Republic of Zambia

SCIENCE
SENIOR SECONDARY SCHOOL SYLLABUS

GRADES 10 – 12

Prepared by:
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CONTENT

PREFACE

The review of this Syllabus was necessitated by the need to improve the quality of education at Senior Secondary School Level as stipulated in the national policy document "**Educating Our Future - 1996".**

Quality education raises the standard of living for all. This leads to sustainable national development. The syllabus also addresses issues of national concern such as Environmental Education, Gender and Equity, Health Education and HIV/AIDS, Family Life Education, Human Rights, Democracy, Reproductive Health, Population Education, Entrepreneurship and Vocation Skills, Life and Values Education.

Another reason for revising this syllabus was to provide linkages with the Junior Secondary School level science which serves to be a prerequisite for senior school science.

It is hoped that this syllabus will provide the users with a sound premise on the basis of which meaningful and effective learning experiences will be developed in order to provide a good foundation for further study of this subject area.

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INTRODUCTION

This syllabus is designed for Grades 10-12. It is intended for pupils not taking Chemistry and Physics as separate subjects.

General Aims

The syllabus aims at providing, through well designed studies of experimental and practical science, a worthwhile educational experience for all the pupils taking the course, whether or not they go on to study science beyond High School level, thereby, contributing to pupils' general education by using the impact of known applications of science concepts and principles on society. This is intended to enable pupils acquire adequate understanding and knowledge so that they can:

- become confident citizens in a technological world, able to make appropriate decisions in scientific matters;
- recognise the usefulness and limitations of the scientific method and, furthermore, appreciate its applicability in everyday life;
- suitably prepare for studies beyond High School level in Science.

The course also aims at developing the following in the pupils:

- abilities and skills that
  - are relevant to the course and practice of science;
  - are useful in everyday life;
  - encourage efficient and safe practice;
  - encourage effective communication;

- attitudes relevant to science; for example
- accuracy and precision;
- objectivity;
- integrity;
- enquiry;
- initiative; and
- inventiveness or creative thinking
- Critical thinking.

Furthermore, the course aims at stimulating interest in and care for the environment and promotes an awareness that the:

- study and practice of science are co-operative and cumulative activities that are subject to social, economical, technological, ethical and cultural influences and limitations;
- applications of science can be both beneficial and detrimental to the individual, to the community, society and the environment.

In addition to the content objectives, objectives under the following should be achieved by pupils:

- Knowledge with understanding

They should demonstrate knowledge and understanding in relation to the following:

- Scientific phenomena, facts, laws, definitions, concepts, theories;
- Scientific vocabulary, terminology, conventions; symbols, quantities and units;
- Scientific instruments and apparatus, including techniques of operations and aspects of safety;
- Scientific quantities and their determination;
- Scientific and technological applications with their social, economic and environmental implications.

- Handling information and solving problems

In words or using symbolic, graphical and numerical forms they should be able to:

- locate, select, organise and present information from a variety of sources;
- translate information from one form to another;
- manipulate numerical and other data;
- use information to identify patterns, reports trends and draw inferences;
- present reasonable explanations for phenomena, patterns and relationships;
- make predictions and propose hypotheses; and
- solve problems.

- **Experimental skills and investigations**

As the pupils study Science they should be able to:

- follow a sequence of instructions;
- use techniques, apparatus and materials;
- make and record observations, measurements and estimates;
- interpret and evaluate observations and experimental results;
- plan an investigation, select techniques, apparatus and materials; and
- evaluate methods and suggest possible improvements.

General Structure of the syllabus

This syllabus is divided into 13 units. The sequence of the Units is not intended to suggest a teaching order. It is hoped that teachers will be flexible when planning their lessons.

Each of the units is described under the headings of "Content", "Objectives" and "Notes". The column headed "Notes" is intended as an extension and illustration of the objectives and is not to be regarded as exhaustive. The teacher can extend it by relating the factual contents and objectives of the syllabus to social, economic and industrial life at both national and local levels as appropriate as possible.
It is envisage that an experimental approach will be adopted and that pupils spend adequate time on individual experimental work.

Mathematical Requirements

The study of Science through this syllabus strengthens the applications of mathematical skills. It is assumed that the pupils are competent in the following mathematical techniques:

- taking accurate accounts of numerical work and handling calculations so that significant figures are neither lost unnecessarily nor carried beyond what is justified;
- making approximate evaluation of numerical expressions;
- formulating simple algebraic equations as mathematical models and be able to solve them;
- changing the subject of a formula;

- expressing small changes or errors as percentages;
- calculating areas of various shapes;
- dealing with vectors in all simple forms;
- plotting results graphically after selecting appropriate variables and scales;
- interpreting, analysing and translating graphical information;
- making calculations involving additions, subtraction, multiplication and division of quantities;
- expressing small fractions as percentages and vice versa;
- calculating an arithmetic mean;
- transforming decimal notation to power of ten notation (standard form);
- use tables or calculators to evaluate logarithms (for calculations), squares, square roots and reciprocals;
- changing the subject of an equation. (these may involve simpler operations that may include positive and negative indices and square roots);
- substituting physical quantities into an equation using consistent units so as to calculate one quantity (e.g. the units of a rate constant K);
- solving simple algebraic equations;
- comprehending and using the symbols/notations;
- testing tabulation pairs of values for direct proportionality by graphical method or by constancy of ratio;

Examination

Assessment objectives will be weighed as follows:

- knowledge with understanding, approximately 65% and recall approximately 30% of the marks;
- Handing information, approximately 35% of the marks.

Learners are expected to enter for Paper 1, 2 and 3

Paper	Type of Paper	Duration	Marks
1	Multiple-choice	1 hr	40
2	Theory (Physics)	1 hr 15 min	65
3	Theory (Chemistry)	1 hr 15 min	65

Paper 1 (1hr; 40 marks)

Paper 1 will contain forty multiple-choice questions. These will cover approximately equal parts of the Physics and Chemistry Sections of the syllabus.
Paper 2 (11/4h; 65 marks)

Section A of this paper will contain a number of compulsory short-answer and structured questions.

Section B of this paper will contain three free-response questions of 10 marks each (Candidates will answer any two of these questions).

Paper 3 (11/4h; 65 marks)
Section A of this paper will contain a number of compulsory short-answer and structured questions.
Section B of this paper will contain three free-response questions of 10 marks each (Candidates will answer any two of these questions).

SCOPE and SEQUENCE

The following table shows the "Scope and Sequence" of Science syllabus from G10 to G12.

SECTION A: PHYSICS

Grade 10		Grade 11		Grade 12	
UNIT 1.0 GENERAL PHYSICS	**SUBTOPIC**	**Unit 3 Thermal Physics**	**SUBTOPIC**	**Unit 8 Static electricity**	**SUBTOPIC**
	10.1.1 International System of Units		11.3.1Simple kinetic theory of Matter.		12.8.1 Static Electricity
	10.1.2 Length and time		11.3.2 Measurement of temperature	**Unit 9 Current electricity**	12.9.1Electric charge, current, and potential difference.
	10.1.3 Mass and, weight		11.3.3 Expansion of solids, liquids and gases.		12.9.2 Electric cells.
	10.1.4 Density		11.3.4 Heat transfer by conduction, convection and radiation.		12.9.3 Electrical resistance
Unit 2 Mechanics	10.2.2 Linear motion				12.9.4 Heating effect of an electric current
	10.2.3 Forces	**Unit 4 Wave motion**	11.4.1 Simple ideas of the wave motion theory.		12.9.5 Magnetic effects of electric currents
	10.2.4 Moment of forces		11.4.3 Electromagnetic spectrum	**Unit 10 Electromagnetic induction**	12.10.1 The phenomenon of electromagnetic induction

	10.2.5 Work, Energy and Power.	**Unit 5 Sound**	11.5.1 Properties of sound		12.10.2 The simple A.C. and D.C. generators
	10.2.6 Simple machines	**Unit 6 Light**	11.6.1 Rectilinear propagation of light.		12.10.3 Transformers
			11.6.2 Refraction of light	**Unit 11 Basic electronics**	12.11.1 Thermionic emission and electrons.
			11.6.3 Lenses.		
		Unit 7 Magnetism	11.7.1 Simple phenomenon of magnetism	**12.12. Atomic physics**	12.12.1 Nuclear atom 12.12.2 Radioactivity

SECTION B: CHEMISTRY

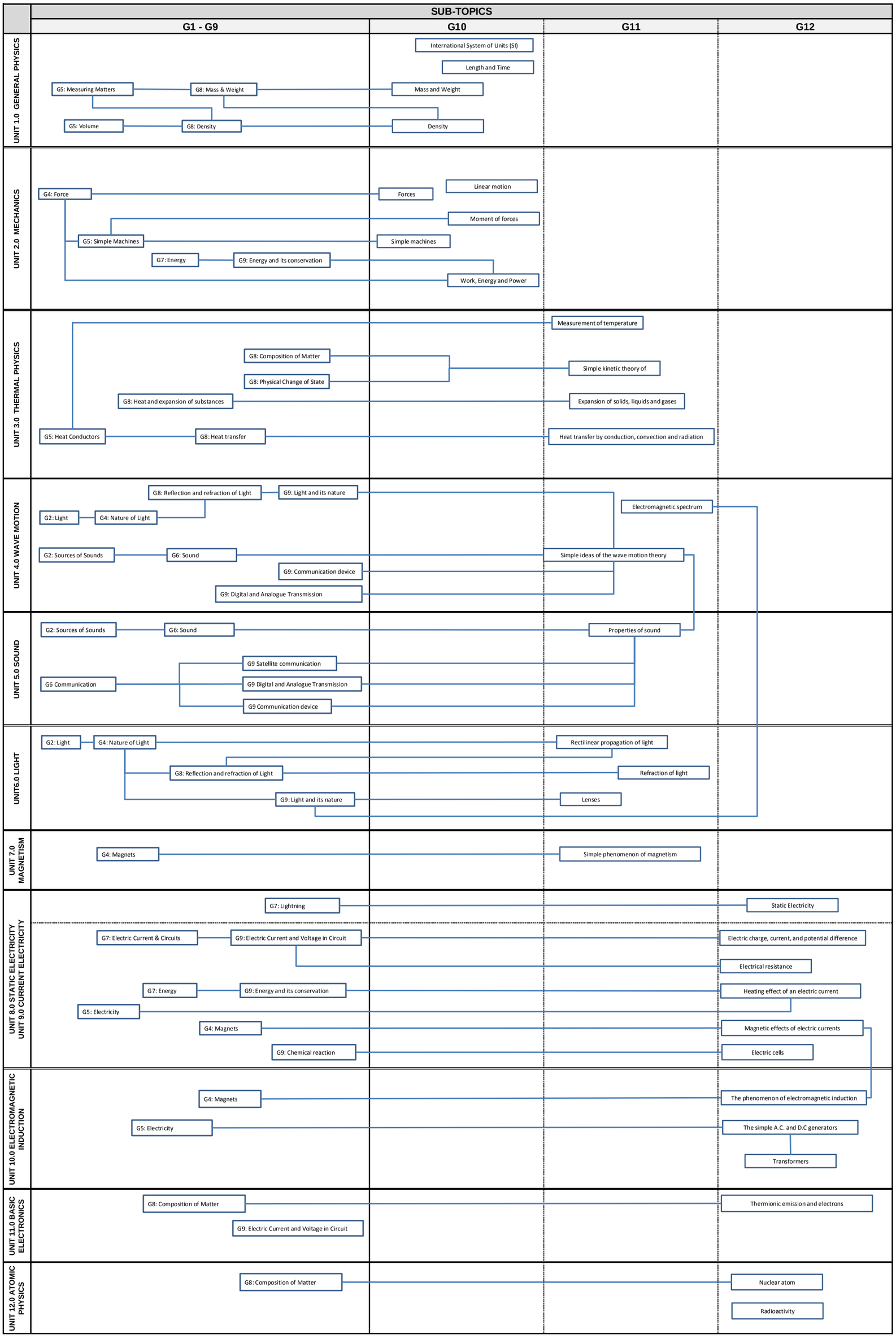
Grade 10		Grade 11		Grade 12	
Unit 1 Introduction to Chemistry	**SUBTOPIC**	**Unit 5 Acids, Bases and Salts**	**SUBTOPIC**	**Unit 10 Metals**	**SUBTOPIC**
	10.1.1 Introduction to Chemistry		11.5.1 Characteristic properties of acids and bases		12.10.1 General properties of a metals
Unit 2 The Particulate nature of matter	10.2.1 Matter and the Kinetic theory		11.5.2 Preparation of salts		12.10.2 Reactivity and Electro Chemical Series
	10.2.2 Diffusion		11.6.3 Types of oxides		12.10.3 Alloys
Unit 3 Experimental Techniques	10.3.1 Measuring of quantities		11.6.4 Identification of ions and gases (Qualitative analysis)		12.10.4 Corrosion
	10.3.2 Criteria of purity	**Unit 6 The mole concept**	11.6.1 Relative masses	**Unit 11 Non Metals**	12.11.1 General properties of non-metals
	10.3.3 Separating mixtures		11.6.2 The mole		12.11.2 Hydrogen
Unit 4 Atoms, elements, compounds and molecules	10.4.1 Atomic structure and Periodic Table				12.11.3 Oxygen
	10.4.2 Bonding	**Unit 7 Chemical reactions and energy changes**	11.7.1 Rates of chemical reactions		12.11.4 Nitrogen
	10.4.5 Chemical formulae and equations				12.11.7 Carbon and carbonates
				Unit 12 Organic Chemistry	12.12.1 Saturated and unsaturated Hydrocarbons
					12.12.2 Alcohols (Alkanols)

		Unit 8 **The Periodic Table**	**11.8.1** Groups and periods		12.12.3 Carboxylic acids (alkanoic acids
			11.8.2 Groups and Periodic trends		12.12.4 Esters (Alkanoates)
			11.8.3 Transition metals		12.12.5 Homologous series
					12.12.6 Macromolecules (Polymers)

