *Learners should be able to:*
1.3 Observing and classifying	
• know how to observe properties of a variety of substances and group (classify) objects in a variety of ways	• describe and record observations accurately of all practical activities in Grade 8 (NOTE: *observe* in science should be the use of five senses: sight, smell, hearing, touch and taste – we do not usually use sense of taste as that could be dangerous; very often the **conclusion** and **observation** are confused, e.g. water boils is a conclusion while bubbles formed is the observation) • analyse and compare properties of substances
1.4 Recording and presenting results	
• understand the importance of recording and communicating results from experimental investigations to other people, both scientists and non-scientists (the use of ICT can be incorporated in this objective)	• record results of experimental investigations in a logical manner, e.g. in tables and graphs (the use of ICT is suggested) • draw up/tabulate results of an investigation in tables, heading each column of the table with the name of the physical quantity and the appropriate unit (e.g. time /s) • select suitable scales and axes for graphs • plot the independent variable on the x-axis (horizontal axis) and plot the dependent variable on the y-axis (vertical axis) • label each graph with the appropriate heading (by convention always the dependent versus independent variable) • label each axis with the physical quantity and the appropriate unit, e.g. time/s • sketch graphs with the appropriate title (by convention and for consistency with Mathematics and Biology the heading will always have the dependent vs. the independent as title)

The practical activities, approaches or demonstrations required for Grade 8, Topic 1 Scientific Processes are listed below. These are considered basic and all learners should be exposed to them as a minimum requirement.
1.1 Estimating & measuring
• *estimate and measure length, mass, time and temperature* • *estimate and measure or calculate volume and area* • *build models of 1 dm^3 and 1 cm^3 containers* • *determine the volume of a liquid, an irregularly shaped object and the classroom* • *measure the temperature changes of heating water*
1.2 Stating the aim (question) of an investigation
• *no minimum activity suggested; if time permits teachers can do alternative activities relevant to topic*
1.3 Observing and classifying
• *group common objects in a number of different ways (cross reference to 2.2.1)* • *observe the effects on the current and the potential difference in different parts of a circuit when:* - *cells are connected in series and parallel* - *bulbs are connected in series and parallel (cross reference to 5.7)*
1.4 Recording and presenting results
• *record the length, mass, time and temperature of the heating of water (cross reference to 1.1)* • *present the results of heating of water (cross reference to 1.1)*

TOPIC 2 MATTER

GENERAL OBJECTIVES *Learners will:*	**GRADE 8 SPECIFIC OBJECTIVES** *Learners should be able to:*
2.1 Nature of matter: physical and chemical changes	
• know the nature and characteristics of physical change and chemical change, the three states of matter and the kinetic particle theory of matter	• describe physical change and chemical change • distinguish between a physical and a chemical change • outline a chemical change by representation in general terms in the form reactants → products • give examples of chemical changes or reactions in everyday life and industrial processes • write down chemical changes in the form of word equations • describe changes in everyday life and in industry and identify them as physical or chemical changes (cross reference to 1.3) • identify a variety of substances by their colour, smell, taste, melting point and boiling point and investigate properties of different substances • outline the three states of matter • outline the kinetic particle theory of matter as: - matter consists of particles - there are spaces between the particles - the particles move continuously - the particle movement or speed depend on the temperature - there are attracting forces between the particles which keep an object together • interpret by means of the kinetic particle theory of matter the processes of expansion, compressibility and diffusion in solids, liquids and gases and changing state (cross reference to 1.3) • outline the processes of sublimation (e.g. ammonium chloride, carbon dioxide, sulfur, iodine, naphthalene) (cross reference to 1.3)

GENERAL OBJECTIVES *Learners will:*	**GRADE 8 SPECIFIC OBJECTIVES** *Learners should be able to:*
2.2 Building blocks of matter	
2.2.1 Elements, compounds and mixtures	
• understands elements, mixtures and compounds	• distinguish between elements, mixtures and compounds • outline that mixtures can be separated by a physical process while compounds only by a chemical process (cross reference to 2.1) • outline that mixtures show the properties of their components while compounds do not • name practical examples of the most common elements, compounds and mixtures found in everyday life, the Earth's crust, the atmosphere and water • explain that elements and compounds are used in everyday life (e.g. in medicines, materials, fertilisers and household chemicals)
2.2.2 Periodic Table	
• understand that the world around us is made up of the elements on the Periodic Table • understand that the Periodic Table is a specific arrangement of the elements, in periods and groups, according to their atomic numbers and atomic structures	• identify the first 20 elements (names and symbols) of the Periodic Table and also those of iron, copper, zinc, silver, tin, iodine, gold, mercury, lead and uranium • relate the Periodic Table as a classification of the elements placed: - according to their properties (metallic elements on the left and the non-metallic elements on the right) - into groups and periods according to their atomic numbers and atomic structures (e.g. alkali metals and halogens)

GENERAL OBJECTIVES *Learners will:*	**GRADE 8 SPECIFIC OBJECTIVES** *Learners should be able to:*
2.2.3 Structure of the atom	
• know the atomic model	• define atom as the smallest building blocks of matter • discuss the development of the atomic model of the first twenty elements leading to the understanding that the atom consists of: - a nucleus of protons and neutrons - electrons orbiting the nucleus - electrons that are arranged in shells that can contain a fixed maximum number of electrons • draw the Bohr structure of the first 20 elements and identify the - number of protons and neutrons in the nucleus - number of protons of an atom = atomic number (= number of electrons) - (relative charges ; masses) of the proton (+1; 1), neutron (0; 1) and electron (-1; 0) - number of protons = the number of electrons resulting in the atom (as a whole) being neutral - mass (nucleon) number as the sum of the protons and neutrons (nucleons) of an atom (p + n = mass number)
2.3 The relationship between the Periodic Table and structure of the atom	
• understand the relationship between the Periodic Table and atomic structure	• outline that electrons are arranged in shells around the nucleus and explain noble gases have full shells and therefore have stable electronic structures • explain the relationship between group number of the Periodic Table and number of electrons in the outer shell • explain the relationship between the period number and the number of shells

GENERAL OBJECTIVES *Learners will:*	**GRADE 8 SPECIFIC OBJECTIVES** *Learners should be able to:*
2.4 Bonding	
• understand covalent bonding and draw Bohr structures to illustrate covalent bonding (restricted to H_2O , CH_4 , NH_3, CO_2, H_2, O_2, N_2 and the diatomic molecules of group 7) ***PLEASE NOTE:*** • *the nucleus will be indicated and a small line to the outside of the atom is drawn to write down the number of protons and neutrons* • *electrons are indicated by crosses or dots* • *electrons from different atoms should be differentiated by crosses and dots* • *overlap of shells should be used* • *all sharing electrons should be in the overlap* • *only the outside shell will be indicated in the bonding sketch*	• relate bonding to position (group) of elements in the Periodic Table to identify the maximum number of bonds an atom can make • describe how non-metal atoms combine with other non-metal atoms by sharing electrons in their outer shells with the result that both atoms achieve full outer shells • draw Bohr structures to illustrate covalent bonding (restricted to H_2O , CH_4 , NH_3, CO_2, H_2, O_2, N_2 and the diatomic molecules of group 7) • explain that two or more atoms combine covalently to form molecules • explain covalent bonding as the electrostatic attraction between the nuclei of a pair of atoms and the shared electrons between those atoms • give the formula of a compound and identify the elements it contains • define a compound as a substance that contains at least two different atoms that are chemically bonded together (e.g. atoms of at least two or more different elements) • outline that atoms and molecules are the building blocks of some material (an extension of the kinetic particle theory of matter) • distinguish between elements and compounds (e.g. diatomic oxygen gas is composed of oxygen molecules but is an element while water is composed of H_2O molecules which is a compound) **PLEASE NOTE:** • *diatomic molecules are made up of two atoms bonded together covalently.* • *diatomic molecules can either be homonuclear or heteronuclear* • *homonuclear diatomic molecules are made up of two atoms of the same element bonded together covalently (examples: H_2, O_2, N_2, diatomic molecules of group 7- F_2, Cl_2, Br_2, I_2).* • *heteronuclear diatomic molecules are made up of two atoms of different kinds bonded together covalently (examples: HF, HCl, CO)* • *polyatomic molecules are made up of more than two atoms bonded together covalently.* • *polyatomic molecules such as CO_2 , CH_4 , H_2O and NH_3 are heteronuclear* • *polyatomic molecules such as O_3 and S_8 are homonuclear* • ***NB**: learners are **NOT** required to draw the structures for O_3, S_8, HF, HCl, CO*

The practical activities, approaches or demonstrations required for Grade 8 Topic 2, Matter are listed below. These are considered basic and all learners should be exposed to them as a minimum requirement.
2.1 Nature of matter
• *observe changes in everyday life and in industry, such as cooking, heating a room, burning coal in electricity plants and many others, and categorise them as physical or chemical changes (cross reference to 2.1)* • *observe the effect of heat on a variety of substances and classify the results as a physical or chemical change* • *perform reactions to observe the permanent change and heat (or energy) changes that occur with chemical reactions* • *the burning of magnesium in air* • *investigate the properties of different substances:* - *expansion (bimetallic thermostat, 'ball-and-ring' experiment, expansion of water or other liquids, e.g. thermometer)* - *compressibility (water and air under compression in syringes)* - *diffusion in all states of matter (diffusion of ink, potassium permanganate or copper sulfate in water) (optional demonstration - only in a fume cupboard: diffusion of nitrogen monoxide [teacher demonstration] or iodine fumes in air)* - *there are spaces between the particles (mixing water and methylated spirits)* • *investigate the sublimation of ammonium chloride, sulfur and iodine* • *illustrate the arrangement of particles with the aid of splitting crystals, e.g. calcite, and letting real crystals grow from saturated solutions of table salt and/or copper sulfate*
2.2 Building blocks of matter
• *no minimum activity suggested; if time permits teachers can do alternative activities relevant to topic*
2.3 The relationship between the Periodic Table and structure of the atom, molecules and compounds
• *make simple models of the Bohr structure of the first 20 elements (see NOTE at 2.4)* • *make simple models to illustrate that atoms bind chemically to form molecules* • *observe examples of common substances to show the difference between elements, mixtures and compounds*
2.4 Bonding
• *sketch simple molecules to illustrate covalent bonding as the sharing of electrons when atoms bind (restricted to H_2O, H_2, O_2, CO_2 , CH_4 , NH_3 diatomic molecules of group 7 & N_2)*

