ZIMBABWE

MINISTRY OF PRIMARY AND SECONDARY EDUCATION

O- LEVEL PHYSICS SYLLABUS

FORMS 3 - 4

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1.0 PREAMBLE

1.1 Introduction

This syllabus is designed to put greater emphasis on the understanding and application of physical concepts and principles. It make learners identify, investigate and solve problems in a sustainable manner. This two - year learning phase will see learners being assessed through continuous assessment and national examination. The 'O' level Physics syllabus is designed to inclusively cater for all categories of learners.

1.2 Rationale

Modern day economies, Zimbabwe included, are driven by technology and Physics concepts form part of the basis. The study of Physics enables learners to be creative and innovative in industry and society can promote the application of physics in industrial processes for value addition is well known. The learning of Physics concepts promotes value creation, addition and beneficiation of natural resources and harness available opportunities for entrepreneurship.

1.3 Summary of Content

'O' level Physics syllabus will cover theory and practical activities in the following areas:
Newtonian Mechanics, Dynamics, Waves, Electricity and Electromagnetism, Thermal Physics and Modern Physics.

1.4 Assumptions

It is assumed that:

- the learner has successfully completed Form 1 and 2 Science syllabus.
- Science clubs are existing and operational in schools.
- use of ICT for research and presentation is known by learners.
- use of measuring instruments such as rulers, balances, second-hand clocks, voltmeters, ammeters and thermometers is known by learners.
- safety measures are available and observed.

1.5 Cross- Cutting Themes

This phase will develop an appreciation of:

- Inclusivity
- Environmental issues
- Indigenous knowledge system
- Financial literacy
- Enterprise Education
- Gender
- HIV and Life skills
- Child Protection.
- Team work
- Food security
- Safety health issues
- Disaster risk management

2.0 PRESENTATION OF THE SYLLABUS

The Ordinary Level Physics syllabus is a single document covering Forms 3 - 4. It contains the Preamble, Aims, Syllabus Objectives, Syllabus Topics, Methodology and Time Allocation, Scope and Sequence, Competency Matrix and Assessment. The Scope and Sequence chart shows the progression of topics from Forms 3 - 4, while the syllabus matrix gives details of the content to be covered.

3.0 AIMS

The aims are to:

3.1 create opportunities for learners to acquire research, experimental and practical skills and attitudes in Physics.

3.2 enable learners to acquire basic principles of Physics for application in life and as a basis for further studies in Physics and related disciplines.

3.3 recognise the usefulness and limitations of the scientific method in the study of Physics.

3.4 inculcate in learners the desire to apply Physics for the benefit of society as guided by the principles of Unhu/Ubuntu and recognising the detrimental effects of misapplication of Physics.

3.5 inculcate in learners the appreciation of the usefulness of ICT in the study and application of Physics.

3.6 develop, in learners the appreciation of the use of Physics in value creation, addition and beneficiation in mining and other industries.

3.7 inculcate in learners the regard for safety and protection of the environment in the study of Physics.

3.8 develop in learners an appreciation of gender, HIV and AIDS issues.

4.0 OBJECTIVES

Learners should be able to:

4.1 follow instructions in practical work in order to manipulate record observations and analyse data to confirm or establish relationships

4.2 demonstrate knowledge about physical phenomena, facts, laws, definitions and concepts of Physics.

4.3 measure and express physical quantities in SI units to a given level of accuracy and precision.

4.4 solve problems using calculations

4.5 generate and transform information in Physics, from one form to another for presentation, interpretation and problem solving.

4.6 design a practical solution through a Physics project to solve a real life problem

4.7 use ICT to simulate Physics phenomena, present and analyse Physics data

4.8 apply safety measures in all practical work

4.9 explain and apply procedures in Physics to protect the environment

5.0 METHODOLOGY AND TIME ALLOCATION

Suggested Methods

It is envisaged that teaching and learning programmes based on this Physics syllabus could feature a wide variety of learning experiences designed to promote acquisition of scientific expertise and understanding, and to develop values and attitudes relevant to science and life. Teachers are encouraged to use a combination of appropriate strategies to effectively and equitably engage and challenge their learners through:

- Planned experiments
- Problem solving based learning
- Individual and group work
- Educational tours

- Project based learning
- Design based learning
- Learning by discovery
- E-learning such as simulation
- Resource person(s)

N.B. Ortho-didactic principles, such as visual tactile, simulation and self-activity, will be applied when need arises to cater for diverse needs of learners.
Safety precautions must always be observed.

Time Allocation

A minimum of 8 periods of 35 minutes each in a week should be allocated as double periods for adequate coverage of the syllabus

6.0 TOPICS

1. Measurement and Physical Quantities
2. Kinematics
3. Forces
4. Machines
5. Mechanical Structures
6. Work, Energy and Power
7. Thermal Physics
8. Internal Combustion Engines
9. Waves
10. Optics
11. Electricity
12. Magnetism
13. Electromagnetism
14. Electronics
15. Atomic and Nuclear Physics

6.0 SCOPE AND SEQUENCE CHART

TOPIC	FORM 3	FORM 4
1.0 MEASUREMENT AND PHYSICAL QUANTITIES **1.1 Measurements**	• Measurement of physical quantities. • Derived quantities • Use of S.I. units	• Definition of voltage, resistance and current • Experiments to measure voltage, current and determine resistance for ohmic conductors
1.2 Scalars and vectors	• Definitions and examples • Resultant of coplanar vectors using graphical method • Applications	
2.0 KINEMATICS **2.1 Speed, velocity, distance, displacement and acceleration**	• Definitions of terms • Equations of linear motion and application	
2.2 Graphs of motion	• Drawing and interpretation of graphs	
2.3 Motion under gravity	• Definition of free fall • Calculations and applications	
3.0 FORCES **3.1 Effect of force on materials**	• Types of forces • Interpretation of force extension-graphs	• Application of forces on beams, trusses and mechanical large structures
3.2 Effect of force on motion	• Definitions of weight, momentum and inertia • State and apply Newton's laws of motion • Circular motion	
3.3. Friction and circular motion	• Effects of friction • Methods of friction • Centripetal acceleration and force	
3.4 Turning effects of a force	• Moments of a force • Turning effect of a force • Principles of moments	

	• Application of moments	
3.5 Centre of mass/centre of gravity	• Definitions of terms • Determination of centre of mas • Stability	
3.6 Pressure	• Definition • Calculations • Pressure in fluids and applications	
4.0 MACHINES	• Definition • Experiments involving inclined planes, levers and pulleys	
4.1. Simple machines	• Definitions • Experiments involving: - inclined plane - levers - pulleys - calculation of velocity ratio. Mechanical advantage and efficiency.	
5.0. MECHANICAL STRUCTURES		
5.1 Mechanical structures	• Beams, trusses, joining materials and large structures	
6.0 WORK, ENERGY AND POWER		
6.1 Work	• Definition • Calculation of work done	
6.2 Energy	• Definition • Types and sources of energy • Energy conversion • Law of conservation and conversion of energy • Calculations involving energy	

