Republic of Malawi

Syllabus for

Physics

Forms 3 and 4

Ministry of Education, Science and Technology

Syllabus for

Physics

Forms 3 and 4

Ministry of Education, Science and Technology

Prepared and published by

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First edition 2013

Acknowledgements

The Ministry of Education, Science and Technology and the Malawi Institute of Education would like to thank all those who participated in various capacities, stages and levels in the development, refinement and final production of this syllabus. The Ministry is particularly indebted to the following for their contributions at various stages of the development of the syllabus for physics:

Austin B Kalambo	-	Malawi Institute of Education
Dr Simeon M Gwayi	-	Mzuzu University
Dr Justice Stanley P Mlatho	-	Chancellor College
Fanwell C Chiwowa	-	Mzuzu Government Secondary School
Joseph Mshanga	-	Domasi College of Education
Dr John Kazembe	-	Bunda College of Agriculture
Harlod Chigalu	-	South East Education Division
Chrissie Soko	-	Department of Inspectorate and Advisory Services
Victor Lungu	-	North Education Division
Jackson Sambila	-	Chinsapo Secondary School
Richard Pichesi Yaya	-	Domasi Demonstration Secondary School

Special thanks also go to the Director of Department of Inspectorate and Advisory Services (DIAS), Raphael Agabu, and his staff, the Director of Malawi Institute of Education, Dr William Susuwele-Banda, and his staff, the head of Department for Curriculum Development (DCD), Coordinator of secondary school curriculum, Mrs Enia Ngalande and her Team (Naireti Molande, Dr Ezekiel Kachisa and Austin Kalambo) for coordinating the process of reviewing the syllabuses.

MoEST and MIE would also like to thank Austin G Madinga and Felix Limburo who helped in the refining of the syllabus. Finally, thanks should also go to Dr Michael Zimba, Patrick Mzaza, Lovemore Likhupa, Milliward Mvula and Andrew Phaundi Shonga for providing expert advice during the development of this syllabus.

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Foreword

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

It is the conviction of the Ministry of Education, Science and Technology that primary education alone is not sufficient for achieving socio-economic development. As argued in the NESP (2008-2017), 'In an evolving and changing world of education, there is no way basic education can be taken as a complete transformer of our society when the world at large is getting more complex and sophisticated'. Therefore, secondary education is critical as it provides additional knowledge, skills and attitudes crucial for enabling Malawians to cope with the complex and sophisticated socio-economic and political environment of the global village to which Malawi belongs. Specifically, secondary education is:

- a human right, and important for achieving gender equity
- important for improving the health and quality of life for individuals, families and communities
- important for the socio-economic and political development of the nation
- necessary for reaching the Millennium Development Goals (MDGs), Education For All (EFA) and for promoting Universal Primary Education (UPE)

Against this background, the Malawi Government through the Ministry of Education, Science and Technology has reviewed the secondary school curriculum with a view to improving its quality and relevance, and to align it with the primary curriculum which has since been reviewed and emphasises continuous assessment as a tool for learning.

The rationale for reviewing the secondary school curriculum is contained in the NESP (2008-2017), and PIF (2000). The documents clearly state that the purpose of secondary education is to provide students with the academic basis for gainful employment in formal, private and public sectors. They further state that secondary education will prepare students for further education according to their abilities and aptitudes. However, it is important to note that for the majority of the children in Malawi, secondary education is terminal. Consequently, the curriculum has put emphasis on practical skills that enable them to achieve self-employment.

It is also clear that a good secondary school curriculum enables a student to develop into an adult with sound intellectual, moral, physical, and emotional abilities. Therefore the curriculum needs to address the whole range of students' abilities and interests. In addition, it should aim at equipping the student to become an independent learner in order to promote personal, family, community and national development. The new curriculum has therefore been deliberately designed to achieve these important goals. The importance of this syllabus therefore, cannot be over-emphasised.

I would like to thank all those who were directly or indirectly involved in the preparation of the syllabuses. Key among the stakeholders are the Director and staff of the Department of Inspectorate and Advisory Services (DIAS) in the Ministry of Education, Science and Technology (MoEST), for facilitating the development of the syllabuses in collaboration with the Director and staff of the Malawi Institute of Education (MIE). I would also like to extend my gratitude to university colleges (both public and private), teachers from secondary schools (both public and private), members of different religious groups and officers representing special interest groups such as the Malawi Revenue Authority (MRA), Reserve Bank of Malawi (RBM), Malawi Bureau of Standards (MBS), Anti-Corruption Bureau (ACB) and Malawi Blood Transfusion Services (MBTS) for their valuable contribution to and participation in the preparation of these syllabuses.

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

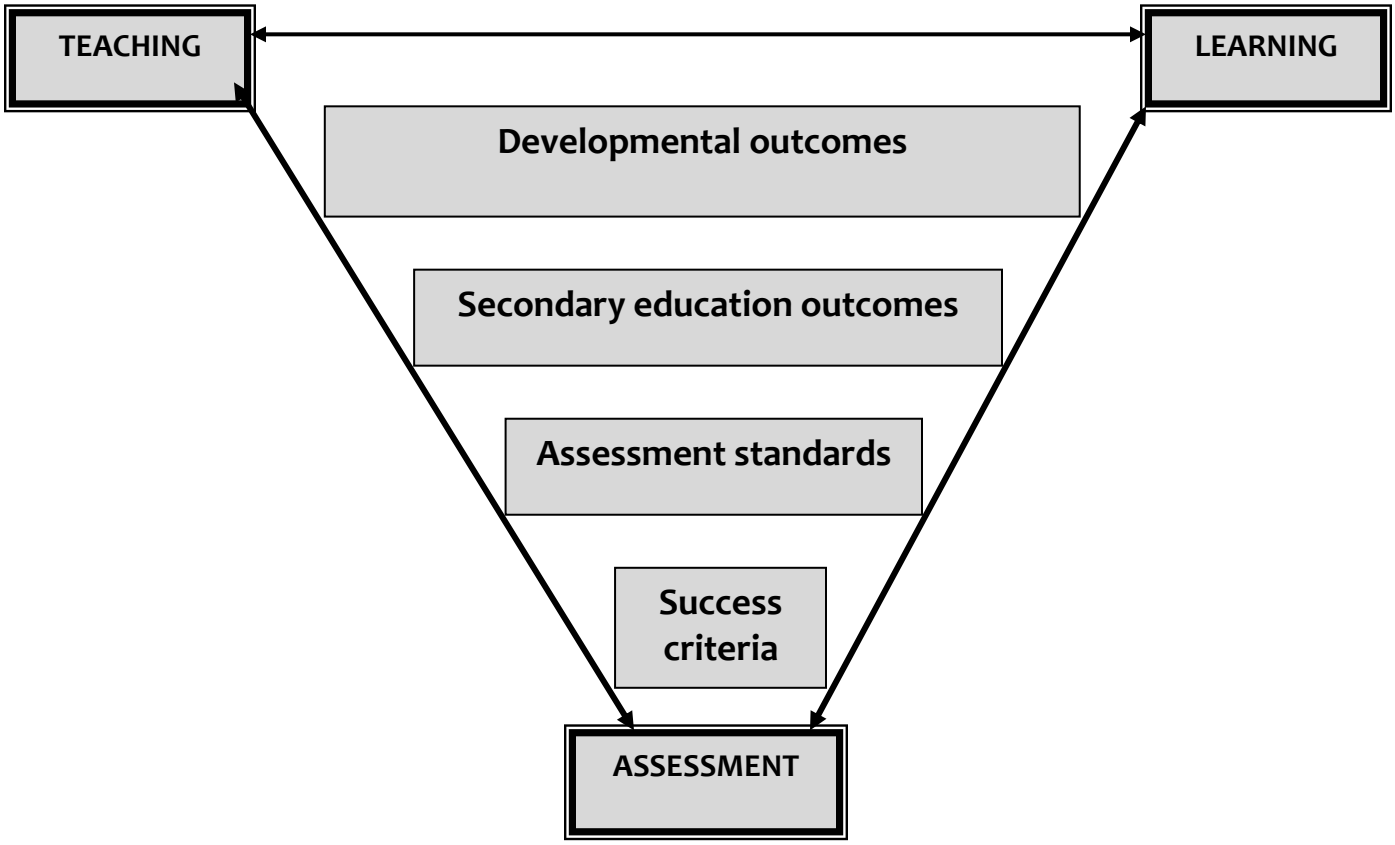
Dr McPhail Magwira
Secretary for Education Science and Technology (SEST)