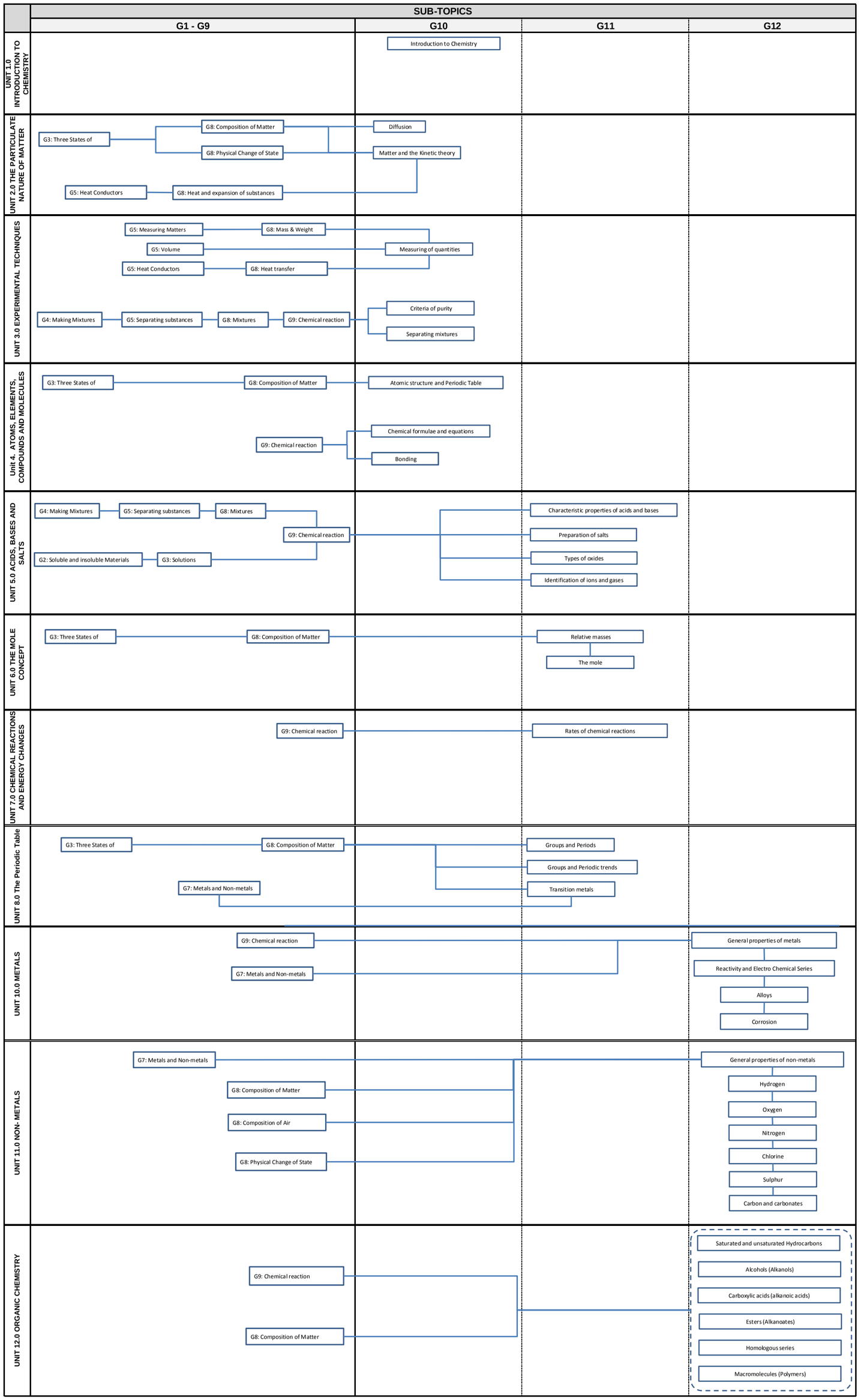
SUBTOPIC-BASED FLOWCHART

The following chart shows the linkage of each sub-topic from G1 to G12. The relevant sub-topics are connected with solid lines.

Subtopic-based Flowchart: Section A



Subtopic-based Flowchart: Section B



SECTION A: PHYSICS

Grade 10

Key competences

- Demonstrate ability to measure length, time, mass, weight and volume
- Show skills and knowledge to calculate density, speed, velocity, acceleration and force
- Demonstrate ability to use different sources of energy
- Demonstrate ability to use simple machines to do work

UNIT 1.0 GENERAL PHYSICS

General Outcomes:

- Develop an understanding of General Physics
- Develop investigative skills

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
10.1 General Physics	10.1.1 International System of Units (SI).	10.1.1.1 Distinguish between basic and derived quantities	• The difference between basic and derived quantities: Basic quantities; mass, length, time etc Derived quantities: force, acceleration, velocity etc	• Comparing basic quantities and derived quantities. • Expressing numbers in scientific notation	• Asking questions about physical quantities • Participating in group actively
		10.1.1.2 Identify basic units and derived units.	• Basic and Derived units: Basic units: metre(m), kilogram(Kg), seconds(S) ,Kelvin(K) Derived unit: Newton(N),metre per	• Specifying number of significant figures	• Applying numbers in standard form

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		10.1.1.3 Recognise prefixes, multiples and submultiples of fundamental and derived units. 10.1.1.4 Use scientific notation and significant figures in numerical problems.	square second(m/s^2) • Fundamental and derived units: Prefixes, multiples and submultiples of basic and derived unit • Scientific notation and significant figures		
	10.1.2 Length and time	10.1.2.1 Demonstrate the use of various measuring instruments to determine length 10.1.2.2 Demonstrate the use of clocks and devices for measuring an interval of time 10.1.2.3 Identify factors that affect the period of a simple pendulum	• Use of measuring instruments: such as rules, vernier calipers and micrometer screw gauge to measure the physical quantity of length • Use of devices for measuring time: Using clocks to measure time intervals and period of pendulum • A simple pendulum: Factors affecting the period of pendulum such as length and amplitude	• Measuring lengths of different objects • Measuring an interval of time using clocks • Communicating factors affecting the period of pendulum	• Participating in group actively • Asking questions for more understanding • Applying the use of clocks and devices to determine the period of pendulum

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	10.1.3 Mass and, weight	10.1.3.1 Distinguish between mass and weight 10.1.3.2 Demonstrate how to measure mass and weight 10.1.3.3Demonstrate how to locate the centre of mass of an object 10.1.3.4 Describe qualitatively the effect of the position of the centre of mass on the stability of an object.	• Differences between mass and weight in terms of units, measuring instrument and quantities • Instruments for measuring mass and weight: Using Triple beam balances and spring balances to measure mass and weight • How to locate the centre of mass of an object: Use of lamina to locate centre of mass of an object • Stability of objects in terms of the position of the centre of mass e.g. equilibrium (stable ,unstable and neutral)	• Comparing mass with weight • Measuring mass and weight of objects • Investigating the centre of mass of objects • Communicating conditions for stability of objects, e.g. base, position of centre of mass	• Asking questions for more understanding • Appreciating the use of beam and spring balances • Participating in group actively in locating the centre of mass

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	10.1.4 Density	10.1.4.1 Determine the density of floating objects 10.1.4.2 Determine the density of a mixture of liquids 10.1.4.3 Describe what relative density is 10.1.4.4 Calculate relative density of air	• Density of floating objects: e.g. cork • Density of miscible liquids: e.g. alcohol and water ($\rho=(m_1+m_2)/(v_1+v_2)$) • What relative density is: Relative density as ratio without units • Calculation of relative density: Use of formula; Relative density of substance (relative density =density of substance/density of water)	• Calculating the density of a floating object using displacement method • Comparing the densities of other objects	• Participating in a group actively • Asking questions for more understanding

UNIT 2.0 MECHANICS

General Outcomes:

- Demonstrate an understanding of mechanics
- Develop investigative skills

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
10.2 Mechanics	10.2.1 Linear motion	10.2.1.1 Describe the terms used in mechanics. 10.2.2.2 Demonstrate the use of equations of uniformly accelerated motion to solve problems 10.2.2.3 Interpret graphical representation of distance-time, Displacement -time, speed-time, velocity-time and acceleration-time. 10.2.2.4 Investigate the consequences of over speeding	• Terms used in machines: such as distance, displacement, speed, velocity, acceleration • Use of the following equations of motion ($v = u + at$, $s = (v + u)t/_2$, $s = ut + ½ at^2$ $v^2 = u^2 + 2as$) • Graphical representation of motion in terms of ; rest, constant speed and constant acceleration • Consequences of over speeding e.g. brake failure resulting into car crush	• Comparing distance with displacement; speed with velocity • Classifying appropriate equation (s) of motion to solve particular numerical problems • Plotting and interpreting graphs • Predicting which object in motion would be damaged the most e.g. a slow moving vehicle or a fast moving vehicle , if they hit an obstacle	• Participating in a group actively • Appreciate the use of equations of motion to solve problems • Appreciating graphs • Appreciating speed limits , road humps, speed traps etc • Appreciating the use of parachutes from height

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		10.2.2.5 Describe the acceleration of free fall for a body near the earth. 10.2.2.6 Describe qualitatively the motion of bodies falling in a uniform gravitational field with and without air resistance	• Acceleration of free fall for a body near the earth it is constant (approximately 10m/s^2) • The falling motion of bodies in a uniform gravitational field: falling terminal velocity	• Calculating acceleration of a body due gravity • Communicating the cause and effect relationship of terminal velocity	
	10.2.3 Forces	10.2.3.1 Explain what force is. 10.2.3.2 Explain the effect of forces on bodies. 10.2.3.3 Describe the inertia law	• The definition of force: Force as “Pull” or “push • Effects of forces :change in shape, change in size, change direction, change of motion (acceleration or retardation) • Resistance to change in state of motion (Newton’s 1st law)	• Communicating the effects of a force using a spring , trolley, Ticker Tape Timer etc • Investigating the relationship between mass and acceleration, e.g. higher inertia is due to larger mass	• Participating in a group actively • Appreciating the use of safety belts on vehicles • Appreciating Newton’s second law of motion • Giving a presentation of group work

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		10.2.3.4 Demonstrate the relationship between force and acceleration 10.2.3.5 Demonstrate the relationship between mass and acceleration.	• The relationship between force and acceleration: A constant force produces a constant acceleration • The relationship between mass and acceleration: Increase in mass results in reduction in acceleration (mass is inversely proportional to acceleration for a constant force)	• Describing the relationship between mass and acceleration • Organizing the data of investigation in a table	• Knowing the safety rules of investigation
		10.2.3.6 Perform calculations on force. 10.2.3.7 Investigate the effect of force on a spring. 10.2.3.8 Demonstrate the effects of friction on the motion of a body. 10.2.3.9 Describe the motion in a circular path due to a perpendicular force.	• How to calculate force: Using formula; Force = mass ×acceleration • Hooke's law (F α e) including graphs. • Effects of friction e.g. heat, wear and tear • Centripetal force: ($F=m(v^2/r)$) and centrifugal force	• Calculating force, mass and acceleration • Communicating the effects of friction	• Applying the restoration force in devises • Participating in class discussion

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	10.2.4 Moment of forces.	10.2.4.1 Perform calculations based on the principle of moments. 10.2.4.2 Investigate the everyday application of moments.	• Mass, weight and distance of a uniform object e.g. metre rule, metal bar, plank etc based on the principle • Application of moments e.g. opening a door or window, opening a bottle with an opener, a see-saw, turning a tap on, tightening a nut with a spanner etc	• Experimenting the principle of moments • Calculating mass ,weight and perpendicular distances	• Participating in a group actively • Justifying why handles of certain objects are long. e.g. a spanner , wheelbarrow etc
	10.2.5 Work, Energy and Power.	10.2.5.1 Explain the meaning of the terms work, energy and power. 10.2.5.2 Identify the units of measurement for work, energy and power	• The definition of Work, Energy and Power: Work (force x distance in direction of force) Energy(ability to do work) Power(rate of doing work) • The units of work, energy and power : Work(joule), Energy(joule) and Power (watt)	• Communicating work, energy and power • Communicating the SI units for work, energy and power • Calculating work, energy and power using appropriate formulae	• Justifying importance of conserving sources of energy • Cooperating in group activities • Appreciating the use of clean energy (pollution free energy) • Cooperating in group activities

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		10.2.5.3 Calculate work using the appropriate formula 10.2.5.4 Identify the different forms of energy 10.2.5.5 Explain qualitatively and quantitatively the terms gravitational potential and kinetic energy. 10.2.5.6 Describe sources of renewable and non renewable energy.	• The formulae of work: Work = (Force) x (distance moved in the line of action of the force) • Different Forms of energy: e.g. mechanical (Kinetic and gravitational potential energy), Chemical, electrical energy etc • Potential and Kinetic Energy: Gravitational potential energy(energy due to position), Kinetic energy(energy due to motion) **NB**: Gravitational potential energy (E_P = mgh) and kinetic energy (E_K = $1/2mv^2$) • Renewable and non-renewable energy: Renewable sources of energy: (solar, wind, hydroelectric , geothermal, bio-gas) Non-renewable energy(chemical/fuel, nuclear energy)	• Analyzing different forms of energy and there sources • Comparing different forms of energy • Communicating renewable and non-renewable resources • Observing the effects of energy sources on the environment • Demonstrating energy transformations • Describing the law of conservation of energy	• Being aware that some energy sources are non renewable • Participating actively in groups • Asking questions for more understanding • Applying the law of conservation of energy

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		10.2.5.7 Explain the effects of the use of energy sources on the environment. 10.2.5.8 Demonstrate energy transformation from one form to another 10.2.5.9 Describe the conservation of energy 10.2.5.10 11Demonstrate the calculation of efficiency of energy conversion using the appropriate formula 10.2.5. 12Demonstrate calculation of power using the appropriate formula	• Effects of use of energy sources on the environment: e.g. air pollution, water pollution, deforestation, land degradation etc • Transformation of energy: e.g. chemical energy(Battery) to electric energy (wire)to light energy(bulb) • Principle of conservation of energy • Calculation of efficiency of energy: Using the formula (Efficiency = energy output/ energy input x 100%) • Calculation of power: Using the formula (Power = work done/ time)	• Calculating efficiency • Calculating power from the formula	

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	10.2.6 Simple machines	10.2.6.1 Describe what a simple machine is 10.2.6.2 Identify the different types of simple machines. 10.2.6.3 Describe the distances moved by the effort and the load in a simple machine 10.2.6.4 Explain the terms of Mechanical advantage (MA), Velocity Ratio (VR) and Efficiency.	• The definition of a simple machine: Enables a large load to be overcome by a small effort • Types of simple machines: e.g. Levers, pulleys, gears, inclined planes, wheel and axle • The relationship between the distance and effort & load in a simple machine: Distance moved by effort and distance moved by the load in the same time • The definition of Mechanical advantage (MA), Velocity Ratio (VR) and Efficiency: Mechanical advantage (MA = Load/Effort) Velocity Ratio (VR = distance moved by effort / distance moved by load) Efficiency (; Efficiency = (MA/VR) x 100%)	• Communicating types of simple machines • Relating the distance moved by the effort to the distance moved by the load at the same time for a particular type of a simple machine • Calculating MA, VR and efficiency of a simple machine	• Cooperating in group activities • Listening to other learners with respect • Appreciating the use of simple machines in doing work, e.g. bottle opener • Applying the use the formula to compare MA of different simple machines

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		10.2.6.5 Perform calculations involving simple machines	• Calculation of MA,VR and efficiency of simple machines		