6.3 Power	• Definition • Calculations involving power	.
7.0 THERMAL PHYSICS **7.1 Kinetic theory of matter**	• Definition of matter • States of matter and their physical properties	
7.2 Thermal properties	• Simple experiments to demonstrate thermal properties	• Calculation of heat capacity and latent heat • Measurement of temperature
7.3 Heat transfer	• Modes and mechanisms of heat transfer and their applications • Experiments on modes of heat transfer	
8.0 INTERNAL COMBUSTION ENGINES		• Describe the operations of a four stroke engine • Explain the role of the carburettor • State the advantage of multiple cylinders in an engine • Compare the operations of a diesel and petrol engine
9.0 WAVES **9.1 Types of waves**	• Definition and classification of waves	
9.2 Wave properties	• Experiments to demonstrate wave properties and characteristics	
9.3 Sound	• Production and sound waves • Experiments to determine speed of sound	
9.4 Electromagnetic waves	• Electromagnetic spectrum • Application of electromagnetic waves	
10.0 OPTICS		• Application of waves: light • Laws of reflection • Experiments using plane mirror • Ray diagrams • Laws of refraction • Experiments to demonstrate refraction • Snell's law and application Experiments on dispersion of light
11.0 ELECTRICITY		

11.1 Electrostatics		• Charging • Interaction between charges • Field lines • Application of electrostatics • Safety and hazards
11.2 Primary and secondary cells		• Definition of terms • Power sources • Measurement of electrical entities • Ohm's law and resistance • Safety
11.3 Current electricity		• Definition of terms
11.4 Electric circuits		• Electric components • Constructing simple circuits
11.5 Electricity in the home		• Wiring of three pin plugs • Use of two pin plugs • Safety precautions
12.0 MAGNETISM		
12.1 Magnetic properties		• Properties and interaction
12.2 Application		
13.0 ELECTROMAGNETISM		
13.1 Magnetic effects of an electric current		• Field patterns • Hand rules
13.2 Force on current carrying conductor in magnetic field		• Factors • Hand rules • applications

13.3 Electromagnetic induction		• generator principle • Lenz's law • Applications
13.4 Transformers		• Transformer principle • Efficiency • AC transmission and power loses
14.0 ELECTRONICS **14.1Electronic components**		• Carbon resistors and colour coding • Reed switch
14.2 Logic gates		• Circuit symbols • Construction of truth tables
15.0 ATOMIC AND NUCLEAR PHYSICS		
15.1. Atomic model		• Description of an atomic model • Isotopes
15.2 Radioactivity		• Definition • Types of radioactive emission and their characteristics • Use storage handling and impact of radioactive emission

FORM 3

8.0 COMPETENCY MATRIX

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
1.0 MEASUREMENTS AND PHYSICAL QUANTITIES **1.1 Measurements**	• measure physical quantities; read an instrument scale to the nearest fraction of a division • determine density of regular and irregular objects • express quantities in terms of S.I. units; • Derive other units from base units	• Length, area, volume, mass, time, temperature. • Liquids, regular, irregular objects. • S.I. units. • Newton, joule watt, volt and others.	• Experiments on measuring length, time, mass. • Determining area and volume. • Determining density experimentally for liquids, regular and irregular objects. • Relating density to flotation and sinking. • Deriving units from base units.	• A ruler, Vernier callipers, thermometer, balance stop-watch, micro meter screw gauge, measuring cylinder, force meter

FORM 3

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT(Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
2.0 KINEMATICS **2.1 Speed, Velocity and Acceleration**	• define displacement, speed, velocity and acceleration	• Displacement, speed, velocity and acceleration.	• Using of ticker tape timer experiment or any other method.	• Ticker tape timer and tape • Electronic speed detector
2.2 Graphs of motion	• plot, draw and interpret graphs of motion	• Distance time graph • Determining velocity using distance time graph. • Speed time graph. • Slope of graphs. • Area under graph: distance.	• Determining distance travelled using speed time graphs of graph. • Determining acceleration, speed and distance from graphs.	
2.3 Motion under gravity	• define free-fall; • determine acceleration of free fall	• Free-fall. • Terminal velocity.	• Experimenting on free fall. • Describing qualitatively the motion of bodies falling in a uniform gravitational field. • Solving problems.	

FORM 3

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING AND NOTES	SUGGESTED RESOURCES
3.0 FORCES **3.1 Effects of force on shape and size of materials**	• explain the effects of a force on size and shape of material • plot, draw and interpret extension load graphs • explain Hooke's Law • calculate spring constant	• Deformation of solids. • Tension and compression. • Hooke's Law and Spring constant.	• Experiments demonstrating Hooke's Law. • Determining spring constant. • Simulating spring- mass systems.	• Foam rubber, springs, modelling putty, plasticine elastic bands, masses and mass hangers • Computers.
3.2 Effect of force on motion	• define weight, momentum and inertia • calculate momentum • explain each of Newton's three laws of motion • use relation between force, mass and acceleration	• Weight, momentum, inertia; p = mv F = ma.	**Limited to linear motion**. (Conservation of momentum is not required). • Experimenting on forces changing state of motion	• Trolleys, inertia car force meters, masses, computers, air tracks, polished surfaces • Computer simulations
3.3 Friction and circular motion	• explain the effect of friction on the motion of a body • describe the ways in which force may change the motion of a body • describe qualitatively motion in a curved path due to a perpendicular force	• Friction • Methods of reducing friction. • Centripetal force. • Centripetal acceleration.	• Experiments demonstrating friction. (No reference to static and dynamic co-efficient of friction). • Stating advantages and disadvantages of friction. • Experimenting on circular motion.	• Trolleys, masses, computers, air tracks, polished surfaces, rough surfaces, oil/grease surfaces • Inextensible strings, bobs/plumb-line
3.4 Turning effect of a force	• define moment of a force • describe the moment of a force in terms of its turning	• Moments. • principle of moments.	• Illustrating using everyday examples.	• Doors, levers, wheelbarrows, crowbar, strings, masses,