TOPIC 3 THE GASES OF THE AIR

GENERAL OBJECTIVES *Learners will:*	**GRADE 8 SPECIFIC OBJECTIVES** *Learners should be able to:*
3.1 Air	
• know the composition of air and realise that the properties of the gases in air have certain consequences and uses	• outline that dry air consists of approximately **21% by volume of oxygen, 78% nitrogen** and small proportions (**1%**) of other gases such as carbon dioxide and argon • relate that the principal gas in the air, nitrogen, does not readily take part in chemical reactions • explain the importance of nitrogen in the air in 'diluting' the oxygen present so that reactions of oxygen are less vigorous and less harmful • explain that air dissolves in water making aquatic life possible • explain that air supports combustion and that oxygen is the active part of air which supports combustion (and respiration) • state that argon is a gas that can be obtained from the atmosphere and that it is useful for filling light bulbs because of its inertness
3.2 Oxygen	
• know the physical properties and reactions of oxygen	• state the physical properties of oxygen, e.g. a colourless, tasteless, odourless gas, slightly denser than air • describe a test for oxygen • describe the reactions of oxygen with elements such as iron and carbon and appropriate safety precautions when these reactions are taking place • write word equations for the reactions of oxygen • describe the role of oxygen in combustion and respiration (integration with Life Science), the energy released (heat and light) and the products formed • describe the use of oxygen in medical and industrial purposes
• know that ozone is formed in the upper atmosphere and shields the Earth from harmful ultraviolet rays	• outline that ozone is a special form of oxygen formed naturally in the upper atmosphere by electric sparks (static and lightning) and that the ozone layer in the stratosphere shields the Earth from harmful ultraviolet rays

GENERAL OBJECTIVES *Learners will:*	**GRADE 8 SPECIFIC OBJECTIVES** *Learners should be able to:*
3.3 Carbon dioxide	
• know the occurrence, reaction and production of carbon dioxide in nature and in industry	• describe the occurrence and production of carbon dioxide in nature and in industry (respiration, combustion, fermentation) • state that carbon dioxide is a product of combustion of carbon-containing fuels and also of respiration • state the physical properties of carbon dioxide, e.g. a colourless, odourless gas with a slightly sour taste, soluble in water, and more dense than air • outline that carbon dioxide is soluble in water • describe the test for carbon dioxide using limewater • write the word equation of carbon dioxide reacting with limewater • relate the properties of carbon dioxide to its uses in everyday life (e.g. not supporting combustion in the use of fire extinguishers, its use for cool drinks and dry ice for cooling purposes), and describe the role of carbon dioxide in cooking, e.g. using baking powder and yeast
• understand that carbon dioxide contributes to the global greenhouse effect	• relate the disadvantages of excess carbon dioxide being liberated into the atmosphere during combustion, contributing to the enhanced greenhouse effect and global warming • suggest possibilities of reducing and limiting the amount of carbon dioxide escaping into our atmosphere

The practical activities, approaches or demonstrations required for Grade 8 Topic 3, The Gases of the Air are listed below. These are considered basic and all learners should be exposed to them as a minimum requirement.
3.1 Air
• *investigate the ability of air to support combustion by burning various substances in a confined space such as an inverted jam jar or glass* • *investigate by burning a floating candle under an inverted bell jar (show that part of the air is used up during combustion)*
3.2 Oxygen
• *prepare oxygen from potassium permanganate or from the reaction of manganese oxide and peroxide* • *test for oxygen (re-lighting a glowing splint)* • *demonstrate or observe the reaction of oxygen with some of the elements sodium, magnesium, calcium, iron, carbon and sulfur (appropriate safety precautions must be observed when these activities are conducted)*
3.3 Carbon dioxide
• *test for carbon dioxide using clear lime water* • *show that carbon dioxide is a product of combustion of carbon containing fuels and also of respiration* • *show that carbon dioxide is soluble in water (e.g. with an effervescent tablet)*

TOPIC 4 MECHANICS

GENERAL OBJECTIVES *Learners will:*	**GRADE 8 SPECIFIC OBJECTIVES** *Learners should be able to:*
4.1 The nature and effects of forces	
• understand forces as they relate to uses and occurrences in the local surroundings and environment • know how to identify forces and understand the effects of forces in everyday life	• define force as an effect of push and pull • outline forces acting on objects and the effects a force can have on a certain object (change the shape and size, change the motion, no observable effect or act at a distance) • state the unit of force as newton (N) • identify forces in terms of their magnitude and direction (horizontal and vertical only) • distinguish between forces that pull and push (attraction and repulsion)
4.2 Weight and mass	
• understand the concepts mass and weight and know the apparatus used to measure these quantities • understand that weight is a specific type of force • understand the mathematical relationship between force and mass	• recognise that weight [w] is a force measured in newton, using a spring balance or force meter or newton meter • define mass as the amount of matter of a body • define weight(w) as the force of gravity acting on a mass and that this force on one kilogram is 10 newton at or near the Earth's surface • distinguish between the concepts mass and weight (unit to measure mass is the kilogram [kg] and weight is the newton) • describe an experiment to measure the mass and weight using a scale (balance) and spring balance • define earth's gravitational field strength (g) as constant of gravitational force of 10 N on 1 kg of mass (10 N/kg) [no need to introduce gravitational acceleration (g) due to gravitational force towards the centre of the earth (10 m/s^2)] • calculate the weight = mass x gravitational field strength (w = m x g) of an object on the Earth if the mass is given

GENERAL OBJECTIVES *Learners will:*	**GRADE 8 SPECIFIC OBJECTIVES** *Learners should be able to:*
4.3 Work	
• understand that when a force causes an object to move in the same direction as the force, work is done on the object	• relate work to a force applied multiplied by the distance moved in the same direction of the applied force • state the unit of work as joule or newton metre (unit of work: joule [J] = 1N × 1m) (**NOTE: the force and movement must be in the same direction and only examples of horizontal and vertical forces should be used)** • interpret the formula W = F × d and calculate the amount of work done when lifting objects of different size (weight) to different heights • explain the relationship between work and energy (if work is done on a body, energy is transferred to it)
4.4 Energy	
• know sources of energy, the law of conservation of energy and know how to identify different forms of energy and energy conversions	• explain energy as the ability to do work • outline that people and machines need a source of energy (e.g. food, petrol) in order to do work • state the law of energy conservation • explain energy conversions using the law of energy conservation and identify different types of energy in the conversions of one form to another • analyse and identify energy sources, including those available in Namibia and the local environment • distinguish between non-renewable and renewable sources
4.5 Friction	
• understand the effect of friction on objects and how friction depends on the surface of the objects	• discuss the effect of friction on objects and how friction depends on the surface (e.g. coarse or smooth, hard or soft) • suggest how to reduce friction and describe the advantages and disadvantages of friction in everyday life • discuss the difference in the ease of movement on/in solid, liquid and gas media (compare vehicles, e.g. cars, ships, hovercrafts, aeroplanes, space ships)

The practical activities, approaches or demonstrations required for Grade 8 Topic 4, Forces are listed below. These are considered basic and all learners should be exposed to them as a minimum requirement.
4.1 The nature and effects of forces

• *investigate the effects of forces and forces acting when:*
  - *a student stands motionless holding a book,*
  - *a book rests on a table and then falls to the floor,*
  - *a student pulls an object attached to a string across the table*
• *use local surroundings (chair, door, window, etc.) to investigate attractive and repulsive forces and the effects of forces on certain objects, e.g. elastic bands, malleability of plastic, a windmill*
• *identify forces in everyday life in terms of their magnitude and direction (horizontal and vertical only)*
• *identify forces acting on a certain object (e.g. forces acting when a student pulls an object attached to a string across the table)*
• *identify effects a force can have on certain objects (change the shape, the motion, no observable effect)*
• *identify forces that act at a distance (cross reference to 4.5)*
• *make, calibrate and use a spring balance for measuring different forces*

4.2 Weight and mass
• *use a mass meter (balance) and spring balance to measure the mass and weight of objects* **NOTE: Special care should be given to mention that mass is measured indirectly by measuring its weight – ether with a spring balance or by comparing the weight with one of a known mass using a beam balance**
4.3 Work

• *investigate the amount of work done when lifting objects of different size and weight to different heights*
• *investigate the amount of work done when objects or persons:*
  - *pull against friction*
  - *climb on a chair or steps*
  - *lifting a schoolbag*

4.4 Energy
• *no minimum activity suggested; if time permits teachers can do alternative activities relevant to topic*
4.5 Friction
• *investigation on the pulling of different objects on different sides (e.g. bricks) across different types of surfaces (e.g. desk, floor)* • *investigation on how to reduce friction using straws, oil and ball bearings*

TOPIC 5 ELECTRICITY

Know how to construct simple circuits and draw the circuit symbols and observe current, resistance and potential difference at any place in a circuit

GENERAL OBJECTIVES *Learners will:*	**GRADE 8 SPECIFIC OBJECTIVES** *Learners should be able to:*
5.1 Charge	
• know the existence of charge	• explain the existence of electrons, protons as introduced in the chemistry section • explain the existence of charge by imbalance of electrons (negative) and protons (positive) (e.g. the separation of charges by rubbing objects against one another)
5.2 Static electricity	
• understand charge and know how to charge objects	• describe how objects can be charged by friction and explain examples in everyday life where charging takes place by friction • state that objects with unlike charges will attract each other and those with like charges will repel each other
5.3 Electroscope	
• know the working of an electroscope	• explain: - the use of an electroscope to demonstrate charges (the existence of charges) - how an electroscope can be charged • explain how charges on a charged electroscope are able to discharge by flowing to the Earth • outline the process of earthing
5.4 Electric current	
• understand current as the movement of charge	• explain the term discharge as the movement of charge and discuss lightning as a form of discharge • discuss the dangers of lightning to people and properties and state how to avoid them • define electric current as movement of negative or positive charges (per unit time) • state that electric current is measured in ampere (A) using an ammeter • distinguish between static electricity and electric current • state that electric current is the flow of charges - negative charges (e.g. electrons) move from negative to positive - positive charges move from positive to negative