Grade 11

Key competences

- Demonstrate ability to show how pressure varies with volume and temperature
- Show skills and knowledge on the construction of thermometers
- Demonstrate ability to show heat transfer in solids ,liquids ,and gases
- Demonstrate ability to show that sound requires a medium for transmission

UNIT 3.0 THERMAL PHYSICS

General Outcomes:

- Demonstrate an understanding of thermal physics
- Develop investigative skills

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.3Thermal physics	11.3.1Simple kinetic theory of Matter.	11.3.1.1 Explain What the kinetic theory is 11.3.1.2 Describe qualitatively the molecular model of matter.	• The definition of kinetic theory: Matter is made up of discrete individual particles that are continuous in random motion • Structure of matter(solid ,liquid ,gases) and intermolecular forces: e.g. cohesive and adhesive	• Predicting the cause of continuous random motion of the discrete individual particles • Interpreting the intermolecular forces i.e. cohesive and adhesive in a much simpler way	• Cooperating in group activities • Being aware of the cohesive and adhesive forces in matter • Asking questions for more understanding

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.3.1.3. Explain changes of state in terms of the kinetic theory of matter 11.3.1.4 Apply kinetic theory to explain rates of diffusion, Brownian motion, evaporation and cooling effect of evaporation. 11.3.1.5 Apply the kinetic theory to explain gas pressure.	• Change of state of matter in relation to kinetic theory • Use of kinetic theory as in Rate of diffusion, Brownian motion, evaporation and cooling effect of evaporation in terms of kinetic theory • Kinetic theory in gas pressure(compressing a gas in a cylinder)	• Experimenting the Brownian motion, diffusion, evaporation and cooling. • Collecting the data as experiment • Formulating conclusion of experiment	• Asking more questions for more understanding
	11.3.2 Measurement of temperature	11.3.2.1 Explain what temperature is 11.3.2.2 Describe physical properties of substances which change with temperature. 11.3.2.3 Measure the temperature with thermometers	• Temperature: as average kinetic energy of the particles of a substance • Physical properties: such as density, electrical resistance etc • Measurement of temperature and Calibration of thermometers	• Communicating information on temperature • Experimenting the thermal expansion of matter(liquid, solid, gases) • Measuring the temperature • Comparing Celsius and Kelvin scale	• Asking questions for more understanding • Cooperating in groups activities • Appreciating the use of thermometers in determining temperature • Appreciating the use of thermocouples

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.3.2.4 Describe suitability of alcohol and mercury for use in liquid-in-glass thermometers. 11.3.2.5 Describe the relationship between the Celsius and Kelvin scales. 11.3.2.6 Describe the structure and use of a thermocouple thermometer. 11.3.2.7 Demonstrate the measurement of temperature using an appropriate thermometer.	• Suitability in terms of colour, expansion, conductivity. • Relation of Celsius and Kelvin scale (K =t + 273) • Structure of thermal couple: consisting different metals, two junctions, sensitive galvanometer • Appropriate use of thermometers: Liquid in glass thermometers and thermocouple		
	11.3.3Expansion of solids, liquids and gases.	11.3.3.1Describe qualitatively the thermal expansion of solids, liquids and gases.	• The thermal expansion of matters: in terms of linear, area and volume expansion	• Experimenting the thermal expansion of solids, liquids and gases	• Appreciating the knowledge about expansion of solids, liquids and gases.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.3.3.2 Explain the effects of expansion of water on aquatic life. 11.3.3.3Demonstrate that solids, liquids and gases expand at different rates. 11.3.3.4Demonstrate how to determine the boiling and melting point of different substances. 11.3.3.5Explain effects of pressure on the melting and boiling points. 11.3.5.6Investigate effects of impurities on the melting and boiling points of substances.	• Effects of Anomalous expansion of water • Different rates of expansions of matter • Boiling and melting point of substances: Graphical representation and interpretation • Effects of pressure on melting and boiling point of substances: e.g. increase in pressure lowers the melting point) Boiling point(increased pressure increases the boiling point) • Effects of impurities on the melting and boiling points of substances: such as Impurities lower the melting point while increase the boiling point of a substance	• Communicating the effects of expansion on of water on aquatic life during extreme cold seasons. • Experimenting the boiling and melting points of matters • Collecting the data on temperature and time • Organising the data in graphs. • Analyzing the data on graph • Inferring the boiling and melting point of matter • Communicating effects of pressure on melting and boiling points • Investigating the effect of impurities on melting and boiling points	• Cooperating in group activities • Asking questions for more understanding • Being aware of the effects of pressure on boiling and melting points • Participating in groups discussion • Asking more questions for more understanding • Applying the use of graphs to relate variables

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.3.3.7 Demonstrate the effect of varying pressure on volume of a gas 11.3.3.8 Describe the relationship between temperature and volume of a gas 11.3.3.9 Explain the Kelvin scale from the relationship between temperature and volume. 11.3.3.10Demonstrate the use of the ideal gas equation to solve simple numerical problems.	• Boyles law: use of equation PV=a constant at constant pressure • Charles law: as temperature against volume of a gas $V_1/T_1 = V_2/T_2$ • Kelvin Scale; volume-temperature change (constant pressure) Graphical extrapolation • The ideal gas equation ($P_1V_1/T_1=P_2V_2/T_2$) and numerical problems.	• Organizing data in the tables to verify the gas laws	
	11.3.5 Heat transfer by conduction, convection and radiation.	11.3.5.1 Explain methods of heat transfer. 11.3.5.2 Use kinetic theory to explain heat transfer.	• Heat transfer methods :Conduction, convection and radiation • Relationship between kinetic theory and heat transfer	• Verifying the methods of heat transfer by experimentation	• Participating in group activities during experiments.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.3.5.3 Demonstrate heat conduction in different substances. 11.3.5.4 Demonstrate the uses of bad and good conductors of heat. 11.3.5.5Demonstrate convection in liquids and gases. 11.3.5.6 Demonstrate the differences between bad and good absorbers of radiant energy 11.3.5.7 Demonstrate the differences between good and bad heat emitters.	• Heat conduction in different substances • Uses of conductors Good conductors; pans, kettle, pots etc; Bad conductors; plastic handles, wooden handles etc • Heat transfer through Convection in fluids • Differences between good and bad absorbers of heat: e.g. shiny(white or silver) and dull(black) surfaces • Differences between good and bad emitters of heat such as shinning (white or silver) and dull (black surfaces)	• Identifying the relationship between kinetic theory to heat transfer • Communicating uses of bad and good conductors in everyday life • Experimenting good and bad absorbers of radiant heat • Observing heat transfer in fluids • Inferring good and bad emitters of heat. • Investigating the daily applications of the methods of heat transfer	• Being aware of the fact that heat transfer can be explained in terms of kinetic theory. • Cooperating in group activities • Listening to others with respect • Appreciating the knowledge about heat transfer and its application

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.3.5.8 Explain every day's applications of knowledge on conduction, convection and radiation.	• Application of knowledge on the processes of heat transfer: e.g. thermos flask, electric kettle ,land and sea breeze, green house effect		

UNIT 4.0 Wave motion

General Outcomes:

- Demonstrate an understanding of wave motion
- Develop investigative skills

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.4 Wave motion	11.4.1 Simple ideas of the wave motion theory.	11.4.1.1 Demonstrate wave motion. 11.4.1.2 Distinguish between longitudinal and transverse waves.	• Wave motion: e.g. vibrations in ropes, Springs • Different types of wave: Transverse (water and light waves) and Longitudinal (sound waves)in terms of direction of oscillation	• Designing experiments to demonstrate wave motion by using ropes, strings • Communicating terms associated with waves	• Asking questions for more understanding • Cooperating in group activities • Being aware of the terms associated with wave motion

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.4.1.3Describe the terms associated with waves 11.4.1.4 Apply the wave equation in solving wave motion problems 11.4.1.5 Explain the use of waves in everyday life.	• Scientific terms: Amplitude (A), period(T),frequency (f), wavelength (λ) and wave front • The wave equation: Displacement-time and displacement – distance graphs of a wave. (Use the equation $v = f\lambda$.) • Use of waves in our life: radio, television, ultrasonic etc.	• Calculating numerical problems using the using the formula: "$v = f\lambda$" • communicating knowledge on the daily application of waves	• Appreciate the use of the formula to calculate speed the of a wave • Participating in group activities
	11.4.3 Electromagnetic spectrum	11.4.3.1 Describe main components of electromagnetic spectrum. 11.4.3.2 Describe the properties of electromagnetic waves	• Main components of electromagnetic spectrum: such as Gamma, X-rays, ultra violet, visible light, infrared, microwaves and radio waves • Properties of electromagnetic waves: e.g. transverse in nature, same speed in vacuum(approximately, $c = 3.0 \times 10^8$m/s) etc	• Communicating all components of electromagnetic spectrum • Communicating properties of electromagnetic spectrum • Analyzing the sources of each of the electromagnetic rays	• Being aware of the components of electromagnetic waves and their properties. • Appreciating the knowledge about the existence of electromagnetic radiation.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.4.3.3 Identify the sources of each of the rays in the electromagnetic spectrum. 11.4.3.4 Describe the method of detection each of the main component of the electromagnetic spectrum. 11.4.3.5 Explain the use of each of the waves in the electromagnetic radiation spectrum. 11.4.3.6 Explain the harmful effects of ultra violet radiation, gamma rays and x-rays to life.	• Sources of rays in electromagnetic spectrum: e.g. sun radioactive materials, oscillating electrical circuit etc • The method for detecting electromagnetic radiation • Uses of electromagnetic waves • Harmful effects of electromagnetic waves e.g. skin cancer etc	• Communicating knowledge on how to detect the rays and their uses • Communicating the uses of electromagnetic waves • Investigating the harmful effects radiation	• Cooperating in group activities • Participating in groups actively

UNIT 5.0 SOUND

General Outcomes:

- Demonstrate an understanding of sound
- Develop investigative skills

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.5 Sound	11.5.1 Properties of sound	11.5.1.1 Explain how sound is produced. 11.5.1.2 Describe what rarefactions and compressions are. 11.5.1.3 Describe the approximate range of audible frequencies. 11.5.1.4 Investigate that sounds requires a medium for transmission. 11.5.1.5 Determine the speed of sound in air. 11.5.1.6 Describe the relative speed of sound in solid, liquid and gas. 11.5.1.7 Demonstrate the characteristics of sound waves.	• Production of sound using vibrating objects • Sound wave essentials: rarefactions ("stretches") and compressions ("Squashes") • Range of audible sound frequencies (20Hz to 20000Hz) • Effects of sound waves traveling through air and a vacuum • Speed of sound in air (approximately 330m/s) • Respective speeds of sound in solids, liquids and gases • The characteristics of sound waves: Loudness of sound and its amplitude Pitch of sound and its frequency	• Experimenting on sound production • Communicating knowledge about wave motion • Designing experiment that sound requires a medium for its propagation through experimentation • Communicating knowledge about the speeds of sound in different medium. • Identifying factors that influence the quality of sound	• Cooperating in group activities • Participating in groups actively • Asking questions for more understanding • Being aware of the fact that sound travels at different speeds in different media • Giving presentation • Listening to others with respect

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.5.1.8 Describe the factors which influence the quality of sound 11.5.1.9 Describe what ultrasonic is 11.5.1.10 Describe the uses of ultrasonic. 11.5.1.11 State how to minimise sound pollution	• Factors which influence the quality of sound: such as overtones or wave form of the note • Ultrasonic: as fundamental frequency of Sounds above human hearing range • Uses of ultrasonic: cleaning, quality control, pre-natal scanning etc • Measures to minimize sound pollution: such as sound proof structures	• Communicating the uses of ultrasonic • Investigating measures to minimize sound pollution	

UNIT6.0 Light

General Outcomes:

- Demonstrate an understanding of Light
- Develop investigative skills

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.6Light	11.6.1 Rectilinear propagation of light	11.6.1.1Describe the rectilinear propagation of light. 11.6.1.2Investigate the formation of shadows and eclipse. 11.6.1.3Describe reflection of light. 11.6.1.4 Investigate the laws of reflection of light	• The nature of light: Straight line propagation of light • Formation of shadows(umbra, penumbra) and eclipses(earth in umbra and penumbra) • Reflection of light on smooth and rough surfaces: as being regular and diffuse • Laws of reflection: as angle of incidence = angle of reflection and incident ray, reflected ray and the normal all lie in the same plane	• Experimenting the nature of light (light travels in a straight line) • Predicting the formation of shadows and eclipse • Experimenting the laws of reflection • Investigating the characteristics of an image formed by plane mirrors using ray diagrams	• Appreciating the existence of light • Cooperating in group activities • Asking questions for more understanding • Giving presentation • Listening to others with respect

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.6.1.5 Demonstrate the formation of images by plane mirrors. 11.6.1.6 Identify the position of an image using plane mirrors.	• Image in a plane mirror (virtual, laterally inverted ,position, position and size) • The position of an image: through Construction of ray diagrams		
	11.6.2 Refraction of light	11.6.2.1 Describe what refraction of light is 11.6.2.2 Explain the terms of refraction of light 11.6.2.3 Verify the laws of refraction of light.	• Refraction of light: as Bending of light rays after passing through different media. • Incident ray, refracted ray ,normal ray and emergent ray) • Laws of refraction: as The ratio sin i/sin r is a constant value(snells law) The incident ray ,the normal, and the refracted ray all lie in the same plane	• Experimenting the refraction of light • Collecting data on the laws of refraction • Calculating the refractive index • Comparing the refractive index to critical angle • Communicating the total internal reflection	• Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively • Applying the knowledge of refraction in daily life

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.6.2.4 Describe what refractive index is. 11.6.2.5 Investigate the refractive index of a glass block. 11.6.2.6 Calculate refractive index of a substance (*n*) using real and apparent depth. 11.6.2.7 Explain the term 'critical angle'. 11.6.2.8 Describe the relationship between critical angle and refractive index. 11.6.2.9 Explain how total internal reflection occurs.	• Refractive index: as Measure of bending of light • Refractive index of glass • Using of formula, refractive index of "substance = real depth/apparent depth" • Critical angle: as angle of incidence at which the angle of refraction is 90^o • the relationship between critical angle and refractive index*:* *n* = sin 90^o/ sin c, Angle of incidence greater than critical angle • Internal reflection: all the light reflected inside the more denser medium		• Appreciating the knowledge on total internal reflection

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.6.2.10 Explain how total internal reflection is used.	• Use of internal reflection: optic fibre for communication		
	11.6. 3 Lenses.	11.6.3.1 Describe different types of lenses. 11.6.3.2 Explain the action of lenses on beams of light. 11.6.3.3 Demonstrate how to determine the focal length, 11.6.3.4 Demonstrate how to obtain images formed by converging lenses	• Types of lenses; Convex (thin converging) and concave (diverging) • Types of rays: Converge and diverge rays of light • Focal length: NB: use of formula: "1/f = 1/u + 1/v, magnification=v/u" • Characteristics of image: in terms of the position, size and nature of images formed by converging lenses.	• Communicating different types of lenses • Experimenting to find out what happens to light when passed through lenses. • Inferring the focal length • Predicting the images formed by converging lenses • Investigating the uses of lenses	• Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively • Giving presentation of group activity • Listening to others with respect • Accept responsibility of group work

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.6.3.5 Describe the uses of lenses in everyday life.	• Use of lens: in correcting defects in vision: short sight-concave lens, long sight-convex lens, LCD, Camera etc.		