FORM 3

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING AND NOTES	SUGGESTED RESOURCES
3.4 Turning effect of a force	effect and give everyday examples • perform an experiment to verify the principle of moments • make calculations involving the principle of moments	• Calculation involving moments.		supporters, stands, bars, retort stands, beams
3.5 Centre of mass	• define centre of mass • define centre of gravity • determine the centre of mass of a plane lamina • describe qualitatively the effect of the position of the centre of mass on the stability of objects	• Centre of mass. • Centre of gravity. • Regular and irregular lamina . • Stable, unstable and neutral equilibria.	• Experiments determining position of centre of mass of regular and irregular lamina and other objects. • Experiments demonstrating stable, unstable and neutral equilibria.	• Irregular laminas, plumb line / bob + string, support stands. • Cones, cubes, chairs, ICT tools
3.6 Pressure	• define pressure • calculate pressure	• definition of pressure. • P = F/A.	• Experiments demonstrating pressure due to different surface areas • Calculating pressure of solid objects using appropriate units.	• Cuboids, regular blocks of wood, balances, metre rule, ICT tools

FORM 3

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURSES
	• calculate pressure in fluids • describe effect of depth on pressure • describe atmospheric pressure • use bar patterns to predict type of weather including wind strength and direction • describe the construction and use of a barometer • describe the construction and use of a simple manometer	• Pressure in fluids P=ρgh. • Atmospheric pressure. • Pressure cooker. • Weather patterns. • Applications and hazards. • Manometer.	• Experiments demonstrating variation of pressure with depth • Demonstrating atmospheric pressure • Analysing simple barometer weather charts • Calculating the manometer • Describing hydraulic systems • Describing water reticulation	• Manometer and liquid containers • Magdebug hemispheres • Drinking straws • Rubber suckers • Pressure cooker
4.0 Machines **4.1 Simple machines**	• describe the use and applications of machines • calculate mechanical advantage, velocity ratio and efficiency • explain energy losses in machines. • describe methods of improving efficiency	• Levers, single string pulley systems (at most 6 pulleys), inclined plane: MA = Load / Effort; VR = Distance moved by the effort force/distance moved by the load. Efficiency = MA/VR x 100. • Friction and mass of the machine.	(Classification of levers is <u>not</u> required). **Calculations limited to levers, pulley systems** • Experiments measuring efficiency	• Pulleys, inclined plane, levers, force metre, metre rule, loads and masses

FORM 3

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING AND NOTES	SUGGESTED RESOURCES
4.1 Simple machines		• Lubrication and mass reduction. • Ball bearings. • Smooth surfaces.		
5.0 MECHANICAL STRUCTURES **5.1 Beams**	• define a beam • describe a beam by its cross sectional area • compare the strength of beams • explain the effects of push and pull forces • explain how stress is distributed in a loaded beam	• Beams. • Types of beams. • Qualitative relation between strength, cross-sectional shape and depth. • Compression, tension, shear and buckle. • Compression, tension and natural zones. Internal stress, areas of strength and weakness.	• Using supported bar which bears a load. • Naming T, L, I, Z, O and H shaped beams, solid and hollow box and cylindrical beams. • Carrying out practical work on beams using similar quantities (mass per unit length) of material but different beams • Experiments demonstrating crushing, compressing, buckling and bending, stretching and snapping	• Beams, supports, loads, • ICT tools • Beams of different area sections; T, L, I, W etc. beams, wooden splits • Different types of beams • Metre rules, supports, loads • Foam rubber, elastic bands, glass rods, load/stress • Hollow stems, green twigs, foam rubber • ICT tools • Plasticine • Stik stuff
5.2 Trusses	• construct trusses • explain the use of triangles in a truss • explain the advantages of trusses over beams	• Trusses. Stability. • Economy, strength and strength/mass ratio.	• Defining a truss. • Comparing weight of structures. • Experiments illustrating strength/mass ratio of a beam and truss.	• Beams, pins, nails, loads, retort stands, pivot, metre rule. • Trusses on buildings. • Laboratory models of trusses using wooden splints. • ICT tools.

FORM 3

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING AND NOTES	SUGGESTED RESOURCES
5.2 Trusses	• explain how a load can be distributed throughout a truss; • identify struts and ties in a truss; • explain the design of a roof truss;	• Compressive and tensile forces. • Transmission of forces by connecting members. • Distribution of load	• Experiments determining which members are under tension and which are under compression. • Constructing models	
5.3 Joining materials	• describe methods of joining materials; • compare the strength of joints	• Joining mechanisms; - Pinning: - Surface contact: • Size of contact area, number and position of pins.	• Making and testing strengths of joints. • Gluing with or without dowels and tongue; • Soldering, brazing and welding; Plastics – welding and gluing.	• Wooden, metallic and plastic materials • Beams, screws, nails bolts and rivets; • Glue • Joints
5.4 Large structures	• identify materials used in large structures • compare properties of construction materials • explain the design and materials used in different types of bridges • explain the use of arches in construction of large structures • explain composition and shape of dam walls	• Wood, metal, reinforced concrete and stones. • Compressive and tensile strength, mass and durability. • Pier bridge, beam bridge, arch bridge and Suspension bridge. • Earth and concrete; straight and arch dams	• Naming materials used in large structures. • Comparing properties of construction of materials. • Comparing durability in relation to decay, corrosion and rusting. • Constructing and loading of models. • (No knowledge of material cost is required but an appreciation of both durability and cost as factors in determining choice). • Identifying materials which make dam walls	• Metals beams, wooden beams, cement, concrete, reinforce concrete beams, quarry stones, gravel, sand • ICT tools • Wooden splints, sand, stones, gravel, clay soil

FORM 3

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
6.0 WORK, ENERGY AND POWER **6.1 Work**	• define work done • calculate work done	• Work done;	• Experiments illustrating work done Work = Force x distance	• Force metres, wooden block, metre rule, stop watch, pulleys, and inclined planes.
6.2 Energy	• define energy • describe forms and sources of energy • relate energy conversions and work done	• Energy Sources • Law of conservation of energy • Energy conversions • Calculations involving energy and work • Safe disposal of batteries and accumulators	• Describing forms of energy such as chemical, HEP, sun, nuclear, geo-thermal, wind and tides. (renewable and non-renewable sources) • Naming sources of heat, light, sound, electrical, kinetic gravitational and potential energy. • Giving relationship between energy and work. • Calculating problems on energy. • Safe disposing of batteries and accumulators	• Wooden blocks • Batteries, cells, chemicals, metals Generator/turbines • Solar cells/panels, solar chargers, solar water heater systems • Academic trips to hot springs e.g. Chimanimani hot springs • Computer simulations