GENERAL OBJECTIVES *Learners will:*	**GRADE 8 SPECIFIC OBJECTIVES** *Learners should be able to:*
5.5 Electrical sources	
• understand potential difference or voltage	• define potential difference or voltage as energy per charge of a cell or battery • state that potential difference or voltage is measured in volt (V) using a voltmeter
5.6 Conductors and insulators	
• know conductors and insulators	• distinguish between a conductor and an insulator • compare the different conductive properties of different substances
5.7 Electric circuits (cells and bulbs in series and parallel)	
• know how to construct simple circuits, connect voltmeters and ammeters in a circuit and draw the circuit symbols • know how to connect electrical components in series and parallel and understand the effects on current and potential difference when bulbs and cells are connected in series and parallel	• explain how to connect electrical components in series and parallel and be able to construct series and parallel circuits • sketch circuit symbols for a cell, conductor wires, a switch and a bulb in a circuit and draw circuit diagrams for all series and parallel circuits • describe from observations the effects on the current in different parts of a circuit when: - cells are connected in series and parallel - bulbs are connected in series and parallel • describe from observations the effects on the potential difference across different parts of a circuit when: - cells are connected in series and parallel - bulbs are connected in series and parallel

The practical activities, approaches or demonstrations required for Grade 8 Topic 5 Electricity are listed below. These are considered basic and all learners should be exposed to them as a minimum requirement.
5.1/2 Charge and static electricity

• *investigate:*
  - *the effects of charged objects on one another*
  - *how different objects attract or repel each other depending on their charges*
• *charge objects by friction, e.g. combs, pen, glass and Perspex rods, plastic straws and pens rubbed on wool, silk, and hair*
• *identify examples of everyday life where charging takes place by friction as in*
  - *walking on a carpet*
  - *pulling off a jersey*
  - *pulling blanket and sheets apart*
• *optional demonstration of the use of the van de Graaff generator to show sparking, electric wind, glowing of a neon lamp, repulsion and attraction*

5.3 Electroscope

• *use an electroscope to:*
  - *demonstrate how an electroscope can be charged*
  - *test if objects are charged*
• *demonstrate how charges on a charged electroscope are able to discharge by flowing to the Earth*

5.4/5 Electric current and electrical sources

• *investigate:*
  - *that electric current is the flow of negative or positive charges and requires a source*
  - *that a cell is a source of chemical energy which can be used to produce electrical energy (cross reference to 4.4)*
  - *that a cell has positive and negative terminals*
  - *the difference between a closed and an open circuit*
  - *that the current will only flow in a closed circuit*

5.6 Conductors and insulators
• *test for conductors and insulators (use an electroscope and circuit with a bulb and cell)* • *investigate to compare substances to see which are better conductors, e.g. metals, plastic, wood, water and solutions*

The practical activities, approaches or demonstrations required for Grade 8 Topic 5 Electricity are listed below. These are considered basic and all learners should be exposed to them as a minimum requirement.
5.7 Electrical circuits (cells and bulbs in series and parallel)
• *investigate to discover what open and closed circuits are, the current convention as well as the function and use of conductors, resistors and insulators by using a circuit board* • *investigate to discover the effects on the current when bulbs and cells are connected in series* • *investigate the effects on the potential difference when cells are connected in series and in parallel* • *sketch and use electrical symbols for a cell, switch, connector and bulb in series and parallel circuits* • *discover what open and closed circuits are, the current convention as well as the function and use of conductors and insulators by using a circuit board (current convention used - charges move from positive to negative terminal)* • *construct and draw circuit symbols for all series and parallel circuits*

9.2.2 Grade 9 learning content

TOPIC 1 SCIENTIFIC PROCESSES

This topic is an introduction to some of the basic scientific skills. The skills in this topic should not be taught in isolation as they form an integral part of the other topics

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
1.1 Estimating and measuring (revision from grade 8)	
• know how to estimate and measure volume, length, mass, time and temperature	• find a measurement by following a sequence of instructions; use appropriate techniques; handle apparatus/material competently and have due regard to safety • estimate or measure and record area, volume, length, mass, time and temperature • convert units of length, mass, time, area and volume
1.2 Stating the aim (question) of an investigation	
• realise the value of investigations to understand the world around us and to check the results of other scientists	• outline that investigations are a way to find out new information, explore the world around us, develop new ideas to explain the world around us and to check the results of other scientists • explain the first steps to an investigation as: - choosing the right question or aim of the investigation - planning how to collect information or data • explain how to make a test fair by identifying an appropriate control • explain the importance of a zero reading or the use of a control • identify dependent (what you measure) and independent variable (what you are changing) • explain direct proportionality and inverse proportion
1.3 Recording and presenting results	
• understand the importance of recording (the use of ICT can be incorporated in this objective)	• explain the importance of units and recorded results of experimental investigations • present results and conclusions of experimental investigations • handle and process experimental observations and data, including dealing with anomalous or inconsistent results

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
1.4 Evaluation and reasoned explanation of results	
• understand the importance of recording and communicating results and conclusions from experimental investigation to other people, both scientists and non-scientists (the use of ICT can be incorporated in this objective)	• evaluate presented results or experimental data by applying scientific knowledge and interpret and draw appropriate conclusions from practical observations and data • analyse anomalous (inconsistent) results, discuss trends in results, identify sources of error and suggest possible preventive measures

The practical activities, approaches or demonstrations required for Grade 9 Topic 1 Scientific Processes are listed below. These are considered basic and all learners should be exposed to them as a minimum requirement.

1.1 Estimating & measuring

- *estimate and measure pH (cross reference to 3.1 & 3.2)*
- *make and estimate measurements of*
  - *force, weight and mass (cross reference to 4.1)*
  - *pressure (including hydrostatic pressure) (cross reference to 4.4 & 4.5)*
  - *behaviour of gases (cross reference to 4.5)*
  - *current, potential difference and resistance (cross reference to 5.5)*
- *determine the density of a liquid and an irregular shaped object (cross reference to 4.7)*
- *convert units of length, mass, time, area and volume*
- *measure the temperature changes of heating water*

1.2 Observing and classifying
• *group common objects in a number of different ways* • *observation of reactions:* - *chemical change (cross reference to 2.4)* - *combustion reactions (cross reference to 2.6)* - *synthesis reactions (cross reference to 2.8)* - *neutralisation and salt formation (cross reference to 3.3)* • *observe properties of metals and non-metals and their reactions with water, air, acids and bases (cross reference to 3.4 & 3.5)* • *observe objects floating and sinking (cross reference to 4.7)* • *observe effects on and magnitude of current, resistance and potential difference in a circuit when bulbs (or resistors) and cells are connected in series and parallel (cross reference to 5.5)*
1.3 Recording and presenting results
• *record results in a logical manner, e.g. in tables* • *present results of an investigation in tables; heading each column with the name of the physical quantity and the appropriate unit (e.g. time /s)* • *record the temperature changes from heating water or ice and present the results (cross reference to 1.1)* • *record the effects on and magnitude of current, resistance and potential difference in a circuit when bulbs (or resistors) and cells are connected in series and parallel and present results of experimental investigations (cross reference to 5.5)*

TOPIC 2 MATTER

Recall from earlier studies the Periodic Table as a classification of the elements into groups and periods according to their properties

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
2.1 Building blocks of matter: atoms, elements, compounds, molecules and mixtures	
• realise that atoms combine to form molecules or ions and that atoms, molecules and ions are the building blocks of all material (extension of the particle model)	• define a compound as a chemical substance that contains at least two different atoms • outline that atoms, molecules and ions are the building blocks of all material (an extension of the kinetic particle theory of matter) • distinguish between elements and compounds e.g. - diatomic nitrogen gas is a molecule (composed of two nitrogen atoms each) and is an element - carbon dioxide gas composed of CO_2 molecules (which are made up of one carbon and two oxygen atoms each) and is a compound - sodium chloride is composed of sodium ions and chloride ions and is also a compound • revise from Grade 8 to distinguish between elements, mixtures and compounds (cross reference to bonding; **NOTE**: the term “molecule” is used for covalently-bonded structures)
2.2 The structure of the atom	
• know the development of the atomic model and understand the relationship between the Periodic Table and atomic structure	• revise from Grade 8 the development of the atomic model (an atom consists of a nucleus of protons and neutrons and is orbited by electrons that are arranged in shells that can contain a fixed maximum number of electrons) • draw the Bohr structure of the first 20 elements and analyse the structures in terms of: - atomic and mass (nucleon) numbers - electronic structures (electrons orbiting the nucleus and their arrangement) - the relative charges and masses of the protons, neutrons and electrons - the relationship between group number of the Periodic Table and number of electrons in the outer shells - the relationship between period number of the Periodic Table and number of shells in atoms

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
2.3 Periodic Table	
• understand the Periodic Table as a classification of the elements into groups and periods according to their properties	• revise names and symbols of elements of the Periodic Table introduced in Grade 8 (expand to include all halogens, noble gasses, period four transition metals, tungsten, lead, gold, mercury and uranium)
2.4 Bonding	
• understand the different types of bonding	• describe and distinguish between covalent and ionic bonding as different types of bonding and relate bonding to position (group) of elements in the Periodic Table
2.4.1 Covalent bonding (revision from grade 8)	
• know how to illustrate covalent bonding as the sharing of electrons when atoms combine	• describe how non-metal atoms combine with other non-metal atoms by sharing electrons in their outer shells with the result that both atoms achieve full outer shells

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
2.4.2 Ionic bonding / electrovalent bonds	
• know how to illustrate ionic bonding as the transfer of electrons to form oppositely charged ions which attract electrostatically **NOTE:** • *electrons are indicated by crosses or dots* • *electrons from different atoms should be differentiated by crosses and dots* • *arrows should be used for electron transfer* • *transferred electrons should be indicated only once in the anion and not in the cation and the anion* • *only the outside shell will be indicated in the bonding sketch*	• describe how the reaction between a metal and a non-metal results in the transfer of electrons from metal atoms to non-metal atoms so that both achieve full outer shells and form positive ions (cations) and negative ions (anions) respectively • predict the positive and negative charges of ions (in terms of attained noble gas electronic structures) • define ions as atoms with a net electric charge due to the loss or gain of one or more electrons (e.g. cations have lost electrons and anions have gained electrons in order to attain noble gas structure) • draw Bohr structures of ionic compounds • explain ionic (electrovalent) bonding as the electrostatic attraction between oppositely charged ions (cations and anions) • describe the lattice of an ionic compound as a regular arrangement of alternating positive and negative ions • write the formulas of ionic compounds including polyatomic ions (i.e. SO_4^{2-} ; NO_3^- ; CO_3^{2-} ; NH_4^+ HCO_3^+ ; OH^-)