The secondary school curriculum in Malawi

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

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

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



The developmental structure of the secondary school curriculum in Malawi

Developmental outcomes

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

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

Secondary education outcomes

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

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

Citizenship skills

1 demonstrate an understanding and appreciation of the symbols of nationhood
2 demonstrate a spirit of patriotism and national unity
3 apply decision-making skills necessary for participation in civic affairs
4 demonstrate a spirit of leadership and service
5 show respect for one's own and other people's rights and responsibilities
6 tolerate other people's attitudes and beliefs
7 demonstrate respect for the rule of law
8 understand characteristics of good governance
9 initiate and implement community development projects
10 demonstrate a sense of good neighbourliness
11 demonstrate a sense of national, regional and international understanding
12 demonstrate cooperative behaviour
13 demonstrate personal and social responsibility

Ethical and socio-cultural skills

14 demonstrate moral, spiritual and ethical attitudes and values
15 appreciate Malawi's diverse cultures and their respective practices
16 appreciate existing national institutions and cultural heritage
17 appreciate the value of the relationship between the individual and society
18 respect one's own and other people's cultures
19 identify beliefs which promote or retard national development
20 evaluate beliefs, taboos and superstitions in relation to national development
21 uphold beliefs which promote national development

Economic development and environmental management skills

22 understand Malawi's economy and economic structure
23 demonstrate entrepreneurial and/or vocational skills for formal or informal employment
24 exploit economic opportunities stemming from agriculture
25 demonstrate an interest in land husbandry, animal husbandry and aquaculture
26 apply appropriate agricultural practices and methods
27 acquire positive attitudes and skills, and apply them to the sustainable development of the natural and physical environment
28 understand the importance of diversified agriculture for Malawi's economy
29 understand the impact of technologies on economic productivity
30 apply relevant technologies to various economic activities
31 apply value addition practices to agricultural and environmental resource utilisation and management
32 appreciate Malawi's environmental resources
33 understand the impact of rapid population growth on natural resources and the delivery of social services
34 apply a variety of measures to conserve Malawi's natural resources
35 apply ICT skills to improve intellectual growth, personal enhancement and communication
36 demonstrate the ability to adapt to climate change and mitigate its impact on the economy and environment

37 appreciate the importance of energy in economic development
38 understand the importance of diversifying the economy through sectors such as tourism, mining and manufacturing

Occupational and entrepreneurial skills

39 demonstrate the spirit of self-reliance through vocational and entrepreneurial activities
40 apply appropriate vocational, occupational and entrepreneurial skills to individual and national advancement
41 demonstrate effective communication skills for the transfer of occupational and entrepreneurial knowledge, skills, attitudes and values
42 apply the principles of science and technology, entrepreneurship and management to promote active and productive participation in the society
43 demonstrate creativity and innovation for the benefit of the individual, community and the nation as a whole
44 demonstrate an understanding of indigenous and non-indigenous knowledge, skills, attitudes and values, and apply them to personal intellectual growth and national development
45 use vocational, occupational and entrepreneurial skills for the creation of economic opportunities in agriculture and other sectors

Practical skills

46 acquire entrepreneurial skills related to agriculture, commerce and industry
47 apply appropriate skills to agricultural, commercial and industrial production
48 demonstrate positive attitudes to manual work
49 demonstrate excellence in any kind of workmanship
50 demonstrate sporting ability and sportsmanship
51 demonstrate the ability to use creative and innovative artistic talents for self-employment

Creativity and resourcefulness

52 demonstrate a spirit of inquiry and creative, critical and lateral thinking
53 use problem-solving techniques to solve practical problems
54 demonstrate an imaginative and creative mind
55 exploit creative potential
56 understand personal strengths and weaknesses and use strengths to promote healthy self-esteem
57 maximise the use of available resources

Scientific and technological skills

58 apply appropriate scientific, technological and vocational skills to improve economic productivity
59 apply relevant innovations in science and technology
60 demonstrate a capacity to utilise appropriate technology
61 demonstrate basic research skills

Rationale for physics

Physics helps students to become more scientifically literate i.e. it enables them to think critically and creatively based on explanations developed and evaluated from experiments and models. The subject will therefore help students to develop a scientific mind/view necessary for identifying and solving current and emerging/new scientific issues.

Moreover, physics is the backbone of natural and applied sciences which are important for social and economic development of the nation. Students will also develop an awareness and understanding of the nature of physics and its role in environmental etc and natural resources management and the importance of safe and efficient management of the country's resources for sustainable development.

Core elements and their outcomes

Scientific investigations and skills

The students will be able to use scientific laws, principles, theories, and relations to explain phenomena and creatively exploit these phenomena to generate and test theories as well as critically analyze and evaluate scientific data from observations and experiments.

Properties of matter

The students will be able to relate the behaviour of matter from the microscopic level to the macroscopic level when subjected to different environments and creatively apply these properties to bring about technological developments at the same time examining the ethical and moral implications of using and applying science.

Mechanics

The students will be able to appreciate and demonstrate the use of appropriate theories to explain various states of motion including the energy interactions and the changes that take place due to forces.

Electricity and magnetism

The students will be able to understand the laws and principles of electricity, magnetism and then apply this knowledge in areas such as analogue and digital electronic systems.

Oscillation and waves

The students will be able to understand and apply knowledge about waves and their properties in designing and developing various technologies in communication, medicine, musical and military equipment.

Nuclear physics

The students will be able to appreciate principles of radioactivity and how radioactive materials are safely handled, used, and stored.

Scope and sequence chart for Forms 1 to 4

Core element	Form 1	Form 2	Form 3	Form 4
Scientific investigations and skills	**Introduction** *(6 periods)* • physics as a Science • scientific investigations • laboratory and safety rules **Measurements I** *(4 periods)* • fundamental quantities • SI units and symbols • prefixes for SI units • conversion of units • basic measuring instruments (scale reading)	**Conducting a scientific investigation** *(4 periods)* • basic scientific investigation processes • investigation from any topic(s) covered in form 1 using the scientific process	**Measurements II** *(3 periods)* • measuring instruments and units - quantities and SI units - standard notation - prefixes for SI units - unit conversion - scale reading **Scientific investigations** *(8 periods)* • designing a scientific investigation - identifying a problem - hypothesising - deciding the type of data to collect - identifying variables i.e. independent variables, dependent variables. control variables and controlling variables • carrying out investigation - collecting scientific data - organizing the data • analysing data of the investigation - identifying errors and their sources in an experiment - classifying errors	

Core element	Form 1	Form 2	Form 3	Form 4
Scientific investigations and skills			- selecting suitable scales in graph plotting - graph plotting - using a graph to analyse scientific data - using a graph to even out errors - drawing conclusions and generalisations from results • communicating results from experimentations - organizing experimental results - making oral and poster presentations of findings - writing a lab report • evaluating the scientific investigation - relating the conclusion to the hypothesis and/or logic or published data - factors that may affect the accuracy of an investigation and how to address them	

Core element	Form 1	Form 2	Form 3	Form 4
Properties of matter	**Particulate nature of matter** *(6 periods)* • meaning of matter • states of matter • composition of matter • evidence of existence of particles in matter • arrangement of particles in different states of matter • properties of three states of matter **Changes in states of matter** *(10 periods)* • properties of the three states of matter • meaning of heat • meaning of temperature • heat and temperature • melting and boiling points • factors affecting melting and boiling points - altitude, impurities	**Thermal expansion of solids, liquids and gases** *(8 periods)* • effect of heat on solids, liquids and gases • rate of expansion • application of expansion **Density** *(9 periods)* • meaning of density • calculations on density • density and states of matter • density and temperature • sinking and floating • applications of density	**Kinetic theory of matter** *(6 periods)* • kinetic theory of solids, liquids and gases - experiment to demonstrate the kinetic theory of matter - kinetic theory of matter in relation to different states of matter • gas pressure - cause of gas pressure - demonstration of gas pressure • temperature - internal energy and temperature • relationship between average molecular speed and temperature • absolute temperature - meaning of absolute temperature	**Thermal expansion** *(5 periods)* • thermal expansion in solids, liquids and gases • expansion and particle behaviour - illustration of particle behaviour in the expansion of matter - expansion in terms of particle behaviour • expansion of water and its effects - expansion of water in frozen state