UNIT 7.0 Magnetism

General Outcomes:

- Demonstrate an understanding of magnetism
- Develop investigative skills

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.7 Magnetism	11.7.1 Simple phenomenon of magnetism.	11.7.1.1 Describe properties of magnets 11.7.1.2 Explain the domain theory of magnetism 11.7.1.3 Demonstrate induced magnetism.	• Fundamental properties of magnet: such as repulsion, attraction direction N-S ,pole, etc • Domain theory of magnetism • Induced magnetism: Transfer of magnetic properties without contact	• Communicating knowledge on magnetism theory • Investigating induced magnetism • Experimenting on magnetization and demagnetization • Observing magnetic field lines using a compass and/ or iron filings	• Cooperating in group activities • Asking questions for more understanding • Participating in group activities actively

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.7.1.4 Demonstrate the making of a magnet 11.7.1.5 Demonstrate the way to destroy a magnet 11.7.1.6 Demonstrate the plotting of magnetic field lines. 11.7.1.7 Distinguish the magnetic properties of iron and steel. 11.7.1.8 Explain the use of magnetic screening and magnetic keepers. 11.7.1.9Describe the uses of magnets.	• Magnetisation: using stroking and electrical method • Demagnetisation: using methods such as Electrical method, hammering, heating etc • Magnetic field lines: Use of Magnetic compass to plot field lines. • Magnetic properties of Iron (susceptible) and steel (retentive). • The use of magnetic screening and magnetic keepers : Magnetic screening (shielding equipment) and magnetic keepers.(prevent loss of magnetic strength) • Use of magnets in our life: circuit breakers, speakers ,electromagnets	• Formulating the pattern of magnetic field lines • Communicating information on the uses of magnets	• Applying the use of magnets in everyday life • Appreciating the uses of magnets

Grade 12

Key competences

- Demonstrate ability to measure current and voltage
- Show skills and knowledge to dispose cells and battery
- Demonstrate ability to save electricity
- Demonstrate ability to cost use of electricity

UNIT 8.0 STATIC ELECTRICITY

General Outcomes:

- Demonstrate an understanding about Static electricity
- Develop investigative skills

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
12.8 Static electricity	12.8.1 Static Electricity.	12.8.1.1 Demonstrate the existence of static charges 12.8.1.2 Explain how to detect electric charges.	• Existence of static charge: Positive and negative charges • Detection of charge: charging by contact, testing the sign of charge using gold - leaf electroscope etc	• Experimenting the existence of charges by rubbing some materials • Detecting charge using an electroscope • Communicating properties and uses of static charge	• Cooperating in group activities • Asking questions for more understanding • Participating in groups actively • Knowing the safe rules of experiment

		12.8.1.3 Describe the properties and uses of static charges 12.8.1.4 Describe the electric charging and discharging of objects. 12.8.1.5 Explain the relationship between current and static electricity. 12.8.1.6 Investigate effects of static charges on the environment.	• Properties and uses of static charges: -Properties; like charges repel, unlike charges attract (Law of electrostatics) -Uses: dust precipitators, ink jet printers, photocopiers. • Electric charging and discharging of objects. • Relationship between current and static electricity in terms of effects as static electricity producers same effect as current electricity. • Effects of static charges on an environment: e.g. lightning etc	• Experimenting charging and discharging of objects • Communicating knowledge on the relationship between current and static electricity • Investigating the effects of static charges on the environment e.g. lightning	• Being aware of the effects of charges

UNIT 9.0 CURRENT ELECTRICITY

General Outcomes:

- Demonstrate an understanding of Current Electricity
- Develop investigative skills

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
12.9 Current electricity	12.9.1 Electric charge, current, and potential difference.	12.9.1.1 Describe the terms associated with electricity 12.9.1.2 Identify the units of electric charge and current. 12.9.1.3 Demonstrate how to measure an electric current. 12.9.1.4 Describe what potential difference is.	• Scientific Terms: such as Electric charge, potential difference and electric current • Units of electric charge and current: as Coulomb and ampere (I =Q/t) • Measure an electric current in the circuit: Ammeter • Potential difference: as energy required to move a unit charge between two points in a circuit	• Measuring an electric current using an ammeter. • Communicating the SI units for voltage • Communicating the concept of the energy dissipated • Measuring potential difference using a voltmeter	• Participating in groups actively • Cooperating in group works • Appreciating the use of electrical appliance • Knowing the safe rules of experiment

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.9.1.5 Describe what the volt is. 12.9.1.6 Differentiate between potential difference (PD) and electromotive force (EMF). 12.9.1.7 Describe the basic concept of EMF. 12.9.1.8 Demonstrate the measuring of potential difference (PD) and electromotive force (EMF).	• Volt: as joules per coulomb • Difference between PD and EMF in terms of work done per unit of charge in driving charge in a circuit and through a component • The basic concept of EMF • Measurement of PD and EMF: Connecting terminals across source of electric current /conductor		

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	12.9.2 Electric cells.	12.9.2.1 Describe the structure of primary and secondary cells. 12.9.2.2 Demonstrate charging and discharging of the accumulator. 12.9.2.3 Identify methods of disposal of used cells	• Structure of primary and secondary cells: Primary cells(dry cell), Secondary (lead acid accumulator) • How to charge and discharge the accumulator: Charging when current is passed a in opposite direction to current supplies, discharging when in use (acid accumulator) • Appropriate methods of disposing used cells.	• Communicating the structure of cells • Investigating charging and discharging an acid accumulator • Communicating appropriate methods of disposing off used cells	• Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively • Applying the knowledge of disposal of cells in dairy life
	12.9.3 Electrical resistance.	12.9.3.1 Explain the meaning of the resistance 12.9.3.2 Demonstrate how to determine resistance in a simple circuit.	• Resistance: opposition to the flow of charge • Value of resistance in series and parallel (use formula $1/R = 1/R_1 + 1/R_2$)	• Measuring the current and potential difference, using a voltmeter and an ammeter	• Asking questions for more understanding • Cooperating in group activities

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.9.3.3 Describe the relationship between current and potential difference in Ohmic and non Ohmic conductors. 12.9.3.4 Describe what the internal resistance of a cell is. 12.9.3.5 Calculate the resistance in series and parallel circuits with Ohm's law.	• Relationship between current and potential difference: (Graph of p.d. against current for Ohmic and non-Ohmic conductors) • Internal resistance of a cell due to chemicals • Ohm's law in series and parallel circuits. (R = V/I)	• Collecting data as experiment • Organizing data in tables and their graphs on ohmic and non ohmic conductor • Formulating the patterns in data	• Participating in group activities actively • Knowing the safe rules of experiment
	12.9.4 Heating effect of an electric current.	12.9.4.1 Demonstrate energy transformations in an electric circuit. 12.9.4.2 Investigate the heating effect of an electric current. 12.9.4.3 Demonstrate how to calculate	• Conversion of energy from electricity to heat • Heating effect of an electric current in heating appliances. • Calculations of	• Analysing energy changes from one form to the other • Investigating the heating effect of an electric current • Calculating electrical energy using E=VIt • Communicating	• Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively • Appreciating the

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		electrical energy. 12.9.4.4 Describe the relationship of voltage, current and power. 12.9.4.5 Demonstrate how to calculate the cost of using electrical Energy 12.9.4.6 Describe the use of switches, fuses, earthing and the three pin-plugs. 12.9.4.7 Explain the need for earthing metal cases and for double Insulation. 12.9.4.8 Describe the meaning of three	electrical energy: Use of formula (E= VIt, etc) • The relationship of voltage, current and power: Power = voltage x current(P=VI) • Cost of using electrical energy: use of kWh as a unit of electrical energy • Electrical components: e.g. switches (on /off power), fuses (prevent appliances from damage), and the three pin-plugs (connecting appliance) • Safety precautions (prevent electric shocks, accidents) • Three types of	relationship among power, voltage and current • Calculating the cost of using electrical energy • Communicating the use of some named electrical components • Investigating the safety precautions • Communicating the colouring of insulators • Investigating the basic wiring system in a house • Communicating ways of conserving energy	use of electricity at home • Cooperating in group activities • Applying the safety precautions in the use of electricity • Appreciating the use of energy saving bulbs

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		wires found in the cable 12.9.4.9 Describe the domestic electrical wiring system 12.9.4.10 Describe ways of conserving electrical energy in homes and industry.	Wires: Live (red or brown), earthing (green and yellow) and neutral (blue) • Household circuits: such as cooker circuit, ring circuit, lighting circuit • Ways of conserving electrical energy: using energy saving bulbs, switch and serve etc.		
	12.9.5 Magnetic effects of electric currents.	12.9.5.1 Explain magnetic field patterns of electric currents. 12.9.5.2 Describe the applications of the magnetic effect of an electric current.	• Lines of force (Magnetic flux) : patterns of electric currents • Applications of electromagnets: electric bells, relay switches etc	• Experimenting the magnetic field patterns of electric currents • Communicating use of electromagnets • Investigating the displacement of a current carrying wire in a field	• Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively • Asking

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.9.5.3 Explain the behaviour of an electric current in a magnetic field. 12.9.5.4 Describe the application of a current placed in a magnetic field. 12.9.5.5 Describe the nature of forces between parallel currents. 12.9.5.6 Describe the effect of magnetic fields on human health and environment.	• The behaviour of an electric current in a magnetic field: Displacement of current carrying wire current or electron beam • Applications of current in a magnetic field: e.g. D.C. motors, galvanometers, ammeter etc • Nature of forces: attraction and repulsion of forces between parallel currents. • Effects of magnetic fields: hearing impairment, radar interference in communication,etc	• Inferring the attraction and repulsion of forces between parallel currents • Investigating the effects of magnetic fields	questions for more understanding • Applying the effects of magnetic field

UNIT 10.0 ELECTROMAGNETIC INDUCTION

General Outcomes:

- Demonstrate an understanding about electromagnetic induction
- Develop investigative skills

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
12.10 Electromagnetic induction	12.10.1 The phenomenon of electromagnetic induction.	12.10.1.1 Investigate the phenomenon of electro-magnetic induction. 12.10.1.2 Describe the factors affecting magnitude and direction of induced EMF. 12.10.1.3 State the direction of current produced by an induced EMF.	• Electromagnetic induction: (induced EMF / current in a wire moving cutting magnetic flux) Faraday's law • Factors affecting magnitude and direction of induced EMF: speed of either magnet or coil, strength of magnet, number of turns of a coil • Direction of induced current: Lenz and Fleming right hand law.	• Experimenting the induction of an EMF/current using a magnet, a coil and ammeter • Collecting data • Organising the data in a table • Interpreting the data • Analysing the factors that affect the magnitude of the induced current/EMF • Inferring the direction of induced current with Fleming right hand rule	• Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively • Knowing the safe rules of experiment

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	12.10.2 The simple A.C. and D.C. generators.	12.10.2.1 Describe simple A.C. and D.C. generators. 12.10.2.2 Compare the simple A.A. generator with a simple D.C. generator in terms of structure and its nature. 12.10.2.3 Describe the action of a diode in rectification. 12.10.2.4 Explain conversion of an A.C. generator to a D.C. generator. 12.10.2.5 Contrast the current produced by the D.C. generator with that produced from batteries.	• Generators: simple A.C. generator (an alternator with slip-rings) and simple D.C. dynamo with a commutator • Structure and its nature of simple A.C and D.C generators • Action of diodes: change A.C. to D.C. by allowing current to flow one way • Conversion of A.C. generator to D.C. generator by use of commutator • The direction of Current from D.C generator(varies) and from batteries(constant)	• Communicating A.C. and D.C. generators • Comparing the structure and nature of an A.C. and D.C. generators • Communicating rectification of alternating current using diodes • Comparing the direction of current produced by a D.C. generator to the one produced from batteries	• Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively • Appreciating the use of the generators and batteries

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	12.10.3 Transformers.	12.10.3.1 Demonstrate the principles of mutual induction.	• Principles of mutual induction: changing current in one coil gives rise to current in the other	• Designing investigations to verify mutual induction • Communicating step up and step down transformers • Calculating problems relating to the transformers and power using formulae • Calculating the efficiency of a transformer • Communicating knowledge on the environmental and cost implications of underground power transmission	• Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively • Appreciating the use of the formula • Being aware of the environmental and cost implications of underground power transmission
		12.10.3.2 Describe the structure and operation of iron core transformers.	• The structure and operation of iron core transformers		
		12.10.3.3 Apply the transformer and power equations to solve numerical problems involving ideal transformers	• Equations of transformer and power: using relations $\frac{Vp}{V_s} = \frac{Np}{N_s}$ and $Vp\ Ip = V_s\ I_s$ (ideal transformer)		
		12.10.3.4 Calculate the efficiency of a transformer given data.	• Calculation of efficiency: [Efficiency = $(V_s\ I_s)$ / (Vp Ip) x 100%]		

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.10.3.5 Explain advantages of high alternating potential difference power transmission. 12.10.3.6 Describe the implications of underground power transmission compared to overhead lines. 12.10.3.7 Describe the effects of improper management of transformers	• Advantage of high alternating potential difference power transmission: as in reducing power losses in cables. • Environmental and cost implications of underground power transmission • Effects of improper management of Transformers such as overheating, low/high voltage		

UNIT 11.0 BASIC ELECTRONICS

General Outcomes:

- Demonstrate an understanding of basic electronics
- Develop investigative skills

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
12.11 Basic electronics	12.11.1 Thermionic emission and electrons.	12.11.1.1 Describe What thermionic emission is 12.11.1.2 Investigate properties of cathode rays 12.11.1.3 Distinguish between direction of flow of electrons and flow of conventional current. 12.11.1.4 Describe applications of electron beams.	• Thermionic emission: release of electrons from a heated cathode • Properties of cathode rays: e.g. Deflected by electric and magnetic fields, travel in straight in lines etc. • Direction of flow of electrons and conventional current • Application of electron beams in CRO ,TV set, X-ray machines etc	• Investigating properties of cathode rays by using a CRO • Comparing the direction of flow of electrons to conventional current • Communicating the devices that make of electron beams in their operation • Investigating the basic structure of a CRO. • Measuring quantities using a CRO	• Asking questions for more understanding • Cooperating in group activities • Participating in group activities actively • Appreciating the use of the cathode rays in specific devices • Being aware of the structure of a CRO • Appreciating the use of a CRO in measuring some quantities