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
2.5 Chemical change	
• understand the process of chemical changes and compare to physical change	• describe the process of a chemical change and compare it to a physical change • outline the course of a chemical reaction as: - reactant(s) $\rightarrow$ product(s) or - A + B $\rightarrow$ C + D - apply these terms to various examples • describe experiments to illustrate the difference between a physical change (e.g. boiling water) and a chemical change (e.g. striking a match) • identify new substances formed by chemical reactions and discuss that the properties of the reactants differ completely from those of the product(s) • outline that a chemical reaction involves a change in energy • distinguish between exothermic reactions (energy given out) and endothermic reactions (energy taken in) • outline that exothermic reactions often need an initial input of energy to start them off but that after this they will proceed spontaneously (cross reference to 4.2) • outline reactions in which energy is spontaneously given off (e.g. the oxidation of a piece of sodium or the reaction of an organic substance with potassium permanganate) (cross reference to 4.2) • suggest reactions such as the burning of wood or the burning of magnesium which are exothermic but require energy to start them off (cross reference to 4.2) • discuss the energy or temperature changes in some endothermic reactions such as heating baking powder to liberate carbon dioxide in the baking process and the reaction between sodium hydrogen carbonate and acid • write down word equations for the reactions of chemical changes

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
2.6 Combustion reactions	
• understand what happens to substances that have undergone combustion	• describe combustion and recognise that combustion, corrosion of metals and respiration are all examples of the same type of reaction which involves the reaction of a substance with oxygen • suggest examples of combustion from everyday life (e.g. burning a match, a fire, a candle, fuel, methylated spirits or paraffin) • discuss examples of the combustion of elements which require heat to initiate (start) the reaction and predict the products of combustion • write down word equations for the combustion reactions above
2.7 Decomposition reactions	
• understand that in a decomposition reaction, a complex compound breaks down into simpler ones	• describe the decomposition reaction (heating) of copper carbonate, copper sulfate (hydrated) and ammonium carbonate and observe the chemical changes and products formed • write down word equations for decomposition reactions
2.8 Synthesis reactions	
• understand that in a synthesis reaction, simple compounds combine to form more complex ones	• identify a number of synthesis reactions in which elements combine to form compounds, such as the combination of iron and sulfur or magnesium and oxygen • explain that many useful substances such as drugs, plastics and fertilisers are made from simple starting materials by synthesis reactions • relate photosynthesis to a naturally occurring synthesis reaction and recognise that it is endothermic • write down word equations for synthesis reactions

The practical activities, approaches or demonstrations required for Grade 9 Topic 2 Matter are listed below. These are considered basic and all learners should be exposed to them as a minimum requirement.
2.1 Building blocks of matter: atoms, elements, compounds, molecules and mixtures
• *build models of atoms, mixtures and compounds by using little spheres of various sizes and colour*
2.2 The structure of the atom
• *no minimum activity suggested; if time permits teachers can do alternative activities relevant to topic*
2.3 Periodic Table
• *collect examples of chemicals in everyday life compounds of different elements, and identify some of these elements*
2.4 Bonding
• *sketch simple molecules to illustrate covalent bonding (including diatomic elements) as the sharing of electrons when atoms combine*
2.5 Chemical change
• *do simple experiments to illustrate the difference between a physical change (e.g. boiling water) and a chemical change (e.g. striking a match) (cross reference to 2.6)* • *investigate to show that new substances with completely different properties are formed during chemical reactions, e.g. iron filings (magnetic) and yellow sulfur powder when heated together yield a new substance, black iron sulphide, which is non-magnetic* • *investigate reactions in which energy is spontaneously given off as in, (for example, the oxidation of a piece of sodium or some drops of glycerol to solid potassium permanganate or expose reactive metals to water or dilute acid) and reactions such as the burning of wood or the burning of magnesium which are exothermic but require energy to start them off*
2.6 Combustion reactions
• *do experiments to illustrate combustion reactions such as the burning of a match, a fire, a candle, methylated spirits or paraffin* • *study examples of corrosion such as a wet iron nail or iron filings left in air to show that the products are similar to a combustion reaction* • *investigate and observe what happens to substances that have undergone combustion [study example of the combustion of elements which require heat to start the reaction such as the burning of magnesium, iron (steel wool), carbon and sulfur in oxygen (or in the air if oxygen cannot be prepared)]*
2.7 Decomposition reactions
• *investigate the decomposition reactions of copper carbonate, copper sulfate and ammonium carbonate and observe the chemical changes and products formed*
2.8 Synthesis reactions
• *investigate synthesis reactions in which elements combine to form compounds, such as the combination of:* - *iron and oxygen (rusting)* - *iron and sulfur* - *magnesium and oxygen*

TOPIC 3 ACIDS, ALKALIS (BASES), METALS AND NON-METALS

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
3.1 Acids and alkalis (bases)	
• know the nature and the effect of acids and alkalis on indicators **PLEASE NOTE** - 0 to less than 4 (strong acid) - 4 to less than 7 (weak acid) - 7 (neutral) - greater than 7 to less than 12 (weak alkali) - 12-14 (strong alkali)	• identify and name examples of acids in everyday life, discuss that acids are common in foods, particularly fruits, and that they have a sour taste • identify and name examples of bases used in everyday life, recognise that bases are common in cleaning materials and that they have a bitter taste and a soapy feel when rubbed between fingers (**NOTE**: no chemical should be touched unless in very dilute state; no chemical should be tasted) • relate acids' chemical composition to hydrogen ions and negative anions (e.g. nitric acid/ nitrates, sulfuric acid/ sulfates and carbonic acid (hydrogen)carbonate/ carbonates • describe pH as a measure of the acidity or alkalinity of an aqueous solution • relate the pH scale from 0 to less than 7 to the measure of acid strength or hydrogen ion involved • relate the pH scale from more than 7 to 14 to the measure of the alkaline character of an aqueous solution (an alkali is a base that is soluble in water) • outline that an indicator is a chemical that changes colour when an acid or an alkali is added to it, that indicators can be used to detect acids and alkalis • outline the properties of acids such as their effect on indicators such as litmus and universal indicator (liquid or paper) • outline the properties of alkalis such as their effect on indicators such as litmus and universal indicator (liquid or paper) • measure the pH of a variety of solutions • distinguish between weak acids such as acetic acid [vinegar] and strong acids such as hydrochloric and sulfuric acids using an indicator and by referring to the pH scale • distinguish between weak alkali such as soap water and lime water, and strong alkalis such as sodium hydroxide using a universal indicator and by referring to the pH scale

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
3.2 Neutralisation	
• understand neutralisation as a reaction between bases and acids; know the pH scale and be able to relate the pH of strong and weak acids and alkalis and the pH of pure water *cross reference to metals:* • understand the reactions between metals (Group I and II) oxides and acids • know the reactions between metal (Group I and II) hydroxides and acids • know the reactions between carbonates and acids	• describe the reaction of a base and an acid and predict the products formed • discuss the acidity of soils and the use of lime to neutralise acidic soil • write down word equations for the reactions involving bases • describe the reaction of an acid on a carbonate and carry out a test for the carbon dioxide evolved • write down word equations for the reactions involving acids • describe the applications of neutralisation reactions in everyday life: – use of acid to clean scale off kettles – lemon changes the colour of tea – use of a weak base to remove acidic stains on cloth and vice versa • describe the pH scale and be able to describe the pH of strong and weak acids and alkalis and the pH of pure water • describe neutralisation as one method of preparing salts, e.g. table salt • name and describe the preparation of salts (such as copper sulfate or table salt) by a neutralisation reaction (from CuO & H_2SO_4 for $CuSO_4$, NaOH & HCl for NaCl) • outline that the use of certain medicines (e.g. antacid) is based on the phenomenon of neutralisation • write down word equations for the neutralisation reactions

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
3.3 Metals	
• know metal properties, their positions in the Periodic Table and the reactions of metals	• identify elements on the Periodic Table and given experimental or theoretical data to classify materials as metals or non-metals according to physical properties such as density, shininess, electrical conductivity, malleability, coldness to touch • arrange metals in order of reactivity from a consideration of their chemical properties • state that a number of important metals are mined in Namibia (U, Cu, Au, Sn) and show, on a map of Namibia, where the main ore deposits are • define alloys as a mixture of a metal with other metals or carbon • describe an alloy as a mixture of a metal with other metals or carbon • explain that the properties of metals can be changed, often to make them more useful, by mixing them with other elements • discuss everyday uses of alloys and be able to name their components and describe some of their special properties (especially brass, bronze and steel) • describe the reactions between metals and: - water and test any gas released - dilute acids and test any gas released - air - pure oxygen • state that carbon dioxide does not support combustion except for that of a very reactive substance such as magnesium (cross reference to 2.6) • explain that the oxides and hydroxides of Group I and II metals are basic and form an alkali when dissolved in water • describe the reactions between acids and: - metal oxides and metal hydroxides (cross reference to 3.3) - metal carbonates and test any gas released • write down word equations for the reactions involving metals

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
3.4 Non-metals	
• know non-metal properties, their position in the Periodic Table and understand the reactions	• describe the reactions (if any) of carbon, phosphorus (red) and sulfur with oxygen • recognise the acidic nature of non-metal oxides • describe the reactions between non-metals and: - pure oxygen - air (incomplete combustion with the formation of monoxide) • describe the reactions between non-metal oxides and water • predict the role of non-metal oxides in the formation of acid rain • write down word equations for the reactions involving non-metals