Core element	Form 1	Form 2	Form 3	Form 4
Properties of matter		**Specific heat capacity** *(4 periods)* • meaning of heat capacity • calculations on heat capacity • meaning of specific heat capacity • difference between heat capacity and specific heat capacity • calculations on specific heat capacity • applications of specific heat capacity **Heat transfer** *(6 periods)* • conduction • convection • radiation • application of heat transfer	**Thermometry** *(6 periods)* • types of temperature scales • differences among temperature scales • converting scales • thermometers and how they function • various types of thermometers - liquid-in-glass thermometer - thermocouple thermometer - constant-volume gas thermometer - resistance thermometer • how thermometers work • temperature measurements using thermometers	• graphs on expansion of water • effects and applications of thermal expansion eg • practical applications of thermal expansion: - separating stuck tumblers - gaps in railway line - tooth filling - removing tightly screwed bottle covers or parts of bicycle/car where shrink fitting and riveting was used

Core element	Form 1	Form 2	Form 3	Form 4
			Pressure *(12 periods)* • meaning of pressure - defining pressure - stating the SI units of pressure • pressure exerted by solids - pressure in solids - factors affecting pressure in solids • factors affecting pressure in liquids - investigating factors affecting pressure in liquids - deriving the formula $p = \rho gh$ - problems involving $p = \rho gh$ • Pascal's principle of transmission of pressure in fluids - demonstration of Pascal's principle of transmission of pressure in fluids - stating the Pascal's principle • atmospheric pressure - demonstration: collapsing can experiment, drinking straws, card on bottle/tumbler experiments - effects of atmospheric pressure - measuring atmospheric pressure	

Core element	Form 1	Form 2	Form 3	Form 4
Properties of matter			• applications of pressure in fluids - examples of applications of pressure - liquid pressure in everyday activities - problems involving pressure • Archimedes' principle - stating Archimedes' principle - verifying Archimedes' principle - stating the law of floatation - applications of Archimedes' principle and relative density - problems involving Archimedes' principle and the law of floatation	

Core element	Form 1	Form 2	Form 3	Form 4
	-		**Gas laws: Boyle's law, Charles law, pressure law** *(8 periods)* • The gas laws - stating the gas laws - relationship between pressure and volume at constant temperature (Boyles law) - relationship between volume and temperature at constant pressure (Charles law) - relationship between pressure and temperature at constant volume (Pressure law) - gas laws and the kinetic theory of gases • applications of the gas laws - everyday applications of the gas laws - problems involving gas laws - making a manometer - measuring lung pressure using a manometer	

Core element	Form 1	Form 2	Form 3	Form 4
Mechanics	**Force** *(13 periods)* • definition of force • SI units of force • examples of where force is used • effects of force on various objects • measuring force • frictional force • mass and weight **Work** *(3 periods)* • meaning of work • SI units of work • relating force to work • calculations on work **Energy** *(9 periods)* • meaning/definition of energy • forms of energy • energy transfer/changes • calculations on energy changes sources of energy (renewable and non-renewable)	**Power** *(3 periods)* • meaning of power • SI units of power • calculations on power **Machines** *(19 periods)* • definition of a machine • examples of simple machines • levers • inclined planes • pulleys • advantages of using machines • mechanical advantage	**Scalar and vector quantities** *(8 periods)* • scalar and vector quantities - defining scalar and vector quantities - distance and displacement • representing vectors - magnitude and direction • vector addition and subtraction - meaning of resultant - adding vectors using parallelogram, triangle rules • resolving vectors **Linear motion** *(18 periods)* • distance, displacement, speed, velocity and acceleration - comparison of distance and displacement - comparison of speed and velocity - definition of acceleration • experiment to determine velocity and acceleration - plot graphs of displacement against time	**Newton's laws of motion** *(10 periods)* • Newton's laws of motion - the three Newton's laws of motion - applications of the laws of motion • simple experimentations to illustrate inertia - meaning of inertia - experiment on inertia • linear momentum - the law of conservation of linear momentum - collisions of various objects - problems involving collisions **Frictional force** *(4 periods)* • applications of frictional force - coefficient of friction - calculations on the frictional force using normal force ($F=\mu N$)

Core element	Form 1	Form 2	Form 3	Form 4
	• law of conservation of energy		- interpretation of the graph of displacement against time - determination of the velocity for a given displacement experimentally - calculate velocity of various objects - plot graphs of velocity against time - interpretation of graphs of velocity against time • acceleration due to gravity - simple free fall experiment - determination of acceleration due to gravity by simple pendulum method • motion-time graphs - plot and interpret distance-time graphs - calculate average speed - plot and interpret speed-time graphs	**Terminal velocity** *(3 periods)* • meaning of terminal velocity - falling of objects in a vacuum and in fluids - factors affecting falling objects - investigation of terminal velocity **Hooke's law** *(8 periods)* • the effects of force - effects of forces on various objects - demonstration of effects of force on various objects • verification of Hooke's law - experiment on Hooke's law - extension-load graphs for an elastic material within elastic limit • limit of proportionality for an elastic solid

Core element	Form 1	Form 2	Form 3	Form 4
			- shapes of a distance-time graphs - shapes of a speed-time graphs - area under a speed-time graph - bodies under free-fall - motion of falling bodies with constant weight • apply the equations of uniformly accelerated motion - equations of uniformly accelerated motion - numerical problems related to motion	- stretching of elastic materials beyond elastic limit - extension-load graphs for an elastic material stretched beyond elastic limit • application of Hooke's law - construction and calibration of a spring balance - extension of springs in parallel and in series - spring constant for various springs - problems involving Hooke's law

Core element	Form 1	Form 2	Form 3	Form 4
			Work, energy, power and machines *(12 periods)* • work - meaning (work = Fd) and SI units - calculate work done by a force acting in the direction of motion - calculate work done by a force at an angle to the direction of motion (work = $Fcos\theta d$) - solve mathematical problems involving work • energy - conservation of mechanical energy - energy-work theorem - solving problems on mechanical energy	**Uniform circular motion** *(8 periods)* • angular displacement and angular velocity - difference between angular displacement and angular velocity - circular motion - relationship between tangential (linear) velocity and angular velocity • Centripetal force - simple experimentations - objects in circular motion • principles of uniform circular motion - problems involving uniform circular motion - applications of circular motion in everyday life

Core element	Form 1	Form 2	Form 3	Form 4
Mechanics			• machines - meaning of machine - meaning of efficiency, mechanical advantage and velocity ratio - calculate efficiency, mechanical advantage and velocity ratio - solve mathematical problems involving machines	**Moments of forces** *(6 periods)* • describing moment of a force - meaning of moments of a force - relationship between force and torque - the principle of moments for a body in equilibrium • verifying the principle of moments using pivots and objects • applying principle of moments in everyday life • problems using the principle of moments. • systems involving moments • centre of mass in lamina and uniform rods

Core element	Form 1	Form 2	Form 3	Form 4
Electricity and magnetism	**Electric current** *(11 periods)* • meaning of electric current and its units • simple electric circuits • components of electric circuits (cell, ammeter, voltmeter, resistor, connecting wires, bulb and switches) • basic circuit symbols • measuring electric current **Voltage** *(6 periods)* • measuring voltage • voltage in series and parallel circuits **Electrical resistance** *(7 periods)* • definition of electrical resistance • factors affecting electrical resistance	**Electrostatics** *(6 periods)* • principles of electrostatics - structure of the atom - description of electrostatics - illustrate charging by friction - electric field - differences between insulators and electrical conductors in terms of charging - earthing - detection of charge using an electroscope - charging by induction - charging by contact - Coulomb's law (only descriptive, no equation)	**Current electricity** *(2 periods)* • definition of electric current - units of electric current - direction of electric current - using the equation I = Q/t - circuit symbols - circuit diagrams **Electrical potential difference** *(2 periods)* • potential difference - definition of potential difference - SI units of pd - definition of electromotive force - potential difference measurements	**Magnetism** *(2 periods)* • magnetisation and demagnetisation - domains - experimentations to illustrate magnetisation and demagnetisation **Electromagnetism** *(12 periods)* • electromagnetism - investigation of electromagnetism - field patterns of electromagnets - magnetic fields of current-carrying conductors - force on current-carrying conductor in a magnetic field(descriptive, no equations) - Fleming's left-hand rule