FORM 3

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING AND NOTES	SUGGESTED RESOURCES
6.3 Power	• define power • relate power to rate of energy transferred • perform calculations involving power	$\text{Power} = \frac{\text{Energy}}{\text{Time}}$ $\text{Power} = \frac{\text{Work done}}{\text{Time}}$ =Fv	• Carrying out e experiments to determine power.	• Electric motor, meter rule, stop watch, load, string, block of wood, Force meter.
7.0 THERMAL PHYSICS **7.1 The kinetic theory of matter**	• the effect of a change describe states of matter in terms of kinetic theory • explain the physical properties of matter • describe qualitatively the thermal expansion of solids, liquids and gases • explain the relative order of magnitude of expansions of solids, liquids and gases • identify and explain some of the everyday applications and consequences of • thermal expansion • describe qualitatively of temperature on the volume of a gas at constant pressure	• Solids, liquids and gases. • Brownian motion. • Charles's law. • Boyle's law. • Equation of state. P1V1/T1=P2V2/T2	• Carrying out practical activities to demonstrate change of state including Sublimation. • Carrying out experiments to illustrate the properties. • Melting boiling and evaporating. • Diffusion – mixing due to molecular motion. • Experiments on Charles's and Boyle's law.	• Kinetic theory model kit. • Brownian motion model kit • Solids, l iquids and gases • Sources of heat • Chalk/dust. • 2 large syringes communicated by rubber tubing, warm water, thermometer, manometer. • Ice water in a beaker, source of heat, thermometer. • Perfume, bromine, smoke. • Charles' law apparatus. • Boyle's law apparatus

FORM 3

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
7.2 Thermal Properties	• compare qualitatively order of magnitude of expansion of solids liquids and gases • explain applications and consequences of thermal expansion and contraction • describe how a physical property which varies with temperature may be used for measurement of temperature • state such properties	• Thermal expansion and contraction. • Thermostats, thermometers, bridges, railway lines and electrical cables, etc. • Measurement of temperature, fixed points liquid in glass thermometer (laboratory and clinical), thermocouple thermometer, advantages and disadvantages of each type of thermometer.	• Carrying experiments to compare expansion and contraction in solids, liquids and gases. • Carrying out experiments with different thermometers.	• Ball and ring experiment, gouge and bar, empty flask fitted with a rubber stopper with a glass tubing, warm water, cold cloth. • Flask filled with water fitted with a rubber stopper with a glass tubing and warm water and ice water in a bowl. • Thermostats, thermometers, bimetallic strips.
	• state the need for and identify fixed points • describe sensitivity range and linearity • describe different types of thermometers • define and describe melting and boiling in terms of energy transfer without change of temperature • describe the effect of impurities and pressure on melting points and	• Melting and boiling. • Latent heat. • Impurities and pressure.	• Carrying out experiments on expansion and contraction of matter. • Determining melting point and boiling point experimentally and graphically. Consider both heating and cooling curves. • Carry out experiments on the influence of atmospheric pressure and impurities on melting points and boiling points to be discussed in terms	• Calorimeter, elements, solids, water, thermometers, balance • Flat bottomed flasks, tongs

FORM 3

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
	boiling points of substances		of kinetic theory demonstrate.	
	• determine the specific heat capacity of a liquid and a solid • calculate the heat transfer from experimental data • explain why different materials have different heat capacities • define specific latent heat • calculate specific latent heat	• Definition of heat capacity and specific heat capacity(c). $\Delta Q=mc(\vartheta_f-\vartheta_i) = IVt.$ • Heat supplied = heat gained Qloss = Qgained = Qsupplied. • Explanation based on particles. • Fusion, vaporization Heat supplied = heat gained. $\Delta Q= ml.$	• Determining specific heat capacity by experiments. • Carrying out calculations on specific heat capacity. • Explaining differences in heat capacities. • Determining specific latent heat experimentally. • Calculating specific latent heat. (**Assumption: No heat is lost or gained to surrounding**).	• Calorimeter, heating elements, solids, water, thermometers, balance, clock, voltmeter, ammeter, connecting leads, power, funnel, ice
7.3 Heat Transfer	• identify good and bad conductors of heat • give a molecular account of heat transfer in solids • relate convection to density changes in liquids and gases	• Metals, non-metals and liquids. • Conduction. • Convection.	• Carrying out experiments to distinguish. between good and bad conductors of heat. • Carrying out experiments to demonstrate conduction and convection. • Experiments to demonstrate convection.	• Lesley cube/wax Conductor meter • Beaker with water + a colorant i.e. potassium permanganate. • Convection chamber

FORM 3

TOPIC	OBJECTIVES **Learners should be able to**:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
	• describe experiments to distinguish between good and bad emitters/absorbers of infra-red radiation • deduce that good absorbers are also good emitters • explain applications of conduction, convection and radiation • describe the function and design of a solar water heater	• Radiation. • Good and bad emitters/absorber. • Solar cooker and vacuum flask, etc. • Solar water heater. • Sea breezes. • Air vents.	• Carrying out experiments with dull and bright surfaces. • Carrying out experiments with parabolic reflectors. • Carrying out Experiments to demonstrate solar water heating.	• Reflectors, vacuum flask and different surfaces. • Parabolic dish, solar water heater. • Wax • Thermometer • Heater • Air conditioner
8.0 INTERNAL COMBUSTION ENGINES **8.1 Four stroke engine**	• describe the operations of a four stroke engine; • explain the role of the carburettor • state the advantage of multiple cylinders in an engine • compare the operations of a diesel and petrol engine	• Compression, power, exhaust and inlet strokes. • Fuel and air supply. • Even firing and power distribution. • Ignition methods, relevant efficiency and carbon monoxide (soot) production. • Size of parts.	• Explaining importance of a clean fuel supply, effects of limitation of air supply (choke control, blocked filters) and fuel supply (worn out jets). • Using a model to demonstrate strokes. • Explaining e fficiency as measured by fuel economy (kilometres per litre).	• Engine models, • Computer models, carburettor

FORM 3

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
8. 1 Social and economic considerations of using fuels	• identify renewable and non-renewable resources; • fuels • describe the social and economic implication of using fuels;	• Renewable and non-renewable fuels. • Deforestation, effects of the by-products, pollution. • Safe handling of fuels.	• Identifying renewable and non-renewable resources. • fuels	• Wood, charcoal, coal, petroleum, bio gas, ethanol Candles
9.0 WAVES **9.1 Mechanical wave properties**	• describe wave motion • describe characteristics of a wave • calculate velocity, frequency and wavelength • describe propagation of waves in terms of wave fronts and rays.	• Transverse and longitudinal waves. • Amplitude, wavelength, frequency and period T= 1/f, V =fλ • Media for mechanical waves. • Reflection and refraction wave fronts and rays	• Demonstrating reflection and refraction of wave fronts practically. • Calculating the period, velocity ,frequency and wavelength of waves • Carrying experiments to demonstrate waves.	• Springs/slinky, ropes ropes, ripple tanks
9.2 Sound	• describe how sound is produced • describe the longitudinal nature of sound waves • state the approximate range of audible frequency	• Vibrations • Compressions and rarefactions. • Transmission of sound in different media	• Carrying experiments on sound production • Carrying out experiments involving transmission in different media. • Determining speed of sound practically.	• Fixed ruler/hacksaw blade • Tuning forks and simple musical instruments • ICT tools • vacuum pump and electric bell watch