The practical activities, approaches or demonstrations required for Grade 9 Topic 3 Acids, alkalis (bases), metals and non-metals are listed below. These are considered basic and all learners should be exposed to them as a minimum requirement.
3.1 Acids
• *investigate the properties of acids [e.g. their effect on indicators such as litmus and universal indicator (liquid or paper)]* • *make simple indicators from flowers* • *investigate the reaction of an acid with a metal and carry out a test for the hydrogen evolved* • *investigate the reaction of an acid with a carbonate and carry out a test for the carbon dioxide evolved*
3.2 Alkalis(bases)
• *investigate the properties of alkalis [e.g. their effect on indicators such as litmus and universal indicator (liquid or paper)]* • *investigate the reaction of acids with alkalis* • *demonstrate the acidity of soils and the use of lime to neutralise the soil* • *measure the pH of a variety of solutions, place them on a pH scale and classify them as strong or weak acids or alkalis*

3.3 Neutralisation
• *prepare a salt (such as copper sulfate or table salt) by a neutralisation reaction* • *observe with a magnifying glass the crystals of salt formed after crystallisation* • *show that the use of certain medicines (e.g. antacid) is based on the phenomenon of neutralisation* • *exhibit in class examples of acids found in the home and laboratory*

3.4 Metals
• *investigate the reactions between metals and:* - *air* - *pure oxygen* • *test the products of the above investigations to:* - *determine if they are soluble in water* - *determine their effect on indicators* - *identify any gas released during the investigation* • *investigate the reactions (if any) between metals (sodium, potassium, magnesium, zinc, iron, copper and lead) and hot and cold water (NOTE: sodium and potassium should only be used in demonstrations with the necessary safety precautions)* • *investigate the reactions (if any) between metals (calcium, magnesium, zinc, iron, copper and lead) and dilute acids and test any gas released* • *use the results of the investigations described above to arrange metals in order of reactivity*
3.5 Non-metals
• *investigate demonstrations of the reactions of carbon, phosphorus (red) and sulfur with oxygen* • *investigate the reactions of non-metals and air (incomplete combustion with the formation of monoxide)* • *investigate the reactions of non-metal oxides and alkalis*

TOPIC 4 MECHANICS

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
4.1 Force, weight, mass, work and energy (Revision from Grade 8)	
• understand the concepts of weight, force and mass • understand that when a force causes an object to move then work is done on the object ***NOTE:*** In Grade 8 and 9 only calculations are required where the force and the distance are in the same direction e.g. either both vertically or both horizontally	• recall from earlier work forces in everyday life and that force is measured in newtons • differentiate between mass and weight • calculate the weight of an object on the Earth if the mass is given and vice versa • relate mass and weight to work • interpret the formula work = force x distance (W = F x d) and calculate the amount of work done when moving objects over a distance • relate the force component (F) in W = F x d as weight = mass x earth's gravitational field strength (g) (w = m x g) • apply W= F x d = m x g x d = w x h to calculate the amount of work done when lifting objects of different masses and weights to different heights (h) • explain the relationship between work and energy (if work is done on a body, energy is transferred to it)
4.2 The kinetic particle theory of matter	
• understand the differences between the states of matter in terms of differences in the behaviour and arrangement of particles	• outline the kinetic particle theory of matter, specifically that: - matter consists of particles - there are spaces between the particles - the particles move continuously (and the speed of particles depends on the temperature) - there are attracting forces between the particles which keep an object together • describe by means of the kinetic particle theory of matter the processes of expansion, compressibility and diffusion in solids, liquids and gases • distinguish between states of matter in terms of differences in the behaviour and arrangement of particles as follows: - **solids** - particles are held together by strong forces; they can vibrate but are not able to move around - **liquids** - the forces between the particles are strong enough to hold the particles together but not strong enough to prevent them moving around

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
	- **gases** - the forces between the particles are not strong enough to hold them together and so they move independently of one another • explain that the change from one state of matter to another involves an energy change; heat energy is either given out or taken in • state that if energy is taken in during a change of state, then the particles will gain kinetic energy and will move faster and that if energy is released, the particles will have less kinetic energy and move more slowly (exothermic and endothermic) • explain physical changes in terms of the kinetic particle theory of matter
4.3 Pressure	
• understand pressure as the relationship between force and the area the force acts on	• relate pressure [p] to the force that is exerted per area (unit of pressure: pascal [Pa] = 1 N/m^2) and outline that due to the smallness of the unit pascal the unit kilopascals [kPa] will be used • interpret the relationship between force and area: explain, for example, what happens to the pressure when either the force or the area is changed and use the formula pressure = $\frac{\text{force}}{\text{area}}$ ($p = \frac{F}{A}$) and do simple calculations • suggest why the spoor of some light animals such as springbok is usually deeper in the sand than that of heavy ones such as elephant
4.4 Hydrostatic pressure	
• understand pressure in liquids (under the surface of the liquid)	• relate that the pressure is the same in all directions at the same depth in a given liquid and explain how pressure in liquids is affected by: - the depth under the surface of the liquid and - the density of the liquid • identify and describe the applications of hydrostatic pressure • outline the application and dangers of hydrostatic pressure in scuba or deep sea diving • suggest how pressure is transmitted uniformly throughout a liquid and relate this to applications such as pressure pumps, brakes and hydraulic jacks

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
4.5 The behaviour of gases and gas pressure	
• understand from the kinetic particle theory of matter the behaviour of gases for phenomena such as gas pressure • understand atmospheric pressure and know how to measure atmospheric pressure and predict climatic conditions	• outline the existence of atmospheric pressure • relate the causes of the difference between atmospheric pressure inland and at the coast in Namibia to what effect this has on respiration, boiling point water, wind and tyre pressure in cars or the inner tube of a soccer ball • explain the use of a barometer to measure atmospheric pressure in the prediction of weather • explain the existence of gas pressure with particular reference to atmospheric pressure • derive and explain, from the kinetic particle theory of matter, the behaviour of gases (e.g. gas pressure caused by particles colliding with the wall of the container) • discuss qualitatively the relationship between volume and pressure of a gas (when one of temperature, volume or pressure is changed)
4.6 Density	
• understand the relationship between a body's mass and its volume	• define density as the mass per unit volume for a material • use the formula density = $\frac{\text{mass}}{\text{volume}}$ ($\rho = \frac{m}{V}$) (units: gram per cubic centimetre [g/cm^3] or kilogram per cubic metre [kg/m^3]) • outline that for a specific material the density is constant and unique at a specific temperature • use density to identify substances **NOTE:** the symbol for density is ' ρ ' (rho) while the symbol for pressure is the letter 'p'.

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
4.7 Floating and sinking objects	
• know how to use density to determine whether an object will float or sink in a liquid • understand the forces of flotation without defining Archimedes principle	• use density to determine whether an object will float or sink in a liquid • explain the forces of floating when objects (boats) float in liquids and the up thrust on a balloon filled with a gas lighter than air • outline the up thrust force on floating objects (Archimedes principle not required) • relate the weight of water displaced by an object in water to the up thrust force while floating or sinking with reference to 4.1 that weight = force • calculate density from experimental results and investigate whether objects will float or sink

The practical activities, approaches or demonstrations required for Grade 9 Topic 4, Mechanics are listed below. These are considered basic and all learners should be exposed to them as a minimum requirement.
4.1 Force, weight, mass, work and energy
• *use a newton spring balance to measure forces* • *measure the weight of objects* • *investigate the amount of work done when lifting objects of different size, mass and weight to different heights* • *investigate the amount of work done when objects or persons:* - *pull against friction* - *climb on a chair or steps* - *lift a schoolbag*

4.2 The kinetic particle theory of matter
• *compare experimentally the rate of diffusion in gases and liquids and explain the difference* • *investigate the diffusion in all states of matter [diffusion of nitrogen dioxide (demonstration only in fume cupboards)]* • *investigate the diffusion of ammonium hydroxide and hydrochloric acid* • *investigate the diffusion of ink, potassium permanganate or copper sulfate in water* • *investigate what happens when an open black bag is held over a burning candle (warm air rises and fills bag)* • *investigate everyday physical changes in terms of the kinetic particle theory of matter, for example:* - *washing drying on a line* - *sugar dissolving in tea* - *dew forming at night* - *how sweating cools the body* - *why we can smell gas shortly after the tap is turned on* - *spreading of perfume*
4.3 Pressure
• *investigate the pressure on different sides of a brick exert on the ground and relate it to the depth of the mark the brick will make in soft ground* • *calculate the pressure exerted by learners on the ground*
4.4 Hydrostatic pressure
• *demonstrate the existence of atmospheric pressure by simple means using containers such as test tubes inverted in water, plastic bottles with air sucked out and a tin that collapses after being heated and sealed* • *measure liquid pressure using a manometer* • *determine and predict pressure at:* - *different depths (container with 3 holes at different depths or pushing plastic bag over the hand and pushing hand into water)* - *the same depth but different directions (balloon attached to glass or transparent plastic tube filled with water and then balloon is pushed into water – like used in a simple manometer)* - *the same depth but with different liquids (with different densities but similar viscosities)* • *demonstrate how pressure is transmitted uniformly throughout a liquid and how this explains applications such as pressure pumps, brakes and hydraulic jacks* • *calculate pressure, force and area in applications such as pressure pumps, brakes and hydraulic jacks (simple calculations only)*

4.5 The behaviour of gases and gas pressure
• *demonstrate, using a bicycle pump, that an increase in gas pressure can cause an increase in the temperature of gas* • *observe that air let out of a tyre is cold to show a decrease in gas pressure can cause a decrease in the temperature of the gas* • *investigate the effect of heat on gas pressure and volume (place a bottle with a balloon on top in hot water or alternative a closed 2 litre plastic bottle placed in hot and cold water)* • *investigate increasing the pressure of air in a closed syringe and then releasing the plunger and explain what happens to the compressed gas and why it returns to the original volume once the plunger is released* • *investigate the "dancing coin" experiment (glass bottle, wet the top surface and place coin on opening, hold bottle between hands or heat and see coin moving after a while)*
4.6 Density
• *investigate the relationship between a body's mass and its volume:* - *for a specific material the density is constant and unique* - *density can be used to identify substances* - *density can be used to determine whether an object will float in a liquid* • *investigate the forces of floating when objects (boats) float in liquids and the up thrust on a balloon filled with a gas lighter than air* • *use the property of density to identify substances by:* - *measuring the mass of bodies of different materials and sizes* - *measuring the volume of bodies of different materials and sizes (for regular shapes)* - *using these measured values to calculate the density, and comparing to known values*
4.7 Floating and sinking objects
• *do a project or an oral discussion on how flotation is used in ships of different types and shapes* • *fill a balloon with hydrogen gas and see it rise in the air or hold plastic bag over a candle (to see that warm air will rise)*