Core element	Form 1	Form 2	Form 3	Form 4
	Effects of electric current *(9 periods)* • heating effect • magnetic effect • chemical effect • cells and batteries - types of cells (wet and dry) - care and maintenance of cells/batteries	• role of electrostatics in everyday life - dangers of electrostatics - applications of electrostatics		• uses of electromagnetism - simple experimentations to illustrate electromagnetic induction. - factors affecting magnitude and direction of the induced emf - Faraday's and Lenz's laws of electromagnetic induction (descriptive, no equations) - ac and dc generators - dc motor

Core element	Form 1	Form 2	Form 3	Form 4
	Magnets ***(6 periods)*** • properties of magnets • basic law of magnetism • poles of magnets • magnetic field patterns • care of magnets • uses of magnets		**Resistance** *(8 periods)* • electrical resistance - definition of electrical resistance and its SI units - factors affecting electrical resistance - Ohm's law - verification of Ohm's law - electrical resistance measurements - calculation of resistance using Ohm's law - resistor colour codes and standard notation - internal resistance of a cell - using the relationship $E = V + Ir$ **Electric circuits, power and energy** *(8 periods)* • electric circuits - circuit symbols - circuit diagrams - resistors in series and parallel circuits	• transformers and power transmission • power loss in transformers and transmission line • environmental impact of power generation and transmission • solving mathematical problems involving transformers • making and testing a simple transformer and an electric motor (project)

Core element	Form 1	Form 2	Form 3	Form 4
Electricity and magnetism			- net effect of resistors in series and parallel circuits - electric currents and voltages in series and parallel circuits • electric power - power ratings of electrical appliances - derivation and use of the equations: $P = VI,\ P = I^2R,\ \mathrm{P} = \frac{V^2}{R}$ and $E = Pt$ • electric energy - electric energy in kilowatt-hours - cost of electric energy - interpretation of electric energy bills (eg electric energy bills from ESCOM) • experiment on heating effect of an electric current • electrical hazards and safety • three pin plugs	**Introduction to digital electronics** *(15 periods)* • Semiconductor devices - meaning of digital electronics - differences between conductors, semiconductors and insulators (Band Theory) - differences between intrinsic and extrinsic semiconductors • doping of semiconductors (N-type and P-type) - operation of a P-N junction diode - current-voltage characteristics for a forward biased diode - application of diode in half-wave and full-wave rectification - basic structure and operation of a bipolar transistor (N-P-N) - light operated switch

Core element	Form 1	Form 2	Form 3	Form 4

				• electronic components and their uses
				  - electric circuits
				  - symbols for electronic devices
				  - uses of electronic devices
				• analogue and digital circuits
				  - difference between analogue and digital circuits
				  - characteristics of analogue and digital signals
				• basic logic gates
				  - operations of basic logic gates
				  - truth tables of basic logic gates
				  - symbols of basic logic gates

Core element	Form 1	Form 2	Form 3	Form 4
Oscillations and waves		**Light** *(20 periods)* • rectilinear propagation of light (experimental treatment required) • formation of shadows and eclipses (umbra and penumbra) • pin-hole camera • image formation and magnification • reflection • images formed by plane mirrors - ray diagrams - parallel and inclined • mirrors • device based on reflection: periscope • problems on pin-hole camera and mirrors inclined at an angle • refraction • effects of refraction - apparent depth - dispersion - bending shape of an immersed object	**Oscillations** *(4 periods)* • oscillations in a pendulum and a loaded spring - amplitude, displacement, period, and frequency of an oscillating system - factors affecting the frequency of an oscillating system (pendulum, loaded spring, cantilever) **Waves** *(8 periods)* • description of a wave • meaning of a wave • characteristics of a wave • transverse and longitudinal waves • meaning of a transverse and a longitudinal wave • differences between transverse and longitudinal waves • wave properties - reflection - refraction - diffraction - interference	**Electromagnetic waves** *(6 periods)* • electromagnetic spectrum - energy, frequency and wavelength - sources of electromagnetic waves • electromagnetic waves - properties - methods of detecting electromagnetic waves - applications of electromagnetic waves - solve problems using $c = f\lambda$ **Light and lenses** *(19 periods)* • converging and diverging lenses - characteristics of converging and diverging lenses - ray diagrams and terms associated with converging lenses

Core element	Form 1	Form 2	Form 3	Form 4
Oscillations and waves			• the wave equation - derivation of the relation $v = f\lambda$ - problems involving $v = f\lambda = \lambda/T$ **Sound** *(7 periods)* • production of sound by vibrating objects • loudness and pitch of sound • free and forced vibrations, natural frequency and resonance • transmission of sound - matter and vacuum • nature of sound waves - compressions and rarefactions - determination of speed of sound in air - sound transmission in gases, liquids and solids - problems involving velocity of sound • factors affecting the speed of sound	• focal length of a converging lens - experimental determination of a focal length of a converging lens - determination of focal length using graphs - graph interpretation • image formation by converging lenses - position, size and nature of the image formed • image formation using ray diagrams - drawing ray diagrams - determination of the position, size and nature of images - magnification of an image • lens and the magnification formulae - derivation of the lens formula - problems involving lenses and magnification formula

Core element	Form 1	Form 2	Form 3	Form 4
				• application of lenses in various optical devices - parts of a simple camera and their functions - use of a simple camera - parts of a slide/film projector and their functions - use of the projector - ray diagrams for a camera and a projector - parts of a telescope and their functions - use of a telescope - making a telescope (project) • image formation in the human eye - parts of a human eye involved in image formation - image formation using ray diagrams - comparison of a camera and the eye • visual defects in the human eye - short sightedness and its correction - long sightedness and its correction

Core element	Form 1	Form 2	Form 3	Form 4
Nuclear physics		**Introduction to nuclear physics** *(5 periods)* • structure of an atom • meaning of isotopes • radioactive isotopes • types of radiation (α, β, and γ radiation) • properties of the different types of radiations • uses of radiation • dangers of radiation • safety measures against radiation exposure		**Isotopes** *(2 periods)* • nuclear structure of an atom - structure of an atom - constituent particles of a nucleus - diagrams of the atomic nuclei - nuclear notation • description of isotopes - definition of isotopes - examples of isotopes - explanation of how one element may have a number of isotopes using nuclide notation

Core element	Form 1	Form 2	Form 3	Form 4
				Radioactivity *(10 periods)* • explanation of radioactivity • definition of radioactivity • natural and induced radioactivity • radioactive emissions • half-life of isotopes • detection of radioactive emissions • definitions of nuclear fission and fusion • balanced nuclear equations (fission and fusion) • problems involving half-life • dangers of radioactive emissions • methods of safely handling and storing radioactive materials • applications of radioactivity - nuclear power generation - agricultural - industrial - medical - radiocarbon dating

Teaching syllabus for Forms 3 and 4

Form 3

Core element Scientific investigations and skills

Outcome The students will be able to use physics laws, principles, theories, and relations to explain and creatively exploit phenomena to generate and test theories as well as critically analyze and evaluate scientific data from observations and experimentations.

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate investigative skills	Students must be able to: 1 use suitable instruments and units for various measurements	**Measurements and SI units**	• discussing quantities and their SI units • describing standard notation • discussing prefixes for SI units • converting one unit to another • scale reading of various measuring instruments - measuring very small dimensions (length), very small time intervals, very small volumes and very small masses	• discussion • oral/written questions • experimentation • demonstration	• charts • textbooks • rulers • vernier callipers • measuring cylinders • thermometers • spring balances • triple beam balances • stop watches • paper clips • drawing pins • micrometer screw gauges • pendulums

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
		Scientific investigations			• digital balances • cathode ray oscilloscopes (CROs)
	2 design a scientific investigation		• identifying a problem • hypothesising • deciding the type of data to collect • identifying variables - independent variables - dependent variables - control variables	• brainstorming • oral questions • discussion	• textbooks • charts
	3 carry out a scientific investigation		• controlling variables • collecting scientific data • organizing scientific data	• discussion • field trips • experimentations • reports	• local environment • students' experiences
	4 analyse data from a scientific investigation		• identifying errors and their sources in an experiment • classifying errors • discussing the minimisation of errors	• discussion • reports	• graph paper • calculators • pencils • erasers • computers

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
			• selecting suitable scales in graph plotting • plotting a graph • using a graph to analyse scientific data • using a graph to even out errors • drawing conclusions and generalisations from results		
	5 communicate results from experiments		• organizing results from experiments • making oral and poster presentation of findings • sketching and labelling experimental set up • writing lab reports	• group discussion • presentation • oral questions • lab reports	• projectors • computers • textbooks • graph papers • lab report templates • charts
	6 evaluate a scientific investigation		• relating a conclusion to the hypothesis and/or logic • discussing shortcomings that may affect a scientific investigation • discussing ways of reducing factors that may affect a scientific investigation	• oral questions • discussion • plenary sessions • peer assessment	• textbooks • written labs reports • evaluation checklists

Core element Properties of matter

Outcome The students will be able to relate the behaviour of matter from microscopic level to the macroscopic level when subjected to different environments and creatively apply these properties to bring about technological developments at the same time examine the ethical and moral implications of using and applying science.