FORM 3

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
9.2 Sound	• explain the need of a medium in the transmission of sound waves • describe experiments to determine the speed of sound in air; • relate pitch, loudness and quality of sound waves to amplitude and frequency • describe echoes and application	• Speed of sound. • Pitch, loudness and quality. • Reflection of sound. • Applications of echoes. • Fishing industries • Depth determination	• Carrying out experiments on pitch, loudness and quality (No treatment of overtones.) • Carrying out simple experiments to demonstrate echoes	• starter gun/wooden block wall shallow well • C.R.O, microphone, signal generator
9.3 Electromagnetic waves	• identify the regions of the electromagnetic spectrum(order of wavelength or frequency) • state the differences and similarities between electromagnetic waves; • state the uses of the different components of the electromagnetic spectrum	• Electromagnetic spectrum • Wavelength, frequency, speed and transmission • Uses of the different components	• No recall of actual wavelengths or frequencies is required • Discussing differences and similarities between electromagnetic waves. • Discussing applications of electromagnetic waves in communication cooking, medical field remote sensing	• Mirror, ICT tools, Oily surfaces with light,Laptop or TV screens with DVD with light • UV and infrared sources , filters, computer

FORM 4

8.0 COMPETENCY MATRIX

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT(Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
10.0 OPTICS **10.1 Reflection of light**	• describe an experiment to illustrate the laws of reflection • use the law: I = r, in reflection; • describe the position and characteristics of an optical image formed by plane mirror • perform simple constructions, measurements and calculations;	• Laws of reflection, • Formation of images by plane mirrors. • Ray diagrams	• Carrying out experiments on reflection • Carrying out experiment to find the image of an object • Constructing images formed by plane mirror	• Optic kit • ICT tools

FORM 4

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING CTIVITIES AND NOTES	SUGGESTED RESOURCES
10.2 Refraction of light	• state laws of refraction; • describe refraction using ray diagrams; • describe refraction of light through transparent blocks and liquids; • define refractive index; • define critical angle; • describe total internal reflection; • describe applications of total internal reflection.	• Optically dense and optically less dense media $\frac{sini}{sinr} = constant$ • Refraction at plane surfaces • Apparent depth • Ray diagrams • Total internal reflection and critical angle. • Fibre optics • Glass prisms instruments • Mirage • Straight object in water	• Carrying out experiments to investigate refraction. • Drawing ray diagrams to illustrate various situations of refraction • Experiments to demonstrate apparent depth • Experiments to determine refractive index. • Experiments to demonstrate total internal reflection. • Demonstrating application of total internal reflection in fibre optics;	• Optic kit • ICT tools • Binoculars ,microscope and periscope
10.3 Lenses	• describe the action of a converging lens and diverging lens on a beam of light; • draw ray diagrams to illustrate the formation of real and virtual images	• Converging and diverging lenses, focal point • Nature and position of images	• Carrying out experiments to show convergence and divergence • Carrying out experiments on formation of real and virtual images by converging lens. • (No treatment of images formed by diverging lenses is required)	• Optic kit, camera

FORM 4

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
	• Explain how to measure the focal length of a converging lens • describe magnification of a converging lens • describe the use of a single lens as a magnifying glass • describe the use of a single lens to form a real image • explain the use of lenses in the correction of short and long sight	• Focal length • Magnification $m = \frac{v}{u} = hi/ho$ • Image characteristics. • Short and long sights.	• Carrying out demonstrations. • (No calculations required) • Experiments to measure the focal length of a converging lens. • Demonstrating the action of a magnifying glass.	Optical kit Metre rule Camera and projector ICT tools
10.4 Dispersion of light	• define dispersion of light • describe the dispersion of light	• Visible spectrum.	• Carrying out experiments on dispersion of light using a glass prism. Order of colours to be specified.	Optic kit and glass prism ICT tools
11.0 ELECTRICITY **11.1 Electrostatics**	• describe experiments to show electrostatic charging • describe forces between charges of static electricity • describe an electric field	• The electron, and positive charges. • Unit of charges. • The Coulomb. • Like and unlike • Charges. • Force and electric charges.	• Carrying out experiments to show electrostatic charging. Carrying experiments to demonstrate attraction repulsion of charges.	• Van de Graaf generator, gold leaf electroscope, Perspex, ebonite, cellulose • Rods/plates, cotton, fur, glass rods • Polythene

FORM 4

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
	• state and describe the direction of field lines and simple field patterns; • distinguish between electric conductors and insulators; • explain separation of charge by induction; • describe natural phenomena of static electricity	• Field lines and field patterns • Conductors and insulators • Induced charge in conductors • Lightning conductors	• Qualitative treatment only • Drawing diagram to show field -patterns. • Demonstrating inductive charging using electroscopes. • Discussing lightning, safety precautions Applications and hazards • Formation, dangers, earthing, shielding. • Constructing a lightning conductor	• Gold leaf electroscope • Lightning conductors/ shields • ICT tools
11.2 Primary and secondary cells **Electromotive force**	• use the concept that the e.m.f is measured by energy dissipated by a source in driving a charge round a complete circuit • show an understanding that the volt is given by J/C	• e.m.f of a cell/battery. • units of e.m.f.	• Sources of e.m.f. • List sources of e.m.f. • Explaining the terms e.m.f. and calculating current. I = Q/t.	• Power supplies, cells, batteries, accumulators, voltmeter,(photo voltaic cells)

FORM 4

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
11.3 Current electricity	explain the flow of current in a circuit use the equation I=Q/t measure current and voltage define potential differences • use the concept that the sum of the potential differences in a series circuit is the same as the potential difference across the whole circuit • state and apply Ohm's law • describe an experiment to determine resistance using a voltmeter and an ammeter • state the limitations of Ohm's law • sketch and interpret the V/I characteristics graphs for metallic (ohmic) and non-ohmic conductors • Use the relationship between the resistance, length and cross-sectional area of a wire	• Electric charge flow. • Ammeter, ampere. • Conventional direction of current. • Different ranges of voltage and current. Voltage in a series circuit. VT=V1+V2+------- Law of conservation of energy Resistance R=V/I Experimental determination of resistance. Thickness and length of a conductors. Temperature R=ρl/A	• Ampere, the volt, milliampere range. • Using a voltmeter to measure p.d. • Using an ammeter to measure current. • Carrying out experiments using voltmeter in a series circuit. • Carrying out experiments to verify Ohm's Law and calculations involving Ohm's law. • Carrying put experiments to determine resistance. • Carrying out simple experiments to investigate the limitations. • Sketching and interpreting the V/I characteristics graphs. • Variations of resistance of conductor with temperature (e.g. in a bulb), tension or if placed in a strong magnetic field. • Carrying out experiments to investigate the relationships.	• Ammeter, voltmeter, multimeters • Carbon Resistors Ammeter, voltmeters, multimeters, power sources, leads, switches. • Colour code chart • Different swg wires of e.g. Constantine, nichrome, copper, micrometre screw gauge, metre rule