		12.11.1.5 Describe basic structure and action of cathode-ray oscilloscope. 12.11.1.6 Describe the uses of cathode-ray oscilloscope.	• Basic structure and action of CRO: electron gun, Control grid, anode Y-plates ,X-plates, fluorescent screen • Uses of CRO: e.g. measuring(peak voltage, time, frequency),TV etc		

UNIT 12.0 ATOMIC PHYSICS

General Outcomes:

- Demonstrate an understanding about atomic physics
- Develop investigative skills

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
12.12. Atomic physics	12.12.1 Nuclear atom	12.12.1.1 Describe the structure of the atom. 12.12.1.2 Describe the composition of the nucleus in terms of protons and neutrons.	• Atomic structure (nucleus and electrons) • Composition of the nucleus (protons and neutrons)	• Communicating an atomic structure • Communicating knowledge on the existence of protons and neutrons in the nucleus of an atom	• Asking questions for more understanding • Cooperating in group activities

		12.12.1.3 Explain mass number and atomic number.	• Mass number and Atomic number: mass (Nucleon) number, A, and atomic (proton), number, Z.		
	12.12.2 Radioactivity.	12.12.2.1 Describe the nature of radioactivity. 12.12.2.2 Describe the characteristics of the three kinds of radioactive radiations: alpha, beta and gamma. 12.12.2.3 Describe methods of detecting radioactive emissions. 12.12.2.4 Explain the origin and effects of background radiations	• Nature of radioactivity (randomness and spontaneity) • Characteristics of three kinds of radioactive radiations: Alpha (**α**), Beta (**β**) and Gamma (***γ***) radiations in terms of penetration, ionization, deflection, charge, relative mass and nature of particles) • Detection of radioactive emissions: by G.M tube, photographic plate, scintillation counter, bubble chamber • Causes of background radiation (cosmic rays, radioactive elements under rocks)	• Investigating the nature of radioactivity • Investigating radiation using a G.M counter • Understanding the causes and effects of background radiation • Comparing nuclear fission to nuclear fusion • Calculating half life of a radioactive material by using decay curves • Communicating the uses of radioactive substances • Communicating knowledge on safety precautions	• Asking questions for more understanding • Cooperating in group activities • Appreciating the use of a GM counter to detect radiation • Being aware of the existence of background radiation and its effects • Appreciating the use decay curves to determine half life

		12.12.2.5 Describe what radioactive decay is. 12.12.2.6 Describe what nuclear fusion and fission is. 12.12.2.7 Demonstrate how to determine half life of a radioactive material. 12.12.2.8 Explain uses of radioactive substances. 12.12.2.9 Describe the safety precautions necessary when handling or storing radioactive substances. 12.12.2.10. Explain the effects of radioactive substances on the environment and health.	• Radioactive decay as disintegration of nucleus by alpha, beta and gamma emissions. • Nuclear fusion and fission: Nuclear fusion as process of joining very light nuclei together and fission as splitting process of nucleus • Half life of a radioactive material: Time taken for activity to reduce by half of the original substance (Decay curves) • Uses of radioactive substances: e.g. medical, industrial, agricultural uses • Use of protective materials: such as gloves, gogloes, overalls and lead shields • Effect of radioactive substances: such as radiation pollution and health hazards	• Investigating management practices which safeguard the environment from radioactive contamination	• Participating in group activities actively • Applying safety precautions when dealing with radioactive substances

		12.12.2.11. Investigate management practices which safeguard the environment from radioactive contamination.	• Appropriate management safe guard practices		

PRACTICAL PHYSICS

The importance of practical work in Physics cannot be over emphasized. Practical work develops manipulative skills in the learner and gives the learner the opportunity to experiment the scientific method. Needless to mention practical Physics is essential for this syllabus because:

a) There is need to expose learners to practical applications of Physics.
b) Learners should understand, interpret and apply scientific methods in a variety of ways including the theoretical and practical approaches.
c) The study of Physics should be linked with environmental education requirements by quoting local phenomena in relation to Physics studies.

There are scientific processes and skills to which learners must be exposed. Examples of these are observing, experimenting, classifying, measuring, estimating, calculating, predicting and problem solving. Learners should also be exposed to scientific attitude like accuracy, curiosity and creativity.

SECTION B: CHEMISTRY

GRADE 10

Key competences

- Demonstrate the ability to measure time ,temperature, mass and volume
- Show basic skills and knowledge in constructing balanced chemical equations with state symbols
- Demonstrate investigative skills in experimental techniques

UNIT 1.0 INTRODUCTION TO CHEMISTRY

General Outcomes:

- Develop an understanding of Chemistry and its branches
- Develop investigative skills about Chemistry

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
10.1 Introduction to Chemistry	10.1.1 Introduction to Chemistry	10.1.1.1 Describe Chemistry. 10.1.1.2 Classify the branches of chemistry 10.1.1.3 Explain the importance of chemistry.	• The study of matter and their chemical changes • Branches such as: Analytical, Biochemistry, Inorganic, Physical and Organic • Improved life through manufacture of soaps, detergents, plastic, sugar, cement, paper, medicines, food production and other life necessities •	• Identifying different branches of chemistry • Comparing Different branches of chemistry	• Awareness of chemistry branches • Appreciating chemistry and application/importance in everyday life. • Applying safety rules in the chemistry laboratory. • Participating actively in group activities

		10.1.1.4 Describe the challenges of chemical industrial activities 10.1.1.5Demonstrate an appreciation of safety in the laboratory.	• Production of undesired harmful by-products • Safety rules in the lab		

UNIT 2.0 THE PARTICULATE NATURE OF MATTER

General Outcomes:

- Demonstrate an understanding of the particulate nature of matter
- Develop investigative skills about states of matter

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
10.2The Particulate nature of matter	10.2.1 Matter and the Kinetic theory	10.2.1.1 Describe matter 10.2.1.2 Classify the basic units of matter 10.2.1.3 Classify the states of matter. 10.2.1.4 Illustrate changes of states of matter. 10.2.1.5 Describe the absorption of heat and release of heat during changes of states of matter	• Anything that has **mass** and occupies space • Units of matter Atoms, molecules ,ions • Kinetic theory: in terms of particle arrangement and movement. Solid, liquid, gas • Changes of states such as melting, freezing, boiling, condensation, sublimation in terms of kinetic theory • The absorption and release of heat during changes of states of matter : Changing states of matter, exothermic-release of heat during a reaction, endothermic-absorption of heat during a reaction, include heating and cooling curves	• Communicating information on the basic units and states of matter • Experiments with the changes of states of matter • Inferring data on the absorption and release of heat during changes of states of matter	• Appreciating the basic units of matter and its existence in three states • Applying changes of states of matter in everyday life • Cooperating in group work.

	10.2.2 Diffusion	10.2.2.1Describe diffusion 10.2.2.2Demonstrate diffusion in fluids 10.2.2.3 Describe the factors that affect the rate of diffusion	• Movement of particles from region of higher concentration to region of lower concentration • Diffusion in fluids: Liquids and gases (Brownian motion) • The factors that affect the rate of diffusion: e.g. molecular mass, temperature, concentration	• Investigating the movement of particles in fluids • Comparing movement of particles in liquids, gases and factors affecting their speed of movement • Observing the spreading of particles in fluids.	• Appreciating diffusion • Asking more questions for better understanding • Fostering teamwork • Applying the different concepts in daily life.

UNIT 3.0 EXPERIMENTAL TECHNIQUES

General Outcomes:

- Demonstrate an understanding of Experimental Techniques and its application in everyday life
- Develop investigative skills in experimental techniques

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
10.3 Experimental Techniques	10.3.1 Measuring of quantities	10.3.1.1 Demonstrate how different quantities are measured 10.3.1.2 Identify different measuring apparatus used in chemistry. 10.3.1.3 Identify various measuring instrument and other apparatus used in chemistry	• Measuring time, temperature, mass and volume • Measuring apparatus such as stopwatch or stop clock, thermometers, balances, burettes, pipettes, volumetric flask, measuring cylinder, and gas syringes • Other apparatus: spatula, stands and clamp, test-tubes, burners, , glass rods, evaporating dish, funnel beaker, conical flask etc.	• Recording accurately measurement of values of various quantities • Identifying different measuring apparatus	• Applying safety rules in use of apparatus • Fostering teamwork
	10.3.2 Criteria of purity	10.3.2.1Describe the differences between a pure substance and a mixture.	• Differences between a substance and a mixture: In terms of melting points and boiling points	• Investigating the purity of substances	• Appreciating purity of substances

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		10.3.2.2Demonstrate how to determine the purity of a substance 10.3.2.3 Explain the importance of purity of a substance	• Determining the purity of a substance: Sharp melting for pure substance and melting over a range of temperatures for a mixture. • Importance of purity in substances such as food stuffs ,medicines, drinks	• Comparing pure and impure substances • Recording data and plotting graphs.	• Applying the knowledge of purity in every day life. • Participating actively in class activities
	10.3.3Separatingmixtures	10.3.3.1Distinguish between physical and chemical changes 10.3.3.2Demonstrate different methods of separating mixtures	• Differences between physical and chemical changes In terms of mass changes, irreversibility/reversibility, chemical substance formed and energy involved. • Methods of separating mixtures: such as decantation, filtration, crystallisation, simple and fractional distillation, magnetism, chromatography, evaporation, sublimation, floatation, use of separating funnel and centrifugation	• Comparing components in the mixture • Planning an investigation to compare physical and chemical changes • Experimenting with different techniques. • Collecting data from paper chromatograms.	• Applying separation techniques in everyday life • Cooperating in group work.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		10.3.3. Interpret simple paper chromatograms.	• Simple paper chromatograms: Uses such as R_f values and distances covered by components (restricted to paper chromatography)		

UNIT 4.ATOMS, ELEMENTS, COMPOUNDS AND MOLECULES

General Outcomes:

- Demonstrate an understanding of atoms, elements, molecules and compounds.
- Develop investigative skills about the nature of substances.
- Demonstrate an understanding of the importance, production, use, and effect on the environment of common elements and simple compounds

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
10.4 Atoms, elements, compounds and molecules	10.4.1Atomic structure and Periodic Table	10.4.1.1 Describe an atom and its structure. 10.4.1.2 Describe the relative charges and approximate relative masses of protons, neutrons and electrons	• An atom as the smallest particle of an element which takes part in a chemical reaction. Structure: use Bohr model (nucleus at the centre surrounded by electron shells) • Relative charges and relative masses of protons, neutrons and electrons: Charges as: +1,0,-1 Masses as: 1, 1, 1/1840	• Communicating information on atoms, elements molecules and compounds • Calculating relative atomic mass • Comparing chemical symbols of elements. • Predicting names of element from symbols.	• Awareness of the atomic structure • Participating actively in class activities. • Asking more questions for better understanding.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		10.4.1.3 Describe the proton (atomic)number and nucleon(mass) number and nuclide notation	• The proton (atomic) number: As number of protons: Z, Nucleon (mass) as number of nucleons: A (protons + neutrons)and nuclide notation $^{A}_{Z}$X	• Interpreting data using the periodic table. • Communicating the use of isotopes everyday life. • Formulating a model for the building of electrons in shells.	• Respect for other peoples ideas in a group Appreciating the medical and industrial use of isotopes.
		10.4.1.4 Describe what an element is	• What an element is: As Element substance made up of same chemical atoms		
		10.4.1.5 Identify elements using their chemical symbols	• Symbols of the elements with atomic number 1 up to 20 and other common elements in the local environment		
		10.4.1.6 Describe the basis of the Periodic Table	• Periodic Table: Group determined by valence electrons, Period determined by number of shells		
		10.4.1.7 Describe what isotopes are	• Isotopes : As atoms with same number of protons but different numbers of neutrons, including radioactive and non-radioactive isotopes		

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		10.4.1.8 Calculate relative atomic mass of an element given the % abundances of isotopes and from mass spectrum. 10.4.1.9 Describe the use of radioactive isotopes 10.4.1.10 Demonstrate the build-up of electrons in shells	• Atomic mass of an element : As sum of the products of the percentages and their mass numbers • Use of radioactive isotopes: Such as in medical treatment of cancer, industrial use as tracers • Electronic configuration of atoms (spdf configuration is **NOT** required)		
	10.4.2 Bonding	10.4.2.1 Describe what a compound is 10.4.2.2 Describe the formation of ions (radicals).	• A compound: As a substance formed from two or more elements chemically combined • Formation of ions (radicals): Cations by electron loss, anions by electron gain	• Classifying compounds into covalent ionic compounds • Formulating chemical formulae of compounds correctly	• Appreciating the use of ionic and covalent compounds • Asking more questions for better understanding • Participating actively in class activities

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		10.4.2.3Describe the formation of ionic (electrovalent) bonds. 10.4.2.4 Describe the formation of covalent bonds 10.4.2.5 Describe the electronic arrangement in simple multiple covalent molecules. 10.4.2.6 Describe the uses of ionic and covalent compounds	• Formation of ionic bonds: Electrovalent bonding as loss and gain of electrons between metallic and non-metallic atoms. Ionic bonds as electrostatic force between cations and anions. Such as NaCl, $CaCl_2$ and MgO • The formation of covalent bonds Covalent bonding as sharing of electrons between non-metallic atoms. Covalent bonds as shared pairs of electrons. Such as H_2, Cl_2,H_2O, NH_3, CH_4, HCl, C_2H_6 • Electronic arrangement in simple multiple covalent molecules: such as double bonds in O_2,C_2H_4 andCO_2, Triple bond in N_2 and C_2H_2 • Uses of ionic and covalent compounds: As refractory materials for ionic compounds (CaO) and polar and non polar solvents for covalent compounds.	• Communicating information on ionic and covalent compounds. • Predicting that substances are ionic or covalent based on elements. • Formulating models of ionic and covalent compounds. • Communicating information on properties of ionic and covalent compounds. • Predicating the chemical formula of compounds given relevant data.	• Applying the concept of valency number in formulating formulae of compounds.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		10.4.2.7 Describe what a molecule is	• Molecule as the smallest particle of an element or compound which exists independently.	• Investigating thermal and electrical conductivity of metals.	
		10.4.2.8 Describe what valency and valence electrons are	• Valency as combining power of an atom or radical. Valence electrons as the number of electrons in the outer most shell.		
		10.4.2.9 Demonstrate how to deduce valency of an element.	• How to deduce valency of an element from the formula of a compound, ionic charge, valence electrons.		
		10.4.2.10 Formulate chemical formulae of compounds.	• Chemical formulae of compounds: Using valency and chemical symbols of elements, charges on ions, models, relative numbers of atoms present, diagrammatic representation.		