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of kinetic theory of matter and its applications	Students must be able to: 1 describe the kinetic theory of solids, liquids and gases	**Kinetic theory of matter**	• discussing particle arrangement in solids, liquids and gases • carrying out an experiment to demonstrate the kinetic theory of matter • discussing the kinetic theory of matter in relation to different states of matter	• role play • drawing • demonstration • discussion • oral/written questions • oral or written report • experimentation	• students' experiences • students • seeds/stones /bottle tops (for atomic arrangement) • water • beakers • iodine • tripod stands • sources of heat • potassium permanganate crystals

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	2 explain the cause of gas pressure		• discussing the cause of gas pressure • demonstrating gas pressure: - heating a container which has been fitted with a balloon - using a pump/syringe • discussing the results	• demonstration • discussion • oral/written questions	• sources of heat • metal cans • balloons • containers • pumps/syringes
	3 explain the relationship between average molecular speed and temperature		• role playing molecular motion in relation to temperature - heating water - heating candle wax • discussing the relationship between internal energy and temperature • discussing the relationship between molecular motion and temperature	• role play • discussion • experimentations • observation • oral/written reports	• students • water • candle wax • sources of heat • containers (tins, beakers) • textbooks
	4 explain the meaning of the term *absolute temperature*		• brainstorming the meaning of absolute temperature • discussing the meaning of absolute temperature	• brainstorming • discussion • observation • oral/written questions	• textbooks • students' • experiences

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of the basic principles of thermometry	Students must be able to: 1 differentiate types of temperature scales 2 describe how various thermometers function	**Thermometry**	• discussing the differences • among temperature scales • converting temperature from one scale to another • identifying various types of thermometers - liquid-in-glass thermometer - thermocouple thermometer - constant-volume gas thermometer - resistance thermometer • discussing how various thermometers work by using various thermometers in taking measurements	• discussion • written exercises • problem solving • demonstration • group discussions • oral questions • pair work	• textbooks • charts • calculators • liquid in glass thermometers • thermocouple thermometer • constant-volume gas thermometer • electrical resistance thermometers

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of pressure and its applications	Students must be able to: 1 define pressure	**Pressure**	• defining pressure • stating the SI units of pressure	• discussion • oral/written questions	• textbooks
	2 determine the pressure exerted by regular solids		• describing the pressure exerted by solids • investigating factors that affect pressure exerted by solids • solving problems involving pressure exerted by solids	• discussion • investigations • problem solving	• regular solids of different sizes • regular solids of different densities • spring balances • rulers • triple beam/digital balances
	3 describe experiments to investigate factors affecting pressure in liquids		• investigating factors affecting pressure in liquids • deriving the formula $p = \rho gh$ • solving problems involving pressure in liquids using the formula: $p = \rho gh$	• investigations • experimentations • oral/written questions	• textbooks • tall plastic bottles • beakers • liquids of different densities

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	4 state Pascal's principle of transmission of pressure in fluids		• demonstrating Pascal's principle in liquids • stating Pascal's principle	• demonstration • oral/written questions	• hydraulic jack • syringes of different sizes • water or any fluid • Pascal's vessels
	5 explain atmospheric pressure		• demonstrating atmospheric pressure: - collapsing can experiment - drinking straws - card on bottle/tumbler experiment • discussing atmospheric pressure • describing the effects of atmospheric pressure • measuring atmospheric pressure using a barometer	• investigations • experimentations • oral/written questions • discussion	• test tubes • glass jars • water/mercury • rulers • cards • cans • tumblers • drinking straws • barometer • source of heat

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	6 describe the applications of pressure in fluids		• discussing the applications of pressure • relate fluid pressure to everyday activities • solving problems involving pressure	• discussion • brainstorming • problem solving • written exercises • educational visits • demonstration • field trips	• textbooks • students' experiences • resource persons • hydraulic jacks • internet
	7 explain Archimedes' principle		• discussing Archimedes' principle • verifying Archimedes' principle • discussing the law of floatation • describing the applications of Archimedes' principle and relative density • solving problems involving Archimedes' principle and the law of floatation	• investigations • discussion • problem solving • oral/written reports • demonstration • experimentations	• measuring cylinders • liquids of different densities • corks • masses • balances • displacement can • beakers

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • develop an understanding of behaviour of gases	Students must be able to: 1 discuss gas laws	**Gas laws**	• stating gas laws • discussing gas laws • demonstrating the relationship between pressure and volume at constant temperature (Boyle's law) • investigating the relationship between volume and temperature at constant pressure (Charles' law) • discussing the relationship between pressure and temperature at constant volume (pressure law) • explaining the gas laws using the kinetic theory of gases	• discussion • oral/written reports • demonstration • experimentations • project work: making a model pump	• syringes • bicycle pumps • thermometers • sources of heat • containers • plastic rulers • glass tubing • Boyle's law apparatus • foot pumps • balloons
	2 explain applications of gas laws		• discussing applications of gas laws • solving problems involving gas laws • making a manometer • measuring lung pressure using a manometer	• discussion • problem solving using written exercises • group work	• textbooks • transparent plastics/glass tubing • water

Core element Mechanics

Outcome The student will be able to appreciate and demonstrate the use of appropriate quantities to explain various states of motion including the energy interactions and the changes that take place due to forces.

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of scalar and vector quantities	Students must be able to: 1 define scalar and vector quantities 2 represent vectors 3 add and subtract vectors 4 resolve vectors	**Scalar and vector quantities**	• discussing scalar and vector quantities • discussing distance and displacement • representing vector quantities in magnitude and direction • drawing vectors to scale • discussing the meaning of the term *resultant* • discussing the parallelogram and triangle rules • applying vector addition and subtraction in finding resultant displacement and force • determining the components of vectors • solving problems involving vectors	• explanation • brainstorming • discussion • oral/written questions • observation • demonstration • discussion • demonstration • oral/written questions • oral/written questions • demonstrations	• charts • tape measure • rulers • rulers • pencils • protractors • graph papers • tape measures • charts • rulers • pencils • protractors • graph papers • rulers • pencils • protractors • graph papers

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of forces and their actions in linear motions	Students must be able to: 1 describe distance, displacement, speed, velocity and acceleration 2 conduct experiments to determine velocity and acceleration	**Linear motion**	• demonstrating the difference between distance and displacement by students • discussing the difference between speed and velocity • discussing acceleration • plotting graphs of displacement against time • interpreting the graph of displacement against time. • determining the velocity of students for a given displacement • calculating the velocity of various objects • plotting the graphs of velocity against time • interpreting the graphs of velocity against time	• demonstration • experimentations • group work • individual exercises • oral/ written questions • demonstration • experimentations • group work • individual exercise • oral/written questions	• rulers • pencils • graph papers • stop-watches • tape measures • ticker-timers • ticker tape • trolleys • trolley-tracks • toy-cars • light-gates • textbooks

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	3 determine acceleration due to gravity 4 explain motion-time graphs		• conducting a simple free fall experiment • determining the acceleration due to gravity by using a simple pendulum • plotting and interpreting distance-time graphs • calculating average speed • plotting and interpreting speed-time graphs • recognising from the shape of a distance-time graph when a body is: - at rest - moving with uniform/ constant speed • recognising from the shape of a speed-time graph when a body is: - at rest - moving with uniform speed	• demonstration • experimentation • group work • oral/written questions • discussion • oral/written questions • written reports • brainstorming • demonstration	• pendulum bobs • rulers • pencils • graph papers • stop watches • tape measure • clamp stands • retort stands • strings • ticker-timers • ticker-timer tapes • trolleys • light-gates • masses • strings • pencils • graph papers • rulers • erasers