FORM 4

TOPIC	OBJECTIVES Learners should be able to	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITES AND NOTES	SUGGESTED RESOURCES
11.4 Electric circuits	• set up simple electric circuits • draw and interpret circuit diagrams • use the fact that the current from the source is the sum of currents in the separate branches of a parallel circuit • calculate resistance in simple circuits	• simple circuits. • draw and interpret circuit diagrams. • I=I1+I2+I3. • $R=R_1+R_2+R_3$. • Series and parallel resistors. $\frac{1}{R}=\frac{1}{R1}+\frac{1}{R2}+--$	• Mounting circuits and measuring current through resistors in parallel. • Carrying out practical activities on electric circuits. • Drawing and interpreting circuit diagrams. • Calculating resistance for series and parallel resistors.	• Cells, switches, resistors variable resistors, bulbs, ammeters, voltmeters and fuses, connecting leads. • Circuit boards, fuses, switches, computer
11.5 Electricity in the home	• describe uses of electricity in the home • calculate electrical power, energy and the cost of electricity • describe electrical hazards and safety precautions • describe the wiring of a three-pin plug	• Heating, lighting and motors, lamps in parallel. • The kilowatt-hour P=VI E=VIt . • Hazards. • Safety precautions.	• Discussing and listing uses of electricity in the home. • Reading of electricity meters and costing. • Discussing damaged insulation, overheating cables and damp conditions.	• Three-pin plug, two-pin plug, fuses, breakers, heating elements, iron, fan, electric meters, motors, ICT tools

FORM 4

TOPIC	OBJECTIVES Learners should be able to	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITES AND NOTES	SUGGESTED RESOURCES
11.5 Electricity in the home	• explain the use of fuses, fuse ratings and switches	• Live, neutral and earth. • Double insulation of appliance.	• Experiments demonstrating electrical hazards must NOT be done. • Wiring of a plug. • Examining appliances with double insulation • Demonstrating the operation of a fuse and a switch. • Explaining why fuses and switches are always on live wire.	• Fuses, switches on live wire • Insulated cables, electricity meters
12.0 MAGNETISM **12.1 Magnetic properties**	• state the properties of magnets • describe magnetic field lines around magnets • explain induced magnetism; • describe methods of magnetisation; • describe methods of demagnetisation;	• Polarity. • Attraction and repulsion. • Magnetic field lines. • Pattern and direction. • Induction. • Single and double stroking, using a solenoid • Demagnetisation by hammering, heating and electrical methods. • Relative ease of magnetisation and demagnetization temporary and permanent magnets	• Carrying out experiments to investigate properties of magnets. • Carrying out experiments to demonstrate induced magnetism. • Carrying out experiments to demonstrate magnetisation.	• Magnets, pocket compass, cell, solenoid/coils, different materials both magnetic and non-magnetic, iron filings, paper, heat, hammer.

FORM 4

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
	• distinguish between magnetic and • non-magnetic materials • distinguish between the magnetic properties of iron and steel	temporary and permanent magnets	• Magnetising and demagnetising pieces of iron and steel.	• Iron and steel rods/cores
12.2 Application of magnetism	• describe uses of temporary magnets • describe uses and application of permanent magnets	• Temporary magnets and their uses. • Permanent magnets and their uses.	• Discussing uses of temporary magnets. • Discussing uses of permanent magnets	• Video and audio tapes, computer discs, electric bell, • Electric motors, loudspeakers, generators, telephone receivers
13.0 ELECTROMAGNETISM **13.1 Magnetic effect of an electric current**	• describe an experiment to demonstrate that a current-carrying conductor has a magnetic field around it • describe an experiment to plot magnetic field patterns due to a current-carrying solenoid • predict the direction of magnetic field of straight conductor and of a solenoid	•Magnetic field patterns. • Magnetic field patterns of solenoid. • Direction of magnetic field. • Right hand grip rule.	• Demonstrating field around current • Carrying conductor using iron fillings and plotting compass. • Plotting magnetic field lines due to a solenoid. • Predicting direction of field lines.	• Long straight conductor, solenoids, switch, leads, pocket /plotting campus, (cell), DC source, ICT tools

FORM 4

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
13.2 Force on current carrying conductor magnetic in a magnetic field	• describe an experiment to show that a current-carrying conductor in a magnetic field experiences a force • describe the field patterns between parallel currents and relate these to the forces which exist between the currents • predict the direction of motion of a current-carrying conductor in a magnetic • describe the application of the magnetic effect of a current • describe the operation of a d.c. motor	• Fleming's left hand rule. • Force between parallel currents, field patterns. • Factors affecting magnitude of force. • Action of an electric bell and a simple relay Electrical to mechanical energy.	• Experiments on field patterns between parallel currents. • Demonstrating the effect of a magnetic field on a current carrying conductor. • Experiments to show relationship between direction of current, field and motion Constructing a simple d.c. motor • Field, current and motion, turning effect commutator	• Two Long straight conductors, switch, leads, pocket / plotting campus, cell. • Electric bell, relay, reed switch, microphone, speaker etc. • DC motor model, insulated wire, block of wood, leads
13.3 Electromagnetic induction	• describe an experiment which shows that a changing magnetic field can induce an e.m.f. in a circuit or conductor • state the factors affecting the magnitude of induced e.m.f. • use the fact that direction of an induced e.m.f opposes the change producing it	• The generator principle. • Strength of magnet, relative motion, number of turns, area of coil. • Lenz's law.	• Carrying out experiments to show generator principle. • Carrying out experiments to investigate factors which affect e.m.f. • Carrying out experiment to show Lenz's law.	• Coils with different number of turns and cross sectional area of coils, solenoids, bar magnets, galvanometer, CRO. • ICT tools