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		10.4.2.11 Identify the differences in properties of ionic and covalent compounds. 10.4.2.12 Describe metallic bonding 10.4.2.13 Describe the electrical/thermal conductivity of metals	• Differences in properties of ionic and covalent compounds: such as volatility, electrical conductivity, density, melting point, boiling point and basic units • Metallic bonding: As lattice of positive ions in a 'sea' of delocalised electrons • Electrical/thermal conductivity of metals: Due to free electron movement/delocalised electrons		
	10.4.5 Chemical formulae and equations	10.4.4.1 Demonstrate how to construct word equations. 10.4.4.2 Formulate balanced chemical equations.	• Word Equations: showing reactants and products separated by a full curled arrow (➔). • The rules of chemical equation: Number of atoms of each element being equal on both sides of the equation. Balancing can be done by inspection. Equations may include state symbols (s-solid, l – liquid, g – gas, aq – aqueous).	• Communicating information on construction and balancing of chemical equations • Formulating balanced chemical equations based on the rules • Constructing ionic equations	• Asking more questions for better understanding • Applying information on construction of word equation and balanced chemical equations

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		10.4.4.3 Construct net ionic equations from balanced chemical equations.	• Net ionic equation: Only ionic aqueous reactants/products must be broken down into their respective ions then cancel out spectator ions to come up with net ionic equation.		• Participating actively in group work.

GRADE 11

Key Competences

- Demonstrate the skills and knowledge in relating number of valence electrons to the Group number and the number of shells to the Period.
- Demonstrate skills in classifying salts according to their solubility.
- Demonstrate ability to classify oxides as acidic, basic, neutral and amphoteric.
- Demonstrate ability to use tests in identifying aqueous cations, anions and gases.
- Demonstrate basic skills and knowledge in calculating stoichiometric reacting moles.
- Show ability to identify factors that affect rates of chemical reactions.

UNIT 5.0 ACIDS, BASES AND SALTS

General Outcomes:

- Demonstrate an understanding of acids, bases and salts.
- Develop investigative skills about acids, bases and salt.
- Demonstrate an understanding of the importance, production, use, and effect on the environment of acids, bases and salts.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.5Acids, Bases and Salts	11.5.1 Characteristic properties of acids and bases	11.5.1.1 Describe acids, bases or alkalis in terms of ions they contain or produce in aqueous solution.	• **Acid** as compound that produces hydrogen ions as the only positively charged ions in aqueous solutions, **Base** generally as an oxide or hydroxide of a metal including ammonium hydroxide **Alkalis** as soluble bases that produce hydroxide ions in aqueous solution as the only negatively charged ions.	• Investigating acids and bases • Comparing the characteristics of acids and bases • Investigating the acidity and alkalinity of substances in everyday life	• Appreciating acids and bases • Applying the uses of acids and bases in everyday life • Cooperating in group activities

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.5.1.2 Describe the meaning of weak, strong, dilute and concentrated acids and alkalis 11.5.1.3 Describe the pH scale 11.5.1.4 Describe neutrality, acidity and alkalinity in terms of pH value 11.5.1.5 Determine the pH value of a solution. 11.5.1.6 Demonstrate the characteristic properties of acids 11.5.1.7 Demonstrate the characteristic properties of bases	• The meaning of weak, strong, dilute and concentrated acids and alkalis: Strength as degree of ionisation, Concentration as the number of ions per volume of solution • pH: As a scale ranging from 0 to 14 showing the degree of acidity and alkalinity. • pH values: 7 for neutrality, below 7 for acidity and above 7 for alkalinity • How to determine the pH value of a solution: Using universal indicator: different colours at different pH values, Using pH meter: precise values • Characteristic properties of acids and bases: Acids such as reactions with metals, bases, carbonates/bicarbonates and effect on indicators. Bases such as reactions with acids and ammonium salts, effect on indicators.	• Communicating information on PH Scale and its volumes • Experimenting with acids and bases and predicting the results of the reactions • Recording data accurately on PH values.	• Appreciating the pH scale values in everyday life • Applying safety rules when experimenting with acids and bases • Caring for the environments during experiments.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.5.1.8 Illustrate the importance of acid-base reactions 11.5.1.9 State the uses of acids and bases.	• Importance of acid- base reactions: Such as in controlling the acidity in the soil, treatment of indigestion, brushing teeth with toothpaste. • Uses of acids and bases Such as control of pH in agriculture, making of soap, in car batteries		
	11.5.2 Preparation of salts	11.5.2.1 Describe what a salt is 11.5.2.2Classify salts. 11.5.2.3 Demonstrate the preparation of an insoluble salt.	• A salt: As a compound formed when the hydrogen ions of an acid are fully or partially replaced by a metal or ammonium ions. Or a compound made of positive metallic/ammonium ions and any negative ion of an acid. • Classification of salts according to their nature and solubility in water: As acid, basic and normal salts. Solubility rules of salts • Preparation of an insoluble salt: Using precipitation method and separated by filtration. E.g. Barium sulphate, Silver chloride	• Classifying of salts according to their nature and solubility in water • Experimenting the preparation of soluble and insoluble salts • Differentiating hydrated and anhydrous salts • Inferring data on the solubility of salts	• Awareness of salts • Applying safety rules in preparation of salts • Participating actively in group work • Appreciating the use of salts in everyday use.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.5.2.4 Demonstrate the preparation soluble salts. 11.5.2.5 Demonstrate the preparation of ammonium, potassium and sodium salts. 11.5.2.6 Demonstrate the existence of hydrated salts and differentiate from anhydrous salts 11.5.2.7 Describe the behaviour of salts with reference to the atmosphere.	• Preparation soluble salts: By reaction of acids with bases, suitable metals and carbonates/ bicarbonates. Separated by crystallisation and filtration. E.g. Zinc sulphate, copper (II) sulphate • Preparation of ammonium, potassium and sodium salt: Using titration method (use of indicator for ease detection of end point) • Existence of hydrated salts and differentiate from anhydrous salts: Hydrated salts as salts containing water of crystallisation. Anhydrous salts as salts not containing water of crystallisation • Behaviour of salts with reference to the atmosphere: As hygroscopic, efflorescent, deliquescent.	• Recording data accurately	

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	11.6.3 Types of oxides	11.5.3.1 Describe the various types of oxides.	• Various types of oxides: Acidic oxides as oxides with acidic properties such as SO_2 and CO_2. Basic oxides as oxides with basic properties such as CaO and MgO. Neutral oxides as oxides with neither acidic nor basic properties such as CO, H_2O. Amphoteric oxides as oxides with both acidic and basic properties ZnO, Al_2O_3 and PbO.	• Classifying different types of oxides. • Predicting names of Oxides from given data. • Recording data accurately.	• Awareness of different types of oxides. • Applying acid-base reactions • Cooperating in group activities.
	11.6.4 Identification of ions and gases (Qualitative analysis)	11.6.4.1 Demonstrate the identity of aqueous cations and anion. 11.6.4.2 Demonstrate the identity of gases.	• Identity of aqueous cations and anion: Cations being aluminum, ammonium, calcium, copper (II), iron (II), iron (III), and zinc using aqueous sodium hydroxide and aqueous ammonia. Anions being carbonate, chloride, iodide, nitrate and sulphate using various reagents. Refer to Qualitative notes. • The identity of gases: ammonia, carbon dioxide, chlorine, hydrogen, oxygen and sulphur dioxide. **Refer** to Qualitative notes	• Observing and interpreting results of reactions of ions with different test reagents • Communicating information on chemical composition of Salts • Inferring data on cations and anions • Investing the identity of gases	• Awareness about composition of salts • Appreciating different types of gases. • Applying safety rules during experiments. • Cooperating in group work

UNIT 6.0 THE MOLE CONCEPT

General Outcomes:

- Demonstrate an understanding of the Mole Concept
- Develop investigative skills about quantitative analysis.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.6 The mole concept	11.6.1 Relative masses	11.6.1.1 Describe what Relative Atomic Mass and relative molecular mass is. 11.6.1.2 Calculate the relative formula mass of a compound	• Relative Atomic Mass (RAM) as relative mass of an element's isotopes as compared to carbon-12 Relative Molecular Mass (RMM) as relative mass of a molecule as compared to carbon-12 • The relative formula mass of a compound: As the sum of the relative atomic masses of all the atoms in the compound	• Comparing the relative atomic masses of elements • Calculating relative molecular mass of compounds • Calculating relative formula mass of a compound	• Appreciating the relative atomic masses and the relative molecular masses • Participating actively in class activities.
	11.6.2 The mole	11.6.2.1 Describe what a mole is 11.6.2.2 Determine the physical masses (m) of any substance using the molar mass (Mr) and the physical volume (v) of any gas at r.t.p and vice versa.	• The mole: as number or quantities of particles e.g. atoms, ions, molecules, electrons equivalent to 6.02 x 10^{23}(Avogadro's constant) • Physical masses (m) of any substance: Applying $n = {}^{m}/_{Mr}$ and $n = {}^{v}/_{Vm}$ where n = number of moles	• Communicating information on the mole concept • Experimenting with chemical substances quantitatively • Experimenting with acid-base titrations	• Applying mole concept • Asking more questions for better understanding • Awareness of the mole concept

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.6.2.3 Describe the relationship of Avogadro's law to reacting moles and volumes of gases at r.t.p and s.t.p. 11.6.2.4Determine the concentration of a solution in applying dilution law. 11.6.2.5 Illustrate calculations involving stoichiometric reacting moles and volumes of gases and solutions. 11.6.2.6 Calculate the percentage yield in a reaction and the percentage purity of a substance	• Relationship of Avogadro's law to reacting moles and volumes of gases: As Molar gas volume (Vm) of any gas at rtp is 24dm^3 or 22.4 dm^3 at stp. • Concentration of a solution: as mol/dm^3 and/or g/dm^3. The number of moles of solute before dilution is the same as after dilution, $M_1V_1 = M_2V_2$ • The percentage (%) yield as actual amount obtained divided by theoretical amount x 100% Percentage(%) purity as amount of substance divided by total amount of the mixture x 100%	• Calculating problems involving mole concept • Recording data accurately • Entering data using the dilution law • Calculating problems involving the mole and volumes of gases and solutions • Investigating limiting reagents in a reaction	• Fostering team work • Applying safety rules when experimentin g. • Applying knowledge of mole concept in everyday life. • Applying the dilution law in calculations involving concentration s of solutions

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.6.2.7 Determine limiting reagent in a given reaction 11.6.2.8 Demonstrate calculations involving different types of acid–base titration reactions.	• Using molar mass and molar volume of a gas using the mole concept. (Questions on gas laws and conversions of gaseous volumes to different temperatures and pressures will **not** be required). Proportional stoichiometric masses and the given quantities • Limiting reagent: Using proportional stoichiometric masses and the given quantities • The different types of acid–base titration reactions: Using titration law	• Communicating information on percentage yields and percentage purity.	

UNIT 7.0 CHEMICAL REACTIONS AND ENERGY CHANGES

General Outcomes:

- Demonstrate an understanding of chemical reactions and energy changes
- Develop investigative skills about various types of reactions.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.7 Chemical reactions	11.7.1 Rates of chemical reactions	11.7.1.1 Describe rate of a chemical reaction. 11.7.1.2 Demonstrate the factors that affect the rates of chemical reactions 11.7.1.3 Describe methods of controlling the rate of chemical reactions. 11.7.1.4 Describe the effect of a catalyst on the activation energy	• Rate of a chemical reaction: As speed of a chemical reaction. • Factors such as temperature, concentration, surface area, catalyst, pressure, light • Methods of controlling the rate of chemical reactions: either reducing or reducing the frequency of collisions between reacting particles such as explosions in flour mills/coal mines when ignited to surface area • Effect of a catalyst on the activation energy: Catalyst lowers the activation energy thus increasing the rate of a chemical reaction.	• Investigating factors that control the rate of chemical reactions. • Comparing experimental results at different conditions • Recording and interpreting experimental results. • Communicating information on rates of chemical reactions. • Interpreting data on the rate of chemical reactions.	• Applying safety rules and the factors that affect the rate of chemical reactions. • Awareness of slow and spontaneous reactions. • Fostering team work.

UNIT 8.0 The Periodic Table

General Outcomes:

- Demonstrate an understanding of the Periodic Table
- Develop investigative skills about the Periodic Table.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
11.8The Periodic Table	11.8.1Groups and Periods	11.8.1.1Describe what the Periodic Table is 11.8.1.2 Identify vertical columns and horizontal rows. 11.8.1.3 Use the Periodic Table to classify elements	• Periodic table as a tool for classifying elements • Structure of periodic table: Vertical columns as Groups and horizontal rows as Periods • Elements classification as metallic and non-metallic	• Communicating information on the periodic table • Comparing groups and periods. • Classifying element s into metallic and non metallic. • Interpreting data on periodic table	• Awareness of the periodic table. • Participating actively in group work.
	11.8.2 Groups and Periodic trends	11.8.2.1 Describe trends in various Groups given information about the elements 11.8.2.2 Describe the physical and chemical properties of elements in Group I,II, VII and VIII.	• Trends in various Groups in periodic table: As chemical relativity of group I, II, and VII, elements • Properties of elements in periodic table: such as solubility, effect of heat on compounds, melting points, boiling points and displacement reactions.	• Investigating the characteristics of representative elements from Groups and effects of halides. • Classifying elements according to their Groups and Periods	• Awareness of elements and their positions on the Periodic Table • Appreciating the uses of elements on the Periodic Table in everyday life

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.8.2.3 Describe the importance of halogens 11.8.2.4 Describe the harmful effects of halides. 11.8.2.5 Use the noble gases in providing an inert atmosphere	For Group VII consider atomicity, colour changes, changes in physical states, for Group I including description as a collection of soft metals. • Importance of halogens: Such as fluoride in toothpaste,chlorine in water treatment, antiseptic, bromide in photographic film • Harmful effects of halides: :such as drugs, pesticides, CFCs in ozone layer depletion (CFCs) • The significance of their non reactivity in providing an inert atmosphere. Such as argon in electrical lamps, helium in balloons.	• Interpreting data on the periodic table about trends in groups • Investigating the effects of halides.	• Applying safety rules when experimenting.
	11.8.3 Transition metals	11.8.3.1 Describe what transition metals are	• Transition metals as a block of elements between Group II and Group III of the Periodic Table	• Investigating the physical and chemical properties of transition elements. • Identifying transition metals	• Appreciating transition metals and their uses • Applying safety rules when experimenting.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		11.8.3.2 Describe general properties of transition metals. 11.8.3.3 Describe the uses of transition metals	• Properties of transition metals: As variable valences, high densities, high melting points, form coloured compounds, catalysts. **Note**: Electronic configuration of transition metals will **not** be required • Uses of transition metals: such as catalysts, alloys, engineering materials NB:Heavy metals are no longer used to make paint for health reasons		