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
			- moving with uniform acceleration - moving with non-uniform acceleration/deceleration • calculating the area under a speed-time graph to determine the distance travelled for motion with uniform speed or uniform acceleration • describing the acceleration of a body under free-fall near the earth • describing qualitatively the motion of bodies with constant weight falling with and without air resistance (including reference to terminal velocity)		
	5 apply the equations of uniformly accelerated motion		• discussing and describing equations of uniformly accelerated motion • solving problems related to motion	• discussion • problem solving • individual exercises • oral questions • brainstorming	• textbooks • charts • calculators

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of work and energy	Students must be able to: 1 calculate work done	**Work and energy**	• discussing work done by an object on another object • calculating work done by a force acting in the direction of motion • calculating work done by a force acting at an angle to the horizontal direction of motion • solving mathematical problems involving work	• discussions • experimentations • written questions • demonstrations	• inclined planes • masses • strings • spring balances • measuring tapes • 1 metre rulers
	2 explain the conservation of mechanical energy		• demonstrating energy changes (KE and PE) • discussing the law of conservation of mechanical energy • discussing the energy-work theorem • solving problems related to work and energy	• demonstrations • discussions • oral questions	• charts • markers • cello tape • pendulums • loaded springs

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of machines	Students must be able to: 1 describe what machines are	**Machines**	• brainstorming the meaning of machines • discussing examples of machines • demonstrating how some machines work	• brainstorming • discussions • demonstration • oral questions	• pairs of scissors • craw bars • inclined planes • wheelbarrows • pulleys • spanners
	2 explain efficiency, mechanical advantage and velocity ratio of a machine		• brainstorming efficiency, mechanical advantage and velocity ratio of a machine • discussing efficiency, mechanical advantage and velocity ratio of machine	• demonstration • discussion • oral questions • written questions	• pairs of scissors • craw bars • inclined planes • wheelbarrows • pulleys • spanners
	3 calculate efficiency, mechanical advantage and velocity ratio of machines		• discussing the calculation of efficiency, mechanical advantage and velocity ratio • calculating efficiency mechanical advantage and velocity ratio of machine	• discussion • oral questions • written exercise	• pair of scissors • craw bars • inclined planes • wheelbarrows • pulleys

Core element Electricity and magnetism

Outcome The students will be able to understand the laws and principles of electricity, magnetism and then apply this knowledge in areas such as analogue and digital electronic systems.

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of current electricity	1 describe electric current	**Current electricity**	• defining electric current and stating its SI units • describing the direction of electron current • using electron current to determine the equation $I = \frac{Q}{t}$ • solving problems using the equation above	• explanation • brainstorming • group discussion • oral/written questions • demonstration	• students' experiences • textbooks • charts • cells • ammeters • connecting wires • bulbs • bulb holders • crocodile clips • circuit boards
	2 describe potential difference		• defining potential difference and stating its SI units • defining electromotive force • measuring potential difference (pd) and electromotive force (emf) using voltmeters	• explanation • brainstorming • group discussion • oral/written questions • demonstration	• students' experiences • switches • voltmeters • connecting wires • crocodile clips • bulb holders

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	3 describe electrical resistance		• defining electrical resistance and stating its SI units • discussing factors affecting electrical resistance • discussing Ohm's law • verifying Ohm's law • measuring resistance using an ohmmeter • calculating resistance using ohm's law • working out the resistance of resistors using colour codes and standard notation • defining the internal resistance of a cell • using the relationship $E = V + Ir$ to solve related problems	• explanation • brainstorming • group discussion • oral/written questions • demonstration • experimentations	• students' experiences • textbooks • charts • cells • voltmeters • ammeters • circuit boards • switches • multimeters • connecting wires • bulbs • bulb holders • resistance wires of different lengths, diameter and material • ohmic and non-ohmic electrical conductors • resistors of different colour codes • resistors with standard notation

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	4 analyse electric circuits		• determining experimentally the effect of resistors in series and parallel circuits • calculating the net resistance of resistors connected in series and parallel circuits • determining electric currents and voltages in parallel and series circuits	• explanation • brainstorming • oral and written questions • demonstration • discussion • experimentation	• students' experiences • textbooks • charts • cells • voltmeters • connecting wires • switches • resistors • ammeters

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	5 determine electric power and energy		• brainstorming and discussing the meaning of power ratings of electrical appliances • deriving and using the equations: • $P = VI,\ P = I^2R,\ \mathrm{P} = \frac{V^2}{R}$ and $E = Pt$ • discussing kilowatt-hour • expressing electrical energy in kilowatt-hours • finding the cost of electrical energy • interpreting electricity bills • determining power of heating elements • discussing electrical hazards and safety (earthing, fuses, overloading, miniature circuit breakers (MCBs),dampness, insulation and short circuit) • discussing the three pin plug	• explanation • brainstorming • oral and written questions • demonstration • discussion	• students' experiences • textbooks • charts • cells • voltmeters • connecting wires • bulbs • bulb holders • three pin plugs • fuses • electricity bills • chart of electrical appliances with power ratings • energy saver bulbs • switches • resistors • ammeters • immersion heaters • heating elements • electric iron

Core element Oscillations and waves

Outcome The students will be able to understand and apply waves and their properties in designing and developing various technologies in communication, medicine, musical and military equipments.

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of wave properties and their applications	Students must be able to: 1 explain oscillation in relation to a pendulum or a hanging mass on a spring	**Oscillations and waves**	• demonstrating an oscillation • discussing the meaning of oscillation • using an oscillating system to explain: - amplitude - displacement - period - frequency • investigating factors affecting frequency of an oscillating system (pendulum, loaded spring, cantilever)	• demonstration • discussion • oral/written questions • oral or written report • experimentations	• strings • springs • masses • rulers • timers/stop watches • retort stands • clamps • G-clamps

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	2 describe a wave		• producing waves • discussing the meaning of a wave • explaining characteristics of a wave: - amplitude - frequency - velocity - period - phase - wavelength • discussing wave front	• demonstration • discussion • oral/written questions • experimentations	• ropes • slinky springs • ripple tank sets • charts • text books • animation CDs/DVDs
	3 differentiate between a transverse wave and longitudinal wave		• demonstrating transverse and longitudinal waves • defining a transverse and a longitudinal wave • discussing the differences between transverse and longitudinal waves	• demonstration • discussion • oral/written questions	• ropes • slinky springs • ripple tank sets • charts • textbooks • animation CDs/DVDs

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	4 describe wave properties		• describing the following wave properties: - reflection - refraction (including refractive index) - diffraction - interference • demonstrating the wave properties (using water waves, microwaves, radio waves, ropes waves)	• demonstration • experimentations • oral/written questions • illustrations • field visits	• charts • ripple tank sets • obstacles • prisms • glass blocks • light sources • ray boxes • mirrors • animation CDs/DVDs • protractors • pencils • optical pins • loud speakers • signal generators • ropes
	5 apply the wave equation in solving problems		• deriving the relation $v = f\lambda$ • solving problems involving the wave equation • $v = f\lambda = \lambda/T$	• discussions • problem solving • oral/written questions	• textbooks • internet

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an appreciation of sound and its properties	Students must be able to: 1 describe experimentations to show that sound is produced by vibrating bodies	**Sound**	• discussing production of sound • experimenting to show that sound is produced by a vibrating object • demonstrating loudness and pitch of sound • discussing loudness and pitch in terms of wave amplitude and frequency	• experimentation • discussion • reports	• guitars • drums • bells • tuning forks • sonometers • hacksaw blades • rulers • empty bottles • G-clamps • whistles • strings
	2 discuss free vibrations, forced vibrations, natural frequency and resonance		• demonstrating free and forced vibrations. • defining natural frequency, free and forced vibrations and resonance • distinguishing between free and forced vibrations • investigating resonance	• demonstration • discussion • investigation • oral/written reports • experimentation	• guitars • tuning forks • empty bottles • water • strings and masses • resonance set • radios

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	3 explain the nature of sound waves		• investigating the transmission of sound in air and in vacuum • discussing the propagation of sound as a series of compressions and rarefactions • determining experimentally the speed of sound in air • comparing the sound transmission in gases, liquids and solids • solving problems involving velocity of sound	• experimentation • oral/written reports • discussion • demonstration • problem solving • reports	• electric bells • bell jars and accessories • sources of power • vacuum pumps • computer animations/ simulations • slinky springs • textbooks
	4 explain the factors affecting the speed of sound		• brainstorming the factors that affect speed of sound • discussing the factors that affect the speed of sound in media	• brainstorming • discussion • oral reports	• drums/tins • timers • measuring tapes • textbooks

Form 4

Core element Properties of matter

Outcome The students will be able to relate the behaviour of matter from microscopic level to the macroscopic level when subjected to different environments and creatively apply these properties to bring about technological developments at the same time examine the ethical and moral implications of using and applying science.