FORM 4

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
	• predict the direction of induced current in a conductor • describe the operation of an a.c. and d.c. generators	• Fleming's right hand rule. • mechanical to electrical energy. • differences between a.c.and d.c.	• Using Flemming's right hand rule to make predictions. • Identifying slip rings, commutator, brush, coil and magnets. • Sketching velocity time graphs. • Discussing the factors affecting output voltage. • Comparing a.c. and d.c. generators.	
13.4 Transformers	• describe the structure and principle of operation of a basic iron-cored transformer • use transformer equations • describe the use of transformer in high-voltage transmission • discuss the energy loss in cables • give advantages of high voltage transmission	• Primary and secondary coils, laminated core, voltage. • Transformer efficiency, cooling and eddy currents. • Magnetic flax heating. • Joule heating. Vp /Ns=Np/Ns and VpIp=VsIs • Current and potential difference in step-up and step-down transformers	• Demonstrating the operation of a simple transformer. • Solving problems using the transformer equation • Discussing efficiency (energy loss). • Discussing the advantages of high-voltage transmission.	• Coils with multiple tapings, iron cores, voltmeters, multi-metres, C.R.O, ac sources, Hall probe • ICT tools

FORM 4

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
14.0 ELECTRONICS **14.1Thermionic emission**	• explain that a hot filament emits electrons • describe how these electrons can be directed into an electron beam describe the effect of a magnetic or electric field on an electron beam	• Emission of electrons from hot metals. • Acceleration and collimation of electrons. • Reflecting of electron beam.	• Demonstrating thermionic emission. • Discussing acceleration and collimation of electrons. NOTE : Direction of deflection of electron beam. • Relating to TV tubes and CRO.	• CRT, tubes and kits, computer, magnetic field source • ICT tools
14.2 Diodes	• describe the function of diodes	• Function of diodes • Switch and rectification • Circuit symbol/ LEDs	• Carrying out experiments to demonstrate the function of a diode.	• LED cells, diodes, circuit boards, electronic kits
14.3 Rectification	• define rectification • explain half and full wave rectification	• Conversion of a.c. to d.c. • Use of diodes, voltage – time graphs.	• Carrying out experiments on rectification and smoothening. • Voltag time graphs	• Electronic kit, diodes, AC source, capacitor, CRO • Power supplies
14.4 Electronic Components	• describe the behaviour of resistor • use a given colour code for resistance values • choose components with suitable power ratings • describe the action of a variable potential divider • describe the action of thermostats and light dependent resistors • describe the action of a capacitor • explain the use of reed switches in circuits	• Colour and coding. Potentiometer use as input transducers Energy store • Time delay circuits	• Reading colour codes and tolerance. • Measuring resistance • Carrying out experiments with resistors capacitors, thermistors, LED, potentiometer	• Coded carbon resistors of various ratings and ranges • Potential dividers/rheostat, thermostats/thermistor • capacitors, bulbs, reed switches, strain-gauge, potentiometers, buzzers

FORM 4

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
14.5 Logic Gates	• describe logic gates	• Logic gates: OR, AND, NOT, NAND and NOR Truth Tables • Combination of logic of not more than three inputs.	• Constructing Truth Tables.	• Electronic kits, logic gate tutor, computer • (2 input gate)
15.0 ATOMIC AND NUCLEAR PHYSICS **15.1 Rutherford's Atomic Model**	• describe the structure of an atom in terms of nucleus and electrons • explain proton and nucleon numbers • explain isotopes	• Nucleus and electrons. • Composition of nucleus. • Proton number Z and nucleon number A. • A=Zn • Nuclide notation AZX. • Isotopes.	• Drawing diagrams of the atomic structure. • Calculating proton and nucleon numbers. • Giving examples of isotopes	• Computer, atomic models • ICT tools • Periodic table
15.2 Radioactivity	• describe radioactivity • state types of radioactive emission • describe the nature and properties of radiation	• Radioactivity. • Stability of nuclei, and particles and rays, detection . • Nature of radiation	• Describing detection of radiation. Carrying out experiments of chances of radio-active decay. • Discussing nature and properties of radiation. • Discussing ionising effects, penetrating power and deflection by magnetic and	• Computer, radiation detectors • ICT tools, simulation software • Dice. Coins

FORM 4

TOPIC	OBJECTIVES Learners should be able to:	UNIT CONTENT (Skills, attitudes and knowledge)	SUGGESTED LEARNING ACTIVITIES AND NOTES	SUGGESTED RESOURCES
	• describe the mechanism of radio-active decay • explain the meaning of half-life • distinguish between fusion and fission • describe the uses of radio-active isotopes	• Nuclear decay; decay radiation. • Decay curve. • Half-life. Fusion and fission, nuclear reactions. i) carbon – 14 dating ii) Biochemical tracers iii) Radiotherapy.	electric fields. • Plotting decay cares. • Carrying out calculations on half life. • Calculating nucleon and proton numbers of balanced equations. • Drawing and interpreting decay curves. • Writing nuclear equations. • Discussing uses of radio-active materials. • Conducting educational tours.	• C.T scans. • ICT tools
15.2 Radioactivity	• Describe how radioactive materials are handled, used and stored in a safe way. • describe the effects of radioactive emission on the environment	• Detection of leaks in pipes • Determination of thickness of materials • Power generation • Sterilisation • Use, storage, handling • Soil, water, air, plant and animal life • Safe disposal of radio-active waste	• Use of photographic film badges for exposure detection. • The impact of radioactive emission on the environment	• Photographic films, computers

9.0 ASSESSMENT

9.1 ASSESSMENT OBJECTIVES

The scheme of assessment is grounded in the principle of inclusivity and equalisation of opportunities hence does not condone direct or indirect discrimination of learners.

Modifications of arrangements to accommodate candidates with special needs must be put in place in both continuous and summative assessments. These modifications must neither give these candidates an undue advantage over others nor compromise the standards being assessed.

NB: For further details for arrangements, accommodations and modifications refer to the assessment procedure booklet.
The three assessment objectives in 'O' Level Physics are:

1: Knowledge with understanding
2: Handling information and problem solving
3: Experimental skills and investigations

1: Knowledge with understanding

Candidates should be able to demonstrate knowledge and understanding of:

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

2: Handling information, problem solving, synthesis, analysis and evaluation

In words or using other written forms of presentation (e.g. symbolic, graphical and numerical), candidates 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, report trends and draw inferences
- present reasoned explanations of phenomena, patterns and relationships
- make predictions and hypotheses
- solve problems, including some of a quantitative nature.

3: Experimental skills and investigations

Candidates should be able to:

- know how to use techniques, apparatus, and materials (including following a sequence of instructions, where appropriate)
- make and record observations and measurements
- interpret and evaluate experimental observations and data
- plan investigations, evaluate methods and suggest possible improvements (including the selection of techniques, apparatus and materials).

9.2 SCHEME OF ASSESSMENT

The assessment scheme for Physics comprises of

a) Continuous assessment, and
b) Summative assessment.