Grade 12

Key competences:

- Demonstrate ability to determine the reactivity series of metals
- Demonstrate ability to prepare and test gases
- Demonstrate ability to identify organic compounds

UNIT 10.0METALS

General Outcomes:

- Demonstrate an understanding of metals
- Develop investigative skills about some properties and uses of metals.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
12.10 Metals	12.10.1 General properties of a metals	12.10.1.1 Describe diagrammatic representations of pure metals 12.10.1.2 Describe the physical properties of metals. 12.10.1.3 Describe the chemical properties of metals	• The diagrammatic representations of pure metals: Similar nuclei positive ions in a 'sea' of delocalised electrons. • The physical properties of metals: in terms of density, melting points, boiling points, appearance • The chemical properties of metals: All metals are electropositive as illustrated in the reaction with air, water / steam, dilute non-oxidizing acids, aqueous solutions of other metal ions.	• Investigating the properties of metals. • Experimenting with different metals.	• Awareness of metals • Fostering team work.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	12.10.2 Reactivity and Electro Chemical Series	12.10.2.1 Describe the reactivity series of metals	• The reactivity series of metals: As arrangement of metals in the order of either their increasing or decreasing order of reactivity as being potassium, sodium, calcium, magnesium, aluminium, zinc, iron, lead, (hydrogen), copper and silver	• Comparing methods of extracting metals • Investigating the reactivity of metals • Predicting the position of a metal in the reactivity series • Communicating the uses of metals in everyday life • Investigating the harmful effects of some metals	• Awareness of methods of extracting metals and dangers some metals pose. • Awareness of the use of metals in everyday life. • Caring for the environment to avoid harmful effects of some metals.
		12.10.2.2. Explain the apparent non reactivity of aluminium.	• Apparent non reactivity of aluminium: Due to the presence of adhesive oxide/coat. Reactivity of aluminium due to adhesive coat		
		12.10.2.3 Demonstrate an order of reactivity.	• An order of reactivity: from a set of experimental results Such as reduction of oxides of metals by other metals		

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.10.2.4 Describe the effects of heat on hydroxides, carbonates, nitrates of metals and ammonium compounds. 12.10.2.5 Describe the extraction of copper, iron, aluminium and zinc from their ores. 12.10.2.6 Describe the uses of copper, iron, zinc and aluminium 12.10.2.7 Explain the harmful effects of some metals.	• Effects of heat on hydroxides, carbonates, nitrates of metals and ammonium compounds: As related to the reactivity/stability of the metallic ion present in the compound. Compounds of more reactive metals difficulty to decompose while compounds of less reactive metals easily decompose. • Extraction of copper, iron, aluminium and zinc: Chemical and electrolytic reduction. Chemical reducing agents being Carbon, carbon monoxide, and hydrogen. • Uses of copper, iron, zinc and aluminium: Such as electrical wires, construction, aircraft parts. • Harmful effects of metals: Such as lead poisoning (brain damaging), sodium ions in raising high blood pressure, alzehermia by aluminium	• Predicting the effects of heat on hydroxides, carbonates of nitrates of metals and ammonium compounds.	

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	12.10.3 Alloys	12.10.3.1Describe what an alloy is 12.10.3.2 Describe diagrammatic representations of alloys. 12.10.3.3 Explain the advantages of using alloys over pure metals. 12.10.3.4 Identify common uses of alloys	• An alloy: As mixture of two or metals/carbon such as steel, brass, bronze • The diagrammatic representations of alloys: Different nuclei positive ions in a 'sea' of delocalised electrons • Advantages of using alloys: Such as alloys exhibiting better properties compared to a pure metal (conductor, strength, weight ratio, hardness) • Common uses of alloys: Such as cutlery, food packaging, aircraft.	• Investigating the characteristics of alloys • Comparing structures of alloys and pure metals. • Communicating of alloys in everyday life.	• Appreciating the use of alloys in everyday life. • Awareness of the use of alloys in everyday life. • Fostering team work.
	12.10.4 Corrosion	12.10.4.1 Describe what corrosion is 12.10.4.2 Relate corrosion to the reactivity of metals.	• Corrosion: As chemical wearing of metals resulting from attack by atmospheric oxygen in presence of moisture. • The corrosion to the reactivity of metals: As more reactive metals easily corrode while less reactive metals do not easily corrode.	• Observing of metals. corrosion. • Relating sacrificial protection methods to reactivity series	• Appreciating ways of minimizing corrosion. • Applying methods of reducing corrosion.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.10.4.3 Describe the different methods of preventing corrosion.	• The methods of preventing corrosion: Such as sacrificial protection, painting, greasing/oiling, alloying and galvanising.	• Communicating information in corrosion.	

UNIT 11.0 NON- METALS

General Outcomes:

- Demonstrate an understanding of Non- metals.
- Develop investigative skills about some industrial uses of non-metals

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
12.11 Non Metals	12.11.1 General properties of non-metals.	12.11.1.1 Describe the physical and chemical properties of non-metals.	• The physical and chemical properties of non-metals: In terms of density, melting points, boiling points, oxidizing agent (electronegative elements)	• Investigating the physical and chemical properties of non-metals • Predicting melting and boiling points of non metals	• Awareness of non-metals.
	12.11.2. Hydrogen	12.11.2.1. Demonstrate the laboratory preparation, collection and test for hydrogen.	• Laboratory preparation, collection and test for hydrogen : By action of moderate reactive metals on water/steam and dilute acids and collect by upward delivery method, puts out a lighted splint with a 'pop' sound	• Experimenting the laboratory preparation of hydrogen. • Predicting the test for hydrogen gas • Communicating the uses of hydrogen in everyday life.	• Appreciating the use of and hydrogen in everyday life. • Awareness of the test for hydrogen • Cooperating in group work..

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.11.2.2 Describe the physical and chemical properties of hydrogen 12.11.2.4 Describe industrial manufacture of hydrogen. 12.11.2.6 Describe the uses of hydrogen.	• The physical and chemical properties of hydrogen: In terms of colour,**o**dour,**d**ensity/"**w**eight",**s**olubilityand chemical (effect on**l**itmus,**i**nflammability,**p**oisonous, **s**upport of combustion)(COWSLIPS) • Manufacture of hydrogen: By cracking, electrolysis of water (brine) and from natural gas • Uses of hydrogen Such as reducing agent, fuel for rockets, manufacturing ammonia and margarine, balloons filler, welding		
	12.11.3. Oxygen	12.11.3.1 Demonstrate the laboratory preparation, collection and test for oxygen.	• Laboratory preparation, collection and test for oxygen By catalytic decomposition of hydrogen peroxide and thermal catalytic decomposition of potassium chlorate, collected above water and re-lights the glowing splint	• Experimenting the laboratory preparation and collection of oxygen • Observing the reactions during the preparation of oxygen	• Appreciating physical and chemical properties of oxygen and its uses. • Applying safety rules when preparing oxygen in the laboratory.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.11.3.2 Describe the physical and chemical properties of oxygen. 12.11.3.3 Describe the industrial manufacture of oxygen 12.11.3.4 Describe the uses of oxygen in industry and in natural processes 12.11.3.6 Explain the importance of ozone layer and dangers of its depletion. 12.11.3.7 Demonstrate the chemical test for water	• The physical and chemical properties of oxygen: Such as colour, odour, solubility ,combustion • Manufacture of oxygen: By fractional distillation of liquid air • Uses of oxygen: Such as burning, welding, in blast furnace and respiration • Importance of ozone layer and dangers of its depletion: It traps radiation, if depleted by CFCs causes skin cancer, respiratory diseases • Chemical test for water: Using white anhydrous copper (II) sulphate which turns blue.	• Predicting the test for oxygen • Communicating information about oxygen.	• Care for the environment when disposing waste products from the experiment. .

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	12.11.4 Nitrogen	12.11.4.1 Describe industrial manufacture of nitrogen. 12.11.4.2 Explain the characteristics and importance of Nitrogen as a gas. 12.11.4.3 Demonstrate the preparation collection and test for ammonia in the laboratory 12.11.4.4 Describe the manufacture of ammonia.	• Manufacture of nitrogen: By fractional distillation of liquid air • Characteristics and importance of Nitrogen : As non reactive insoluble gas hence used as refrigerant, food packaging. Manufacture of ammonia gas. • The preparation collection and test for ammonia: Action of a base on ammonium salt and collected by upward delivery method, turns damp red litmus paper blue. • Manufacture of ammonia: Haber Process (Temperature, catalyst, pressure (Haber process).	• Experimenting the laboratory preparation of ammonia • Observing colour changes during the preparation of ammonia • Communicating information on manufacture of ammonia • Using the model of haber process.	• Awareness of physical and chemical properties of nitrogen and ammonia and their uses • Care for the environment when disposing by experiment • Cooperating in group work • Caring for the environment when using fertisers. .

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.11.4.5 Describe the physical and chemical properties of ammonia. 12.11.4.8 Describe the thermal dissociation of ammonium salts. 12.11.4.9 Describe the uses ammonia 12.11.4.10 Describe the manufacture of nitric acid 12.11.4.10 Explain the importance of nitrogenous fertilizers 12.11.4.11 Describe the effects of nitrogenous fertilizers on the environment	• The physical and chemical properties of ammonia: In terms of **c**olour, **o**dour, **d**ensity/"**w**eight", **s**olubility and as reducing agent, a base/alkali, a complexing reagent. • Thermal dissociation of ammonium salts: Such as ammonium chloride, ammonium nitrate, ammonium carbonate • The uses of ammonia: In manufacture of fertilizers, explosives, nitric acid • Manufacture of nitric acid: by Ostwald Process • Importance of nitrogenous fertilizers: Nitrogen for growth. Include Phosphorous for root development and potassium for seed formation (NPK) • Effects of nitrogenous fertilizers on the environment: Such as eutrophication and acidic soils		

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	12.11.7 Carbon and carbonates	12.11.7.1 Describe what allotropes are 12.11.7.2 Describe the physical properties of the allotropes of carbon. 12.11.7.3 Describe the formation and properties of carbon monoxide.	• Allotropes: As different forms of an element existing in the same physical state • The physical properties of the allotropes of carbon: In terms crystalline and non-crystalline allotropes of carbon • Formation and properties of carbon monoxide: By incomplete combustion of carbon and carbon compounds, reduction of carbon dioxide by carbon. In terms of colour, odour, density, solubility, poisonous. Reacts as reducing agent.	• Experimenting the laboratory preparation of carbon dioxide • Observing colour changes during the preparation of carbon dioxide • Communicating the uses of Carbon dioxide in everyday life. • Communicating information on the green house effects.	• Awareness of physical and chemical properties of carbon dioxide and limestone and their uses. • Awareness of Global warming • Appreciating the use of Carbon dioxide and lime in everyday life. • Caring for the environment when disposing by products of an experiment. • Cooperating in group activities.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.11.7.4 Demonstrate the laboratory preparation, collection and the test for carbon dioxide. 12.11.7.4 Describe the physical and chemical properties of carbon dioxide. 12.11.7.5 Describe the uses of carbon dioxide. 12.11.7.6 Describe the manufacture of lime from limestone. 12.11.7.7 Describe the uses of lime and slaked lime.	• Laboratory preparation, collection and the test for carbon dioxide: By reaction of dilute acids with carbonates or bicarbonates, collected by downward delivery method/ above water, forms white precipitate with limewater • The physical and chemical properties of carbon dioxide: In terms of colour, odour, density, solubility. Reactions with limewater/alkalis, water and carbon • Uses of carbon dioxide: Such as in fire extinguishers, carbonated drinks, dry ice, baking, photosynthesis • Manufacture of lime from limestone: By thermal dissociation of limestone • Uses of lime and slaked lime: Such as in neutralizing acidic soils, lime as a drying agent for ammonia		

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.11.7.8 Describe the uses of limestone. 12.11.7.9 Describe the green house effect	• Uses of limestone: Such as in manufacturing of lime, cement, glass, iron • Green house effect: As global warming due to increase of carbon dioxide in the atmosphere		

UNIT 12.0 O RGANIC CHEMISTRY

General Outcomes:

- Demonstrate an understanding of Organic Chemistry
- Develop investigative skills about organic compounds

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
12.12 Organic Chemistry	12.12.1 Saturated and unsaturated Hydrocarbons	12.12.1.1 Describe what an organic compound is 12.12.1.2 Describe what hydrocarbon is 12.12.1.3 Name the structures of the aliphatic alkanes up to five carbon atoms. 12.12.1.4 Demonstrate the structures of isomers and their names.	• Organic compound: As a compound of carbon other than oxides and carbonates • Hydrocarbon: As a binary compound of carbon and hydrogen. • Structures of the aliphatic alkanes: Involve concept of catenation (Chain), use the general formula C_nH_{2n+2}, Named by IUPAC system, all should end with *ane*, • Structures of isomers: Use idea of branched(side chains) and unbranched butane and pentane and nomenclature follows IUPAC system	• Comparing alkanes and alkenes • Comparing properties of alkanes and alkenes • Observing colour changes during the reactions of alkalis • Comparing different fractions of circle oil.	• Appreciating economic values of alkanes and alkenes. • Awareness of organic compounds. • Caring for the environment when using organics compounds. • Participating actively in group activities. • Awareness of the uses of alkalines and alkalies .