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of thermal properties of matter	Students must be able to: 1 define temperature	**Thermal expansion**	• brainstorming the meaning of temperature • discussing the concept of temperature • differentiating heat from temperature	• brainstorming • experimentations • discussion • oral questions	• textbooks • beakers • sources of heat • water • thermometers • metal rods
	2 describe thermal expansion in solids, liquids and gases		• demonstrating thermal expansion in solids, liquids and gases • discussing expansion of solids, liquids and gases	• demonstration • experimentations • discussions	• sources of heat • needles or optical pins • thermo flasks • water or any liquid
	3 explain expansion in terms of particle behaviour		• role playing to illustrate particle behaviour in expansion of matter • discussing expansion in terms of particle behaviour	• role play • discussions	• balloons • students • bottle tops or seeds

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	4 describe the unusual expansion of water and its effects 5 explain the effects and applications of thermal expansion		• investigating the expansion of water in frozen state • examining graphs from given data on expansion of freezing water • discussing practical applications of thermal expansion: - separating stuck tumblers - railway line gaps - tooth filling - removing tightly screwed bottle covers - gaps or rollers in bridges - gaps in fences • identifying parts of a bicycle/car where shrink fitting and riveting was used	• investigation • oral/written reports • discussion • discussion • investigation • practical work • demonstration • oral/written questions • field trips	• graph papers • text books • students' experiences • charts • stuck tumblers • tightly screwed bottle tops • glass tubes • rubber bungs • flasks or containers • bicycle

Core element Mechanics

Outcome The student will be able to appreciate and demonstrate the use of appropriate quantities to explain various states of motion including the energy interactions and the changes that take place due to forces.

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of forces and their actions in linear motions	1 describe Newton's laws of motion	**Newton's laws of motion**	• demonstrating the three laws of motion • discussing the three laws of motion • stating Newton's laws of motion • deriving the equation $F = ma$ • discussing the applications of the laws of motion	• discussion • oral/written questions • demonstration • brainstorming	• students' experiences • textbooks • calculators • spring balances • rubber bands • trolleys • linear air track
	2 describe simple experimentations to illustrate inertia		• demonstrating inertia • discussing inertia	• demonstrations • discussions	• masses • containers • coins • cardboards • papers • tumbler • cup

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	3 describe the law of conservation of linear momentum		• describing linear momentum • discussing the law of conservation of linear momentum • demonstrating the collisions of various objects • solving problems involving collisions	• brainstorming • discussion • demonstration • oral questions • written questions	• linear air tracks • light gates • timers
	4 describe applications of frictional force	**Frictional force**	• discussing coefficient of friction (horizontal planes only) • calculating the frictional force using normal force (horizontal planes only, $F = \mu N$)	• discussion • individual exercises • oral/written questions • question and answers	• textbooks • calculators • spring balances • masses • smooth and rough surfaces • strings

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	5 explain terminal velocity	**Terminal velocity**	• demonstrating the falling of objects in a vacuum and in fluids • describing the falling of objects in a vacuum and in fluids • discussing factors that affect falling objects. • investigating terminal velocity	• demonstration • discussions • brainstorming • peer assessment	• free fall apparatus • vacuum pump • textbooks • fluids of different viscosity • ball bearings • rubber bands • measuring cylinder or long glass tubes • stop watches • metre rules • computer animations/ assimilations

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of the behaviour of elastic materials under tension	Students must be able to: 1 explain the effects of force	**Hooke's law**	• stating that a force may produce a change in size and shape of an object • discussing effects of forces on various objects • demonstrating effects of force on various objects including elastic materials	• discussion • demonstration • oral/written questions	• rubber bands • textbooks • flexafoams • expendable springs • retort stand • bosses • clamps • rulers
	2 verify Hooke's law experimentally		• stretching elastic materials within elastic limit • plotting and interpreting extension-load graphs for an elastic spring within the elastic limit	• experimentation • discussion • observation	• textbooks • expendable • springs • retort stands • bosses • clamps • graph papers • pencils • rulers

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	4 apply Hooke's law in solving related problems		• constructing and calibrating a spring balance • extending springs in parallel and in series • determining the spring constant for various springs • solving problems involving Hooke's law	• experimentation • discussion • observation • reports • oral and written questions	• textbooks • various expendable springs • masses • retort stands • bosses • clamps • graph papers • pencils
	5 explain the significance of the term limit of proportionality for an elastic solid.		• stretching elastic materials beyond elastic limit • plotting and interpreting extension load graphs for an elastic spring beyond the elastic limit	• experimentations • discussion • observation • demonstration	• textbooks • expendable springs • masses • retort stands • bosses • clamps • graph papers • pencils • rubber bands

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of circular motion	Students must be able to: 1 differentiate angular displacement and angular velocity	**Uniform circular motion**	• demonstrating circular motion • discussing circular motion • defining angular displacement and angular velocity • discussing angular displacement and velocity • discussing relationship between tangential (linear) velocity and angular velocity	• demonstration • observation • discussion	• strings • masses • textbooks
	2 describe simple experimentations to illustrate centripetal force		• conducting experimentations • demonstrating objects in circular motion	• demonstration • observation • report • group work • experimentation	• textbooks • strings • spring balances • masses
	3 apply principles of uniform circular motion		• solving problems involving uniform circular motion • discussing applications of circular motion in everyday life	• discussions • oral/written questions • brainstorming • field trips	• textbooks • students' experiences

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of moments of forces	Students must be able to: 1 describe moment of a force 2 apply principle of moments in everyday life	**Moments of forces**	• discussing the meaning of moments of forces • verifying the principle of moments using pivots and objects • stating the principle of moments for a body in equilibrium • discussing the relationship between force and torque • solving problems using the principle of moments. • discussing systems involving moments • determining centre of mass in lamina and uniform rods	• discussion • demonstration • experimentation • group discussions • self assessment • oral/written questions • field trips • experimentation • reports	• textbooks • hinged objects • pivot/wedge • beam/half metre rule • triple beam balances • masses • students' experiences • bicycle • bottle openers • door • retort stands • bosses • clamps • cardboard papers • strings • nails • masses • spanners

Core element Electricity and magnetism

Outcome The students will be able to understand the laws and principles of electricity, magnetism and then apply this knowledge in areas such as analogue and digital electronic systems.

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of magnetism and electromagnetism	Students must be able to: 1 describe magnetisation and demagnetisation 2 describe electromagnetism	**Magnetism and electromagnetism**	• discussing magnetisation and demagnetisation • investigating magnetisation and demagnetisation • discussing magnetisation and demagnetisation in terms of domains • investigating electromagnetism • investigating field patterns of electromagnets • describing magnetic fields of current-carrying conductors - straight wire - loop - solenoid • discussing the force on current-carrying conductor in a magnetic field of a bar magnet	• explanation • group discussion • oral and written questions • demonstration • experimentations • discussion • experiments • group work • oral/written questions • explanation	• students' experiences • textbooks • connecting wires • steel bars • ac and dc power supplies • hammers • solenoids • bar magnets • textbooks • connecting wires • soft iron bars • plotting compasses • horse-shoe magnets • solenoid • cells

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	3 explain uses of electromagnetism		• discussing Fleming's left-hand rule • applying Fleming's left-hand rule • performing simple experimentations to illustrate electromagnetic induction. • stating the factors that affect magnitude and direction of the induced emf • stating the laws of electromagnetic induction (Faraday's law and Lenz's law – descriptive, no equations) • explaining the working of an alternating current (ac) and direct current (dc) generators	• experimentation • discussion • demonstration • oral/written questions • observation	• dc power supplies • solenoids • nails and coils • bar magnets • iron fillings • galvanometer • connecting wires • transformers • ac power supplies • voltmeters • cathode ray • oscilloscopes