TOPIC 5 ELECTRICITY AND MAGNETISM

know how to construct simple circuits and draw the circuit symbols and use multi meters or analogues meters to measure current, resistance and potential difference at any place in a circuit, explain effects on current and potential difference when bulbs, resistors and cells are connected in series and parallel

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
5.1 Charge and static electricity	
• understand charge, know how to charge objects	• outline the existence of electrons and protons as introduced in the chemistry section and explain the existence of charge by the imbalance of electrons and protons (positive and negative) • show and explain how charges on a charged electroscope are able to discharge by flowing to the Earth
5.2 Electrical current	
• understand current as the movement of charge	• explain that electrical current is determined by the flow of charges and is measured in amperes [A] using an ammeter • draw, set up and interpret circuit diagrams and use symbols for electrical components • explain the connection of cells and bulbs in series and parallel • predict and measure, using an ammeter, electrical current at different positions in series and parallel circuits • distinguish between static electricity and electrical current

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
5.3 Potential difference and electrical energy	
• understand that current is made to flow around a closed circuit by the difference in electric potential between the poles of a cell, a source of chemical energy which can be used to produce electrical energy	• outline that electrical current requires a source and discuss that a cell is a source of chemical energy which can be used to produce electrical energy and identify the positive and negative terminals of a cell • outline that electrical current is the flow of charges, current will only flow in a closed circuit and the current is made to flow around a circuit by the difference in electric potential between the poles of a cell • explain that potential difference is measured in volts [V] and measured across an electrical component in a circuit using a voltmeter • recall that electricity is a source of energy that is easily converted into other forms of energy • explain and use a circuit board to show how electrical energy can be converted into heat and light • use a fuse wire to show the heating effect of an electrical current • demonstrate and discuss the generation of electricity from other forms of energy such as chemical (cells and coal), solar, potential (hydroelectric) and kinetic (wind and water) energy
5.4 Resistance	
• know the basic concept of resistance	• explain that resistance is opposition to current flow, is measured in Ohms using an Ohmmeter • discuss that different materials have different resistance • explain the resistance in circuits using different numbers of resistors or bulbs in series and parallel • explain the effect on the resistance of a wire if: - the length is changed - the diameter is changed - the temperature is changed • explain how a rheostat is used to vary resistance and current • identify examples of the everyday use of rheostats or variable resistors, such as in volume controls in radios and light dimmers

GENERAL OBJECTIVES *Learners will:*	**GRADE 9 SPECIFIC OBJECTIVES** *Learners should be able to:*
5.5 Electrical circuits (cells and resistors, bulbs in series and parallel)	
• know how to construct circuits and draw the circuit symbols and understand the effects on current and potential difference when bulbs, resistors and cells are connected in series and parallel	• identify and construct circuits • draw the circuit symbols • measure current, resistance and potential difference at any place in a circuit • explain effects on and magnitude of current, resistance and potential difference when bulbs (or resistors) and cells are connected in series and parallel
5.6 Magnetism	
• understand magnetism and magnetic properties and uses of magnets	• outline that magnetism is a property of magnetic matter resulting in attractive and repulsive forces, and that the Earth has bar magnet properties • identify metals that are attracted by magnets and those that are not • sketch the magnetic lines of force around a magnet [bar magnet and horseshoe magnet] • describe the interaction between two magnets • state uses of magnets, such as in speakers and to remove scrap metal from garbage • state that a magnet freely suspended will align itself with the Earth's magnetic field (by convention the north-seeking pole will be termed the "north pole" of the magnet) • state the proper storing of magnets

The practical activities, approaches or demonstrations required for this topic and sub-topics Grade 9 Topic 5, Electricity and Magnetism are listed below. These are considered basic and all learners should be exposed to them as a minimum requirement.

5.1/2 Charge, static electricity and electrical current

- *given the diagram of a simple circuit be able to set it up and draw the circuit diagram of a given simple circuit*
- *investigate and measure the current in circuits using different numbers of cells and bulbs in series and parallel (note all measurement should be able to be done by using multi meters and analogue meters)*
- *measure the current in a circuit containing a resistor, using 1, 2 and 3 cells in series*
- *measure the current at different points around a circuit (the current is the same at all positions around a series circuit)*
- *measure the current in different branches of a parallel circuit (the sum of the current in the different branches of a parallel circuit is equal to the total current drawn from the cell(s))*

5.3 Potential difference and electrical energy

- *use a circuit board to show how electrical energy can be converted into heat and light*
- *use a fuse wire to show the heating effect of an electrical current*
- *investigate and measure the voltage in circuits using different numbers of cells and bulbs in series and parallel:*
  - *the voltmeter reading across a bulb for the same circuit using 1, 2 and 3 cells respectively (increasing the number of cells in series in a circuit increases the current flowing around the circuit and increases potential difference across components in the circuit)*
  - *the voltmeter readings across all bulbs in a series circuit (show that the sum of these is equal to the voltmeter reading across the whole circuit)*
  - *the voltmeter reading across a bulb when connecting different numbers of cells in series and parallel*

5.4 Resistance

- *investigate and measure the resistance in circuits using different numbers of resistors or bulbs in series and parallel*
- *investigate and measure the resistance of a wire when:*
  - the length is changed
  - the diameter is changed
  - the temperature is changed
- *investigate the effect of using different materials such as copper and graphite on resistance*
- *investigate the effect of a rheostat in series with bulbs in a circuit*

5.5 Electrical circuits (cells and resistors, bulbs in series and parallel)

The practical activities, approaches or demonstrations required for this topic and sub-topics Grade 9 Topic 5, Electricity and Magnetism are listed below. These are considered basic and all learners should be exposed to them as a minimum requirement.

- *construct a circuit using a cell, conductor wires, a switch, a bulb and meters*
- *discover what open and closed circuits are, the current convention as well as the function and use of conductors, resistors and insulators by using a circuit board (current direction - from positive to negative terminal)*
- *investigate how electrical energy can be converted into heat and light*
- *investigate the use of a fuse wire to show the heating effect of an electrical current*
- *demonstrate how to connect electrical components in series and parallel and how to connect voltmeters and ammeters in a circuit (NOTE: voltmeter is always in parallel)*
- *investigate and measure the magnitude of the current in different parts of a circuit when:*
  - *cells are connected in series and parallel*
  - *bulbs and resistors are connected in series and parallel*
- *investigate and measure magnitude of the potential difference in different parts of a circuit when:*
  - *cells are connected in series and parallel*
  - *bulbs and resistors are connected in series and parallel*
- *given the diagram of a simple circuit be able to set it up, and draw the circuit diagram of a given simple circuit*
- *investigate and measure the current in circuits using different numbers of cells and bulbs in series and parallel:*
  - *measure the current in a circuit containing a resistor, using 1, 2 and 3 cells in series*
  - *measure the current at different points around a circuit (the current is the same at all positions around a series circuit)*
  - *measure the current in different branches of a parallel circuit (the sum of the current in the different branches of a parallel circuit is equal to the total current drawn from the cell(s))*

5.6 Magnetism

- *investigate to identify metals that are attracted by magnets and those that are not*
- *use iron filings to show magnetic lines of force around a magnet (bar and horseshoe)*
- *draw the shape of the indication of magnetic lines of force around a bar magnet and a horseshoe magnet (in one plane only)*
- *investigate the alignment of a freely suspended magnet with the Earth's magnetic field*
- *investigate the interaction between two magnetic poles*
- *make and use a compass*

10. Assessment

A learner-centred curriculum and learner-centred teaching encompass a broad range of knowledge and skills which are relevant to the knowledge-based society. The specific objectives in the syllabus state what understanding and skills a learner must demonstrate as a result of this teaching-learning process, and which objectives will be assessed. However, it is intended that the curriculum should focus on learning, not on assessment and examination. Assessment and examination are only to support learning.

10.1 Continuous assessment

In order to capture the full range and levels of competence, a variety of formal and informal continuous assessment situations is needed to give a complete picture of the learner's progress and achievements in all subjects. Continuous assessment must be clear, simple and manageable, and explicitly anchored in learner-centred principles and practice. Teachers must provide a reliable and valid assessment of the learner's performance in the specific objectives. The information gathered about the learners' progress and achievements should be used to give feedback to the learners about their strong and weak points, i.e. where they are doing well, and why, and where, how and why they need to improve. The parents should be informed regularly about the progress of their children in all subjects, be encouraged to acknowledge achievements, and given suggestions as to how they can support the child's learning activities.

The learner's progress and achievements in this subject must be reported to parents in the school report.

10.2 Formative and summative assessment

The two modes of assessment used are formative continuous assessment and summative assessment. Formative continuous assessment is any assessment made during the school year in order to improve learning and to help shape and direct the teaching-learning process. Assessment has a formative role for learners if and when:

- it is used to motivate them to extend their knowledge and skills, establish sound values, and to promote healthy habits of study;
- assessment tasks help learners to solve problems intelligently by using what they have learnt;
- the teacher uses the information to improve teaching methods and learning materials.

Summative assessment is an assessment made at the end of the school year based on the accumulated total of the progress and achievements of the learner throughout the year in a given subject, together with any end-of-year tests or examinations. The result of summative assessment is a single end-of-year promotion grade.

10.3 Informal and formal methods

The teacher must assess how well each learner is mastering the specific objectives described in the syllabus and from this gain a picture of the all-round progress of the learner. To a large extent, this can be done in an informal way and in their participation in general, through structured observation of each learner's progress in learning and practice situations while they are investigating things, interpreting phenomena and data, applying knowledge, communicating and making value judgements.

When it is necessary to structure assessment more formally, the teacher should as far as possible use situations similar to ordinary learning and practice situations to assess the competency of the learner. Formal written and oral tests can be used to assess only a limited range of specific objectives and therefore should not take up a great deal of time. Short tests should be limited to part of a lesson and only in exceptional cases use up a whole lesson.

10.4 Evaluation

Information from informal and formal continuous assessment is to be used by the teacher to ascertain where it is necessary to adapt methods and material to the individual progress and needs of each learner. At the end of each main unit of teaching and at the end of each term, the teacher, together with the learners, should evaluate the learning-teaching process in terms of tasks completed, participation, what the learners have learnt, and what can be done to improve the working atmosphere in and achievements of the class.