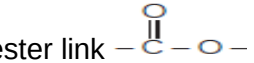
TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.12.1.5 Describe what fractional distillation of petroleum (crude oil) is 12.12.1.6 Describe the uses of the fractions of crude oil 12.12.1.7 Describe the chemical properties of alkanes. 12.12.1.8 Account for the apparent non reactivity of alkanes as compared to other organic compounds 12.12.1.9 Illustrate instauration in alkenes.	• Fractional distillation of petroleum: As different fractions of crude oil collected at different boiling temperatures • Uses of the fractions of crude oil: Such as domestic fuel, road construction. NB: leaded fuel is no longer recommended due to harmful effects • Chemical properties of alkanes: Such as combustion, cracking, substitution, steam reforming • The apparent non reactivity of alkanes: Lack of a specific site of chemical attack (functional group) and they are saturated. • Instauration in alkenes: Using the concept of		

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.12.1.10 Name the structures of the alkenes up to 5 carbon atoms. 12.12.1.11 Demonstrate the structures of isomers of alkenes. 12.12.1.12 Describe the chemical properties of alkenes.	catenation and models. • Structures of the alkenes up to 5 carbon atoms: Use the concept of catenation and the general formula $C_nH_{2n.}$ Structures must contain one carbon to carbon double bond. Named using the IUPAC system all should end with- *ene* • Structures of isomers of alkenes: Using the unbranched structures of butene and pentene (positional isomers) • Chemical properties of alkenes: Such as combustion, addition reactions (hydrogenation, hydration, hydrohalogenation, halogenation, addition polymerisation)		

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.12.1.13 Illustrate the differences and similarities between saturated and unsaturated Hydrocarbons 12.12.1.14 Describe the chemical tests for unsaturated hydrocarbons (alkenes) 12.12.1.15 Describe the uses of alkenes.	• Differences and similarities between saturated and unsaturated Hydrocarbons: Using structures and bromine solution to distinguish between saturated and unsaturated hydrocarbons • The chemical tests of hydrocarbons: As alkenes decolourise bromine solution rapidly. • Uses of alkenes: As in formation of polymers (Petrochemical industries)		

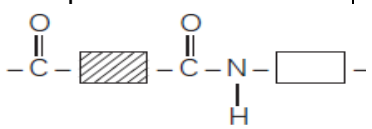
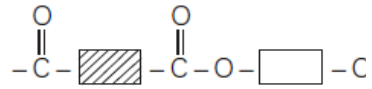
TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	12.12.2 Alcohols (Alkanols)	12.12.2.1 Describe the chemical composition of an alcohol. 12.12.2.2 Name structures of primary alcohols up to five carbon atoms. 12.12.2.3 Demonstrate isomerism in alcohols 12.12.2.4 Describe the formation of alcohols.	• Chemical composition of an alcohol: As an organic compound with a hydroxyl group with general formula $C_nH_{2n+1}OH$ • Structures of primary alcohols up to five carbon atoms: Using concept of catenation (Chain). Named following IUPAC nomenclature and all should end with- ***ol***). • Isomerism in alcohols: Using branched and unbranched and positional isomers of propanol, butanol and pentanol. • Formation of alcohols: By hydration of alkenes, hydrolysis of esters and fermentation for ethanol	• Identifying structures of alcohols. • Communicating isomerism in alcohols using models. • Predicting structures os alcohols based on the general formula. • Investigating the properties of alcohols.	• Appreciating the properties and economic uses of alcohols • Caring for the environment for the environment in the experiment when experimenting with alcohols.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.12.2.5 Describe the chemical properties of alcohols 12.12.2.6 Describe the uses of alcohols	• Chemical properties of alcohols: Such as combustion,esterification,dehydration and oxidation • Uses of alcohols: Such as fuel, antiseptic, organic solvent, alcoholic beverages.		
	12.12.3 Carboxylic acids (alkanoic acids)	12.12.3.1 Name structures of carboxylic acids up to five carbon atoms. 12.12.3.2 Describe the formation of carboxylic acids	• Structures of carboxylic acids up to five carbon atoms: Using concept of catenation (Chain), organic compounds with a carboxylic group (COOH), general formula $C_nH_{2n+1}COOH$, all should end with- ***oic acid.*** • Formation of carboxylic acids: By the oxidation of alcohols and hydrolysis of esters	• Inferring the structures of carboxylic acids • Investigating the chemical properties of carboxylic acids • Communicating the uses of Carboxylic acids in everyday life • • Predicting structures of Carboxylic acids based on general formula.	• Appreciating the properties and economic uses of carboxylic acids. • Applying safest rules when using Carboxylic acids. • Cooperating in group activities.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.12.3.3 Demonstrate the chemical properties of carboxylic acids. 12.12.3.4 Describe the uses of carboxylic acids	• Chemical properties of carboxylic acids: Such as reaction with bases, carbonates, metals and alcohols (esterification) • Uses of carboxylic acids: Such as formation of esters		
	12.12.4 Esters (Alkanoates)	12.12.4.1 Name the structures of esters up to five carbon atoms. 12.12.4.2 Describe the chemical properties of esters 12.12.4.3 Describe the uses of esters	• Structures of esters up to five carbon atoms: Using the concept of catenation (Chain), Organic compounds with an ester link  and all should end with ***–oate*.** • Chemical properties of esters: Such as combustion and hydrolysis • Uses of esters: Such as in perfumes, food flavourants because of having pleasant smell.	• Observing the structures and characteristic properties of esters • Communicating the chemical properties of esters	• Participating actively in class work. • Caring for the environment when using Esters in everyday life. • the properties and economic uses of esters.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	12.12.5 Homologous series	12.12.5.1 Describe what homologous series is 12.12.5.2 Describe the general characteristics of homologues (members).	• Homologous series: As a collection of organic compounds belonging to the same family with the same general formula (consider alkanes, alkenes, alcohols, acids, esters). • The general characteristics of homologues: Such as members of each homologous series have the same general formula and similar chemical properties. Physical properties (states, melting point, boiling point, density, solubility) of members show gradual changes as molecular mass changes. Adjacent members differ by CH_2 and have a general method of preparing members.	• Classifying the different homologous series. • Communicating information on the homologous series.	• Awareness of homologous series. • Fostering team work.

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
	12.12.6 Macromolecules (Polymers)	12.12.6.1 Describe what macromolecules (polymers) are	• Macromolecules (polymers): As giant molecules formed by combination of many small molecules (monomers)	• Classifying macromolecules • Identifying linkages in different macromolecules	• Awareness of polymers. • Appreciating economic use of polymers. • Caring for the environment when using macromolecules in everyday life. • Cooperating in group work.
		12.12.6.2 Describe what synthetic macromolecules are.	• Synthetic macromolecules: As human made giant molecules (polymers).	• Comparing the structure of nylon and teryline • Predicting the structure of different macromolecules based in the monomers they contain.	
		12.12.6.3 Describe the formation of polyalkenes.	• Formation of polyalkenes: By addition polymerisation E.g. polyethene, polyvinylchloride, polypropene, polystyrene.		
		12.12.6.4 Classify the types of plastics	• Types of plastics: As thermal plastics and non-thermal plastic		
		12.12.6.5 Describe the formation of nylon and Terylene.	• Formation of nylon and Terylene: By condensation polymerisation, Nylon: from a diamine and dioic acid structures		

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
			represented as:  Terylene: from diol and dioic acid. Structures represented as: 	• Comparing natural and man made macromolecules • Identifying of linkages in nature/macromolecules • Designing an experiment to investigate the hydrolysis of fats and its products.	• Caring for the environment when disposing by products of an experiment.
		12.12.6.6 Differentiate between the structure of Nylon and Terylene.	• Different structure of Nylon and Terylene: Nylon as polyamide and Terylene as polyester.		
		12.12.6.7 Describe typical uses of plastics and synthetic fibres.	• Typical uses of plastics and synthetic fibres: Plastics used as in carrier bags, buckets, pipes Nylon and terylene as in clothing, tents, strings, ropes.		
		12.12.6.8 Describe the biodegradability of synthetic fibres.	• Biodegradability of synthetic fibres: As non-biodegradable (cannot be broken down by microorganisms)		

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.12.6.9 Describe what natural macromolecules are	• Natural macromolecules: Such as Carbohydrates, proteins and fats (lipids)		
		12.12.6.10 Describe composition of carbohydrates	• Composition of carbohydrates: Carbohydrates contain carbon, hydrogen and oxygen in the form $C_xH_{2y}O_y$ where x is a multiple of six		
		12.12.4.11 Identify linkages in starch, proteins and fats	• linkages of starch, proteins and fats: In starch – glycosidic, –O–□–O–□– Proteins – amide, fats – ester linkages		
		12.12.4.12 Relate linkages in synthetic and natural polymers.	• Linkages in synthetic and natural polymers: Such as difference and similarities between nylon and proteins. Terylene and fats.		

TOPIC	SUBTOPIC	SPECIFIC OUTCOMES	CONTENT		
			KNOWLEDGE	SKILLS	VALUES
		12.12.4.13 Describe hydrolysis of fats (saponification)	• Hydrolysis of fats (saponification): As formation of soaps and glycerine (glycerol)		
		12.12.4.14 Identify the products of the hydrolysis of starch and proteins.	• Products of the hydrolysis of starch and proteins: Using chromatography to identify the amino acids from proteins, simple sugars from starch.		

Chemistry Practical Syllabus

The following points should be considered during practical in chemistry:

(i) The student should have the knowledge of volumetric analysis in relation to one set of titrations.
The student is expected to comprehend acid-alkali titrations using ordinary methyl orange, screened methyl orange, phenolphthalein or any other suitable indicator. Other titrations using different reagents may be set as well e.g. redox titration.

(ii) Other experiments involving the determinations of quantity, temperature change and rates of reactions are necessary. Experiments of this nature will rely on the use of ordinary apparatus in the laboratory.

(iii) Experiments involving identification of an unknown substance or mixture could be set. A learner is expected to observe and investigate the expected outcome. This may comprise elementary chromatography and simple tests for oxidising and reducing agents. Detailed analysis is not necessary but a learner is expected to have the knowledge of the reactions of the cations with aqueous sodium hydroxide and aqueous ammonia which should include elementary cations like aluminium, ammonium, calcium, copper(II), iron (II), iron (III) and zinc.
A learner should also carry out the tests for the anions such as carbonate, chloride, iodide, nitrate and sulphate. Chemical tests for gases which should include ammonia, carbon dioxide, chlorine, hydrogen, oxygen and sulphur dioxide.
Organic substances and ions not mentioned above may be included in the practical sessions. A learner is expected to have sufficient knowledge in this area. Examination involving different salts with cations similar to the ones specified above may be set but candidates are expected to draw out their conclusions from the observations.
N.B. No note books, course books, information booklets and text books will be allowed in the practical examination.
A learner shall be expected to perform simple calculations as outlined by the chemistry syllabus. However non programmable calculators are allowed.

Practical techniques

Schools and students are reminded of the importance of accuracy in quantitative and qualitative exercises during the practical lessons.

(i) A learner is expected to read the burette accurately and to the nearest volume of 0.1cm^3. At least 3 titrations should be done by a student to ensure a correct result and marks. Only values that fall within ±0.2 with respect to the supervisor's volume will score full marks.

(ii) A student is expected to take note of the temperature readings to the nearest 0.5^oC. Recommended thermometer range is -10^oC to 110^oC. The time should be recorded in seconds and the stop clock/stop watch will be the most convenient timing instrument.

(iii) Learner must show the ability to ignore certain values on the titration table and use only those that are consistent and compute the average of the consistent values. Consistent values must fall within 0.2 to one another.

- In case of qualitative exercises a learner should use around 1cm depth of a solution i.e. (about 2cm^3) in a test tube. Reagents should be added drop by drop and thoroughly mixing them, to ensure effective results for each test. The student should make sure that no further changes may occur if more reagents are added. A learner should take note of the stage at which the precipitate forms and also the colour changes. Furthermore the learner must take note of chemicals used to detect gases, if any, during the experiments. Observations must be recorded as stipulated in the qualitative notes. Equations are not required during practical.

Apparatus

The following apparatus should be stocked for teaching and examination purposes. Each learner should be provided with the necessary apparatus to conduct the experiments.

Bunsen burner
Test-tubes
Measuring cylinder calibrated 25cm^3 or 50cm^3.
Filter funnel.
Beaker (polystyrene, glass) volume of 250cm^3.
Conical flasks with volume of 250cm^3.
Burette with a volume of 50cm^3.
Pipettes with volumes of 25cm^3 or 20 cm^3
Pipette fillers.
Thermometers calibrated -10^oC to 110^oC at intervals of 1^oC.
Stop clocks/stop watches which record time in seconds.

Wash bottles.
Pyrex test tubes are essential for heating purposes with capacities 125mmx 16mm.
Boiling tubes i.e. of dimension 150mm x 25mm.
Stirring rods for stirring or mixing purposes.
Electronic balances /triple beam balances.

Reagents

The following standard reagents should be stocked among others. These are of paramount importance during practical.

Hydrochloric acid 1.0 mol/dm^3
Nitric acid 1.0 mol/dm^3
Sulphuric acid 0.5 mol/dm^3
Aqueous ammonia 1.0 mol/dm^3
Aqueous sodium hydroxide 1.0mol/dm^3
Lime water (a solution of calcium hydroxide)
Aqueous silver nitrate 0.05 mol/dm^3
Aqueous potassium dichromate (VI) 0.1 mol/dm^3
Aqueous potassium iodide 0.1 mol/dm^3
Aqueous lead (II) nitrate 0.2 mol/dm^3
Aqueous potassium permanganate (VII) approximate 0.02 mol/dm^3
Barium nitrate 0.2 mol/dm^3

In addition chemical substances such as aluminium foil, red litmus paper, blue litmus paper and universal indicators should be in stock.

QUALITATIVE ANALYSIS TESTS

Notes for use in qualitative analysis

Test for anions

Anions	Test	Test result
Carbonate (CO_3^{2-})	Add dilute acid	Effervescence occurs, carbon dioxide produced
Chloride (Cl^-) [in solution]	Acidify with dilute nitric acid , then add aqueous silver nitrate	White ppt.
Iodide (I^-)[in solution]	Acidify with dilute nitric acid , then add aqueous lead (II) nitrate	Yellow ppt.
Nitrate (NO_3^-)[in solution]	Add aqueous sodium hydroxide, then aluminum foil, warm carefully.	Ammonia produced
Sulphate (SO_4^{2-}) [in solution]	Acidify with dilute nitric acid, then add aqueous barium nitrate	White ppt.

Test for aqueous cations

Cations	Effect of aqueous sodium hydroxide	Effect of aqueous ammonia
Aluminium ions (Al^{3+})	White ppt.soluble in excess giving a colourless solution	White ppt., insoluble in excess
Ammonium ions (NH_4^+)	Ammonia produced on warming	-
Calcium ions (Ca^{2+})	White ppt., insoluble in excess	No change
Copper ions (Cu^{2+})	Light blue ppt., insoluble in excess	Light blue ppt., soluble in excess, giving a dark blue solution
Iron(II) ions (Fe^{2+})	Green ppt., insoluble in excess	Green ppt., insoluble in excess, turns reddish-brown on standing
Iron (III) ions (Fe^{3+})	Red-brown ppt., insoluble in excess	Red-brown ppt., insoluble in excess
Zinc ions (Zn^{2+})	White ppt.,soluble in excess giving a colourless solution	White ppt. soluble in excess giving a colourless solution.

Test for gases

Gas	Test	Test result
Ammonia	Introduce damp red litmus paper to the gas	Turns damp red litmus paper blue
Carbon dioxide	Bubble the gas through limewater	White precipitate formed
Chlorine (Cl_2)	Introduce damp blue litmus paper to the gas	Turns litmus paper red then bleaches it
Hydrogen (H_2)	Introduce a lighted splint into the gas	Puts out the lighted splint with a 'pop'sound
Oxygen (O_2)	Introduce a glowing splint into the gas	Glowing splint relighted
Sulphur dioxide (SO_2)	Bubble the gas through acidified potassium dichromate (VI)	Turns orange potassium dichromate green.