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
			• describing the working of a dc motor • explaining the working of a transformer and power transmission • discussing power loss in transmission line and in transformers • discussing ways of minimising power losses in transmission and transformers • discussing environmental impact of power generation and transmission (hydro, nuclear, fossil fuels, solar, geothermal energy and biomass) • solving mathematical problems involving transformers • making and testing a simple transformer and an electric motor (project)	• explanation • discussion • experimentations • observation • field visit • oral/written exercises	• horse shoe magnets • model motors • ac power supply

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of basics of electronics	Students must be able to: 1 discuss semiconductor devices	**Introduction to digital electronics**	• discussing the differences between conductors, semiconductors and insulators (Band Theory) • explaining the difference between intrinsic and extrinsic semiconductors • discussing doping of semiconductors (*N*-type and *P*-type) • explaining the operation of a *P-N* junction diode • sketching the current-voltage characteristics for a forward biased diode	• experimentations • discussion • demonstration • oral/written questions	• textbooks • cathode ray oscilloscopes • connecting wires • dc power supplies • diodes • load resistor • insulators

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	2 discuss electronic components and their uses		• identifying electric circuits symbols for electronic devices (capacitors, inductors, light dependent resistors, diodes, transistors, light emitting diodes(LEDs), photovoltaic cell, logic gates, thermistors) • describing uses of the electronic devices	• experimentations • discussion • demonstration • oral/written questions	• text books • charts • capacitors • inductors • light dependent resistors • diodes • transistors • light emitting diodes • photovoltaic cells • logic gates • thermistors • breadboard • component holders

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	3 describe analogue and digital circuits		• discussing meaning of digital electronics • discussing the difference between analogue and digital circuits • explaining the characteristics of analogue and digital signals • discussing the application of diode in half-wave and full-wave rectification • describing the basic structure and operation of a bipolar transistor (*N-P-N)* • discussing how a light operated switch works	• experimentations • discussion • demonstration • oral/written questions	• text books • cathode ray oscilloscopes • connecting wires • signal generators • diodes • resistors • ac supply • light dependent resistor • digital modules (diodes, • dual power supplies, integrated circuits for various gates, resistors, capacitors, transistors, transformers, phototransistors, LEDs, LED digital display)
	4 describe the operations of basic logic gates		• discussing the operations of logic gates (AND gate, OR gate, NOT gate, NOR gate, NAND gate) • identifying the symbols of the logic gates • constructing the truth tables of the logic gates	• experimentation • discussion • demonstration • oral/written questions	

Core element Oscillations and waves

Outcome The students will be able to understand and apply waves and their properties in designing and developing various technologies in communication, medicine, musical and military equipments.

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of electromagnetic waves and their properties	Students must be able to: 1 describe the electromagnetic spectrum	**Electromagnetic waves**	• analysing the electromagnetic spectrum in terms of energy, frequency and wavelength • discussing the sources of electromagnetic waves	• discussion • oral/written reports • question and answer • demonstration	• charts • text books • infrared (IR) detectors • spectrum projectors • white screens • galvanometers
	2 explain the properties of electromagnetic waves		• brainstorming the properties of electromagnetic waves • discussing the properties of electromagnetic waves	• brainstorming • discussions • oral/written questions	• textbooks • students' experiences • charts

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	3 describe the methods of detecting electromagnetic waves		• demonstrating detection of electromagnetic waves • discussing methods of detecting electromagnetic waves	• demonstrations • discussion • reports	• Geiger-Muller tubes • mild radioactive substances (sources) • photographic films • gold-leaf electroscopes • photographs of x-rays • hot objects
	4 describe the applications of electromagnetic wave		• exploring the applications of electromagnetic waves • discussing the uses of electromagnetic waves	• exploration • discussion • oral/written questions • field trips	• resource persons • charts • text books • internet
	5 apply wave equation in solving problems concerning electromagnetic waves		• discussing problems concerning electromagnetic waves • solving problems using the wave equation: $c = f\lambda$	• problem solving • discussion	• textbooks • calculators

Assessment standard	**Success criteria**	**Theme/topic**	**Suggested teaching and learning activities**	**Suggested teaching, learning and assessment methods**	**Suggested teaching and learning resources**
We will know this when the students are able to: • demonstrate an understanding of light and its applications	Students must be able to: 1 describe converging and diverging lenses	**Light and lenses**	• describing converging and diverging lenses • discussing, with reference to diagrams, the terms associated with converging lenses	• discussion • oral/written questions • exercises	• pencils • rulers • erasers • lenses • lens holders • ray boxes/light sources
	2 determine the focal length of a converging lens		• finding the focal length of a converging lens experimentally using a distant object and mirror method • finding the focal length of a converging lens experimentally using graphical method • interpreting the graphs	• problem solving • oral/written questions • experimentation • discussions • exercises	• pencils • rulers • erasers • graph papers • lenses of different focal lengths • mirrors • light sources • screens • lens holders

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	3 explain image formation by converging lens		• investigating the position, size and nature of the image formed by a converging lens	• experimentation • discussion • oral/written questions	• lenses • screens • meter rulers • light sources • textbooks • lens holders
	4 describe image formation using ray diagrams		• drawing ray diagrams • determining the position, size and nature of images using ray diagrams • deducing the magnification of an image	• discussions • experimentations • written exercises	• pencils • rulers • screens • lenses • light sources • text books
	5 solve problems involving the lens and magnification formulae		• deriving the lens formula • solving problems involving converging lenses • using magnification formula	• demonstration • problem solving • oral questions • written exercises	• textbooks • charts • scientific calculators

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	6 describe the applications of lenses in various optical devices		• discussing parts of a simple camera and their functions • constructing a simple camera (project) • discussing parts of a slide/film projector and their functions • drawing ray diagrams to locate position and size of an image formed by a camera and projector • discussing parts of a telescope and their functions • making a telescope (project)	• discussion • project • oral/written exercises • demonstration	• pin hole cameras • pencils • rulers • text books • charts • slide projectors • optical cameras
	7 explain image formation in the human eye		• drawing and labelling parts of a human eye involved in image formation • explaining how the human eye forms an image using ray diagrams • comparing a camera to human eye	• discussion • oral questions • written exercises • group work	• pencils • erasers • charts • text books • models of the human eye • telescope

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	8 describe the defects of vision in the human eye and how they can be corrected		• explaining short sightedness and its correction using ray diagrams • explaining long sightedness and its correction using ray diagrams	• discussion • oral /written exercises	• students 'experiences • charts • text books • pencils • rulers

Core element Nuclear physics

Outcome The students will be able to appreciate principles of radioactivity and how radioactive materials are safely handled, used and stored.

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of the atomic nuclei	Students must be able to: 1 describe the nuclear structure of an atom	**Isotopes**	• describing the structure of an atom • identifying the constituent particles of a nucleus • drawing diagrams of the atomic nuclei • representing the nucleus using the nuclear notation	• explanation • discussion • oral/written • questions • observation • demonstration	• textbooks • periodic tables • charts • models of atoms
	2 describe isotopes		• discussing isotopes • listing examples of isotopes • explaining, using nuclide notation, how one element may have a number of isotopes	• explanation • discussion • brainstorming • oral/written questions • observation • demonstration	• textbooks • periodic tables • charts

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
We will know this when the students are able to: • demonstrate an understanding of radioactivity	Students must be able to: 1 explain radioactivity	**Radioactivity**	• defining radioactivity • discussing natural and induced radioactivity	• discussion • oral and written questions	• textbooks • periodic tables • charts
	2 describe radioactive emissions		• discussing the types of radiations • discussing half-life of isotopes • solving problems involving half-life of isotopes • explaining ways of detecting radioactive emissions • defining nuclear fission and fusion • discussing balanced nuclear equations (fission and fusion)	• explanation • discussion • brainstorming • oral and • written questions • demonstration	• textbooks • periodic tables • charts • radioactive sources (standardized) • Geiger-Muller tubes • ratemeters (counters)

Assessment standard	Success criteria	Theme/topic	Suggested teaching and learning activities	Suggested teaching, learning and assessment methods	Suggested teaching and learning resources
	3 discuss dangers and applications of radioactivity		• discussing dangers of radioactive emissions • describing methods of how radioactive materials are safely handled and stored • discussing the applications of radioactivity: - nuclear power generation - agricultural/biochemical tracers - industrial - medical (radiotherapy) - sterilization/food preservation - radio carbon dating	• field trips • brainstorming • oral and written questions • demonstration • field trips	• textbooks • periodic tables • charts • radioactive sources (standardized) • Geiger-Muller tubes • (counters)

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