10.5 Criterion-referenced grades

When grades are awarded in continuous assessment, it is essential that they reflect the learner's actual level of achievement in the specific objectives, and are not related to how well other learners are achieving these objectives or to the idea that a fixed percentage of the learners must always be awarded a Grade A, B, C, and so on (norm-referencing). In criterion-referenced assessment, each letter grade must have a descriptor for what the learner must demonstrate in order to be awarded the grade. Grade descriptors must be developed for each subject for each year. It is important that teachers in each department/section work together to have a shared understanding of what the grade descriptors mean, and how to apply them in continuous assessment, so that grades are awarded correctly and consistently across subjects. Only then will the assessment results be reliable.

10.6 Grade descriptors

The learner's summative achievement in the specific objectives will be shown in letter grades A to E, where A is the highest and E the lowest grade for learners achieving minimum competency level. In cases where a learner has not reached the minimum level of competency a U will be awarded. When letter grades are awarded, it is essential that they reflect the learner's actual level of achievement in relation to the specific objectives. The relation between the letter grades and specific objectives is shown in the table below. As far as possible a letter grade should be used as the mark instead of a percentage.

Grade	% Range	Grade descriptors
A	80%+	**Achieved objectives exceptionally well.** The learner is outstanding in all areas of competency.
B	70-79%	**Achieved objectives very well.** The learner's achievement lies substantially above average requirements and the learner is highly proficient in most areas of competency.
C	60-69%	**Achieved objectives well.** The learner has mastered the specific objectives and can apply them in unknown situations and contexts.
D	50-59%	**Achieved objectives satisfactorily.** The learner's achievement corresponds to average requirements. The learner may be in need of learning support in some areas.
E	40-49%	**Achieved the minimum number of objectives to be considered competent.** The learner may not have achieved all the specific objectives, but the learner's achievement is sufficient to exceed the minimum competency level. The learner is in need of learning support in most areas.
U	0-39%	**Ungraded.** The learner has not been able to reach a minimum level of competency in the objectives, even with extensive help from the teacher. The learner is seriously in need of learning support.

10.7 Conducting and recording assessment

Continuous assessment should be planned and programmed at the beginning of the year, and kept as simple as possible. Marks given for class activities, practical activities, project work, assignments, homework and short tests may be recorded for continuous assessment.

10.8 Assessment objectives

The assessment objectives for Physical Science are:

10.8.1 Assessment objective A: Knowledge with understanding

Learners should be able to demonstrate knowledge and understanding in relation to:

- scientific language, terminology, symbols, quantities and units;
- instruments and apparatus, including techniques of operation and aspects of safety;
- the use of scientific facts, concepts, patterns and principles.

The objective is made up of Specific objectives which require the learner to identify, give examples, name, list, state, indicate, give reasons, suggest ways, recognise, define, discuss and to outline.

10.8.2 Assessment objective B: Handling information, application and solving problems

The learners, using written, symbolic, graphical and numerical material, should be able to:

- analyse novel situations in a logical and deductive manner;
- locate, select, organise and present information from a variety of sources;
- translate information from one form to another;
- use information to identify patterns, report trends and draw inferences;
- present reasoned explanations for phenomena, patterns and relationships;
- make a value judgement about scientific and technological applications and their social, economic and environmental implications;
- solve problems.

This objective is made up of specific objectives which require the learner to predict, relate, describe, calculate, find, estimate, determine, sketch, and select, analyse, extract and analyse, synthesize, compare and discuss, deduce, explain, distinguish, suggest, interpret, and evaluate.

10.8.3 Assessment objective C: Practical (experimental and investigative) skills

Learners should be able to:

- use and organise techniques, apparatus and materials;
- observe, measure and record;
- handle, process and evaluate experimental observations and data;
- plan investigations.

10.9 Continuous assessment: detailed guidelines

A specified number of continuous assessment activities per term should be selected, graded and recorded. Not more than two assessments per term are to be topic tests. These continuous assessments must be carefully planned and marked according to a marking scheme, marking criteria or memorandum. Detailed guidance can be found in the Continuous Assessment Manual for Physical Science. The criteria used to assess activities other than tests should be given to the learner before the assessment activity. Evidence of the work produced by good, average and low-achieving learners, as well as the written assignment and marking scheme, has to be kept at school until the end of the next year. Teachers can choose to grade and/or record more than the required continuous assessments if it is necessary for formative purposes. An end-of-year summative grade will be based only on the assessment tasks described in the syllabus. Not more than forty percent (40%) of the summative grade may be based on tests, which include topic tests and end-of-term tests.

Types of continuous assessment tasks

In Physical Science in the Junior Secondary phase the continuous assessment tasks are as follows:

Practical investigations: These are assessments of practical skills done during a practical activity where learners are required to plan and carry out investigations, and collect, report and analyse information. Except for one big investigation or project during the first or second term, these activities should assess not more than two skills at a time and should count 5 to 15 marks each.

Topic tasks: These are activities that most teachers already use in their day-to-day teaching. These are recorded, assessed activities that could introduce a topic, be used during the teaching of a topic and /or revision of a topic. They may well include assessment involving specific objectives to do with locating information, conducting surveys, analysing information or presenting information. Topic tasks will involve assessments of specific objectives in all assessment objectives; however, not all assessment objectives need to be present in every topic task. The greatest emphasis should be placed on assessment objectives B and C to meet the weighting shown in the Test Specification Grid in section 10.12.

Projects: A project is a longer assignment than a topic task or practical investigation, and gives learners an opportunity to complete an investigation into one of the themes /topics outlined in the syllabus. This type of investigation will enable the teacher and learner to pursue a topic in greater depth and in a more lively and creative way than possible with short discrete topic tasks or practical investigations. The project should count 30 marks and the final mark should be divided by two (to give 15 marks – same as the practical investigations) when entered into the record forms under ‘Practical Investigation’ in the second term.

Topic tests: Completed topics should be concluded with a test indicating the achievements of the learners in these topics.

End-of-term test: This will be a more comprehensive topic test of the term's work. No homework should be assigned during the time of writing the End-of-term tests.

Summary of continuous assessment tasks

Continuous assessment Grades 8						
	Term 1		Term 2		Term 3	
Components	**Number & marks**	**Total**	**Number & marks**	**Total**	**Number & marks**	**Total**
Practical Investigations	2×15	30	1×15	15	1×10	10
Projects			(1×30)÷2	15		
Topic tasks	2×10	20	2×10	20	2×10	20
Topic tests	(2×20)÷2	20	(2×20)÷2	20	(2×20)÷2	20
End-of-term tests	65 x 2	130	65 x 2	130		
Term marks		200		200		
Weighted term marks	200÷2	100	200÷2	100		

Continuous assessment Grades 9				
	Term 1		Term 2	
Components	**Number & marks**	**Total**	**Number & marks**	**Total**
Practical Investigations	2×15	30	1×15	15
Projects			(1×30)÷2	15
Topic tasks	2×10	20	2×10	20
Topic tests	(2×20)÷2	20	(2×20)÷2	20
End-of-term tests	65 x 2	130	65 x 2	130
Term marks		200		200
Weighted term marks	200÷2	100	200÷2	100

The continuous assessment (CA) marks for one term (trimester) is converted to a mark out of 100 (weighted mark). Only this should be used for the report at the end of term 1 and 2. Learners should not write an examination at the end of the first two trimesters, but only an end of term test.

10.10 End-of-year examinations: detailed guidelines

In Grade *8* there will be an internal end-of-year examination. The purpose of this examination is to focus on how well learners can demonstrate their thinking, communication, and problem-solving skills related to the areas of the syllabus which are most essential for continuing in the next grade. Preparing for and conducting this examination should not take up more than two weeks altogether right at the end of the year.

The description of the various papers for the written examination is as follows:

Written examination Grade 8 – 9			
Grades	**Description of paper**	**Duration**	**Marks**
8 and 9	Written Examination This will consist of ONE paper consisting of two sections: **Section A:** 30 Multiple choice questions (30 marks) **Section B:** Variety of structured questions (100 marks)	2 hours30 minutes	130

There will be a semi-national external examination at the end of Grade 9. These papers will be set by DNEA and will be marked regionally. Samples will be moderated by DNEA. The

purpose of the examination is to assess how far each learner can demonstrate his/her achievement in reaching the specific objectives as a preparation for everyday life and for further studies or training, and to what extent the system as a whole is enabling learners to achieve optimally.

10.11 Promotion marks

For Physical Science in Grade *8 - 9* Continuous Assessment contributes 35% to the summative assessment mark and the end-of-year examination contributes 65%.The weighting of each assessment component is as follows:

Component	**Description**	**Marks**	**Weighting**
Written examination	Paper 1: Section A:	30	15%
	Paper 2: Section B:	100	50%
Continuous assessment	Topic tasks, Topic tests, Practical investigations/Projects, End-of-term test	70	35%
Total Marks			**100%**

The promotion marks are calculated as follows:

Promotion mark Grade 8				
	Term 1	**Term 2**	**Term 3**	**Total**
Term mark	200	200	50	
CA mark	450÷45×7			70
End-of-year examination	130 Marks			130
Promotion mark	Average Term Mark + End-of-year Examination ÷ 2 200÷2			**100**

Promotion mark Grade 9			
	Term 1	**Term 2**	**Total**
Term mark	200	200	
CA mark	400÷40×7		70
End-of-year examination	130 Marks		130
Promotion mark	Average Term Mark + End-of-Year Examination ÷ 2 200÷2		**100**

10.12 Specification grid

The Specification grid below indicates the approximate weighting allocated to each objective for both Continuous Assessment and for the Written Examination.

Assessment objectives for written examination			
Components	**Weighting**	**Paper 1 Section A**	**Paper 1 Section B**
Objective A Knowledge with understanding	30%	9 marks	30 marks
Objective B Handling information, application & solving problems	65%	20 marks	65 marks
Objective C Practical (experimental and investigative) skills	5%	1 mark	5 marks
Total	100%	30 marks	100 marks

Assessment objectives for continuous assessment	
Components	**Weighting**
Objective A Knowledge with understanding	10%
Objective B Handling information, application & solving problems	40%
Objective C Practical (experimental and investigative) skills	50%
Total	100%

10.13 Assessment Criteria

10.13.1 Notes on practical assessment of objective C

It is recommended that a minimum of FIVE practical investigations should be assessed and recorded (two investigations during the first, two during the second and one during the third term. One of the investigations during the second term should be a project or a practical investigation that will allow at least three major skills to be demonstrated by learners. The assessment should be chosen approximately equally from the Chemistry and Physics sections of the syllabus. The criteria for assessment of practical exercises are set below.
The general skills listed for Objective C: Practical (Experimental and Investigative) skills are related to the basic specific objectives considered most suitable for continuous assessment. Hence, Objective C basic specific objectives are assessed mostly as part of CA.

10.13.2 Assessment rubric for skill A: Practical techniques

This includes experiments, handling and organising apparatus and materials, developing apparatus from readily available materials, following instructions to carry out an experiment, and showing due regard for safety in conducting experiments.

Teachers should use the following 5 point scale when evaluating the performance tasks of Skill A:

Points	General criteria for practical techniques
5	The assessed skill is performed well above average, neatly and independently, with little or no support or guidance from the teacher.
4	The assessed skill is performed above average with little or no support or guidance from the teacher.
3	The assessed skill is performed at an average level with some support or guidance from the teacher.
2	The assessed skill is performed below average with some support or guidance from the teacher.
1	The assessed skill is performed well below average, requiring pronounced support or guidance from the teacher.
0	This mark is only given when the learner is not assessed due to non-participation without valid reason*

*If a learner is absent or not participating with a valid reason, she/he should be given an opportunity to perform the involved skill or ability at a later stage.

10.13.3 Notes on the assessment of skills B, C and D

Skill B: Observing, measuring and recording
This includes writing down detailed quantitative and qualitative data, reading scales and tabulating results.

Skill C: Handling, processing and evaluating data
This includes inferring conclusions from data, processing numerical data, drawing graphs and charts and dealing approximately with anomalous or inconsistent results.

Skill D: Planning and carrying out investigations
This includes analysing a practical problem systematically and producing a logical plan for an investigation.

These skills are made up of specific objectives which require the learner to report to their class, collect, locate and display investigations and conclusions, collect and present a report, collect and present information, write an essay, conduct a survey, design and carry out a project, demonstrate skills practically, produce a poster, write a news report, carry out and analyse information and data.

Annexe 1 Glossary of terms used in science teaching and assessment activities

Analyse	Examine information in detail to discover patterns and relationships, or to study and determine relationship or accuracy
Apply/use	Emphasises the correct use of a equipment, procedures, rules or facts, e.g. a child may be able to use a Bunsen burner, but not do so correctly or have no regard to safety
Calculate	A numerical answer is required - working must be shown
Classify	To arrange or organise according to systematic groups, classes, properties, characteristics or categories
Collect data / samples	Pose questions, select sources and/or design questionnaires. Physically collect samples
Compare / differentiate	To explain the resemblances, similarities or differences between two or more numbers, objects, or figures by considering their attributes/characteristics; or to determine if two or more items, entries or variables are the same and if not, identify differences and give a reason for your answer
Distinguish / identify	Tell apart, show or indicate the difference between, find out what is unique about a material or situation Example: Distinguish between a heat and solar energy
Construct / draw / record	Make an accurate drawing, graphs, tables, charts or representation by using mathematical instruments and/or rules. In case of diagrams, make detailed drawing with heading and all relevant labels. In graph work or charts, an accurate to scale curves or lines should be given with a heading and relevant labels and units. In tables the heading and labels should be given. In tables the units should be given in the heading of the columns or with each entry but not both
Convert	Change from one unit of measure to another
Deduce	Use the information provided to come to a conclusion, e.g. reference to a law or principles, or the necessary reasoning is to be included in the answer
Define	A literal statement is required
Describe / observe	Write down what you do, or what you would see, hear, feel, smell and taste, in as much detail as possible with due regards to safety
Design	Make a plan or drawing to show the appearance of something before it is made
Determine	Use the information given to work out the answer – no working
Discrete data	Individually separate data, e.g. colour of cars – as opposed to continuous data, such as height
Discuss	Give a critical account of the points involved in the topic
Estimate	Implies a reasoned statement or calculation about something. Produce an approximate answer using rational, logical procedures (e.g., rounding for numbers and benchmarks for

	measures)
Evaluate	Use the information provided to make a judgement about something
Explain	Give a reason for your answer
Find	A general term which means calculate, determine or measure
Give / state / write down / express	Write down your answer
Interpret	Reasoning or some reference to theory, depending on the content; explain the meaning of something
Investigate	Examine a problem in a systematic way
List	Give a number of points, generally each of one word
Name	Identify by mentioning the name of something
Outline	Give a brief answer writing down the main points
Predict	To determine the next step or value (to make an educated guess), based on evidence or a pattern; make a logical deduction either from your own knowledge or from the information given in the question or both
Recognise	Be aware of a fact or problem
Relate	Find the relationship between one or more variables
Select	Choose from a number of alternatives
Sketch	Make a rough drawing that shows the salient or distinguishing features of an object; in diagrams, make a simple, freehand drawing and in graph work, the shape and/or position of the curve should be given
Study	Use the information or data provided to investigate a problem in a systematic way
Suggest	Use your knowledge of the context of the problem and mathematical procedures to give what you think is the best strategy to use or answer to the question use your knowledge of science and the information in the question to give what you think is the best answer

Annexe 2 Numbers and formulas

2.1. Numbers

The decimal point will be placed on the line, e.g. 52.35.
Numbers from 1000 to 9999 will be printed without commas or spaces.
Numbers greater than or equal to 10 000 will be printed without commas. A space will be left between each group of three whole numbers, e.g. 4 256 789.

2.2 Formulas

Learners should be able to state the symbols for the following physical quantities and where indicated, state the units in which they are measured.
The acceptable methods of stating units will be (e.g. metres per second or m per s) be written as m/s or m s-1 (Note: the solidus (/) will be used for a quotient and indicate units in labels of tables and graphs e.g. distance/cm).

Quantity	Word formula with units	Formula
Density	density [ρ] = mass [m] ÷ volume [V]	$\rho = \frac{m}{V}$
Weight	weight [w] = mass [m] × acceleration due to Earth's gravity [g] NOTE: $g \approx 10\ m/s^2$	$w = m \times g$
Work	work [W] = force [F] × distance moved in the direction of the force [d]	$W = F \times d$
Pressure	pressure [p] = force [F] ÷ area [A]	$p = \frac{F}{A}$
Ohm's Law	voltage [V] = current [I] × resistance [R]	$V = I \times R$
Power	power [P] = voltage [V] × current [I]	$P = V \times I$
Current	current [I] = charge [Q] ÷ time [t]	$I = \frac{Q}{t}$
Voltage	voltage [V] = energy [E] ÷ charge [Q]	$V = \frac{E}{Q}$
Billing Cost of Electricity	Energy [E] = power [P] × time in hours [t]	$E = P \times t$

Annexe 3 Symbols, units and definitions of physical quantities

Quantity	Symbol	Unit	Name of units
length	*l, h*	*km, m, cm, mm*	kilometre, metre, centimetre, millimetre
area	*A*	m^2, cm^2	square metre, square centimetre
volume	*V*	m^3, cm^3, dm^3	cubic metre, cubic centimetre, cubic decimetre
weight	*w*	*N*	newton
mass	*m*	*kg, g*	kilogram, gram
time	*t*	*h, min, s*	hour, minute, second
density	ρ	kg/m^3, g/cm^3	kilogram per cubic metre, gram per cubic metre
speed	*u*	*km/h, m/s, cm/s*	kilometre per hour, metre per second, centimetre per second
velocity	*v*	*km/h, m/s, cm/s*	kilometre per hour, metre per second, centimetre per second
acceleration	*a*	m/s^2	metre per second squared
constant of gravitational force of 10 N on 1 kg of mass (10 N/kg) on or near the surface of the Earth, or the acceleration of free fall	*g*	m/s^2 *or N/kg*	metre per second squared or Newton per kilogram
force	*F*	*N*	newton
work done	*W*	*J*	joule
energy	*E*	*J*	joule
power	*P*	*W*	watt
temperature	*T*	^oC, *K*	degree Celsius, Kelvin
potential difference/voltage	*V*	*V, mV*	volt, millivolt
current	*I*	*A, mA*	ampere, milliampere
resistance	*R*	Ω	ohm

Annexe 4: Assessment record sheet for Grade 8, terms 1 and 2

Assessment record sheet: Physical Science Grade: Year:
School: Teacher:

		Practical investigations			Topic task			Topic test				Total	End-of-term test	Term mark	Weighted term mark
Name of learner		1	2	Total	1	2	Total	1	2		40÷2		(65×2)		200÷2
	Mark	15	15	**30**	10	10	**20**	20	20	**40**	**20**	70	130	200	**100**
	1														
	2														
	1														
	2														
	1														
	2														
	1														
	2														
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	2														
	1														
	2														
	1														
	2														

Annexe 5: Assessment record sheet for Grade 8, term 3

Assessment record sheet: Physical Science												Grade:				Year:
School:																Teacher:
Name of learner	Practical investigations	Topic task			Topic test				Term 3	Term 2	Term 1	Total term mark	CA mark	Exam mark	Total	Promotion mark
	1	1	2	Total	1	2	Total	40÷2				T3+T2+T1	(450÷45)×7			200÷2
	10	**10**	**10**	**20**	**20**	**20**	**40**	**20**	**50**	**200**	**200**	**450**	**70**	**130**	**200**	**100**

Annexe 6: Assessment record sheet for Grades 9

Assessment record sheet: Physical Science Grade: Year:
School: Teacher:

		Practical investigations			Topic task			Topic test				Total	End-of-term test	Term mark	Weighted term mark	Total term mark	CA mark	Exam mark	Total	Promotion mark
Name of learner		1	2	Total	1	2	Total	1	2		40÷2		65×2		200÷2	T1+T2	(400÷40)×7			200÷2
		15	15	**30**	10	10	**20**	20	20	**40**	**20**	70	130	200	**100**	400	70	130	200	**100**
	1																			
	2																			
	1																			
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The National Institute for Educational Development
Private Bag 2034
Okahandja
NAMIBIA

Telephone: +264 62 509000
Facsimile: +264 62 509073

Website: http://www.nied.edu.na