The final grade in Physics is 20% continuous assessment and 80% summative assessment.
The assessment shall be administered as follows:

Paper 1: Multiple choice questions
Paper 2: Structured theory questions
Paper 3: Practical Test
Paper 4: Continuous Assessment
Learners are required to enter for all the 4 papers

Paper	Tye of Paper	Duartion	Marks	Paper Weighting
1	Multiple choice	1 hr	40	19
2	Theory	2 hrs 15 min	100	48
3	Practical Test	2 hrs	30	14
4	Continuous Assessment	.....	40	19

Paper 1: Theory : the paper consists of 40 compulsory multiple choice items of the direct choice type.
Each question shall have 4 response items.

Paper 2: Theory. The paper has 2 sections.
Section A will carry 40 marks and will consists of a number of compulsory structured questions of variable mark value.
Section B carries 60 marks and will consist of 4 structured questions .Each question will carry 20 marks. Candidates will be required to answer any 3 questions.

Paper 3: Practical Test
This paper will consist of 2 compulsory questions each carrying 20 marks

Paper 4: Continuous Assessment
This paper will consist of standardised tests in Practical, Theory and a Project during the 5 terms.

9,3 SPECIFICATION GRID

SKILL	Paper 1	Paper 2	Paper 3	Paper 4
1.0 KNOWLEDGE AND UNDERSTANDING	**15%**	**15%**		**15%**
2.1 COMPREHENSION, PROBLEM SOLVING	**40%**	**50%**		**40%**
2.2 ANALYSIS, SYNTHESIS AND EVALUATION	**45%**	**45%**		**45%**
3.0 PRACTICAL			100%	
TOTAL	**100%**	**100%**	**100%**	**100%**

APPENDIX

SUMMARY OF KEY QUANTITIES, SYMBOLS AND UNITS

Learners should be able to state the symbols for the following physical quantities and, where indicated, state the units in which they are measured. Learners should be able to define those items indicated by an asterisk (*).

Quantity Symbol Unit

QUANTITY	SYMBOL	UNIT
Length	L,h	Km.m,cm,mm
Area	A	M^2,cm^2
Volume	V	M^3,cm^3
Weight	W	N
Mass	M	Tones, Kg, g, mg
Time	T	h, mini,
Period	T	S
Density	p	Kg/m^3, g/m^3
Speed	U,v	Km/h, m/s,cm/s
Acceleration	A	m/s^2
Force	F	N
Acceleration of free fall	g	m/s^2, N/kg
Moment of a force	M	N/m
Work done	W, E	J
Power	P	W
Pressure	P	Pa, n/m^2, mmHg
Temperature	Θ, T	$^{\theta}C$, K
Heat capacity	C	$J/^oC$, J/k
Specific heat capacity	C	$J/(g^o)$, J/(gk)
Latent heat	L	J
Specific latent heat	l	J/kg, j/g
Frequency	F	Hz
Wave length	λ	m,cm

Angle of incidents	**I**	**Degree(º)**
Angle of reflection, refraction	**r**	**Degree(º)**
Critical angle	**c**	**Degree(º)**
Potential difference/voltage	**V**	**V,mV**
Current	**I**	**A,mA**
Charge	**Q**	**Q/C,As**
e.m.f.	**E**	**V**
Resistance	**R**	**Ω**

MATHEMATICAL REQUIREMENTS

Arithmetic

Learners should be able to:
(a) recognise and use expressions in decimal and standard form (scientific) notation
(b) use appropriate calculating aids (electronic calculator or tables) for addition, subtraction, multiplication and division. Find arithmetic means, powers (including reciprocals and square roots), sines, cosines and tangents (and the inverse functions)
(c) take account of accuracy in numerical work and handle calculations so that significant figures are neither lost unnecessarily nor carried beyond what is justified, rounding answers correctly when necessary
(d) make approximations and estimates to obtain reasonable answers

Algebra

Learners should be able to:
(a) change the subject of an equation
(b) solve simple algebraic equations, including linear simultaneous equations
(c) use direct and inverse proportion
(d) substitute physical quantities into physical equations using consistent units
(e) formulate simple algebraic equations as mathematical models of physical situations and to represent information given in words

Geometry and trigonometry

Learners should be able to:
(a) understand the meaning of angle, curve, circle, radius, diameter, square, parallelogram, rectangle and diagonal
(b) calculate areas of right-angled triangles and circles, areas and volumes of rectangular blocks, volumes of cylinders
(c) use the angle sum of a right angle and adjacent angles on a straight line
(d) use sines, cosines and tangents
(e) use usual mathematical instruments (rules, compasses, protractor, set square)
(f) recognise and use points of the compass (N, S, E, W)

Graphs

Learners should be able to:
(a) translate information between graphical, numerical, algebraic and verbal forms

(b) select appropriate variables and scales for graph plotting
(c) for linear graphs, determine the slope and state the intercept and intersection
(d) choose, by inspection, a straight line which will serve as the best straight line through a set of data points presented graphically
(e) recall standard linear form y = mx + c and rearrange relationships into linear form where appropriate
(f) understand, draw and use the slope of a tangent to a curve as a means to obtain the gradient

GLOSSARY OF TERMS

It is hoped that the glossary will prove helpful to learners as a guide, although it is not exhaustive. The glossary has been deliberately kept brief not only with respect to the number of terms included but also to the descriptions of their meanings. Learners should appreciate that the meaning of a term must depend in part on its context. They should also note that the number of marks allocated for any part of a question is a guide to the depth of treatment required for the answer.

1. Define (the term(s) ...) is intended literally. Only a formal statement or equivalent paraphrase, such as the defining equation with symbols identified, being required.

2. Explain/What is meant by ... normally implies that a definition should be given, together with some relevant comment on the significance or context of the term(s) concerned, especially where two or more terms are included in the question. The amount of supplementary comment intended should be interpreted in the light of the indicated mark value.

3. State implies a concise answer with little or no supporting argument, e.g. a numerical answer that can be obtained 'by inspection'.

4. List requires a number of points with no elaboration. Where a given number of points is specified, this should not be exceeded.

5. Describe requires learners to state in words (using diagrams where appropriate) the main points of the topic. It is often used with reference either to particular phenomena or to particular experiments. In the former instance, the term usually implies that the answer should include reference to (visual) observations associated with the phenomena. The amount of description intended should be interpreted in the light of the indicated mark value.

6. Discuss requires learners to give a critical account of the points involved in the topic.

7. Predict or deduce implies that candidates are not expected to produce the required answer by recall but by making a logical connection between other pieces of information. Such information may be wholly given in the question or may depend on answers extracted in an earlier part of the question.

8. Suggest is used in two main contexts. It may either imply that there is no unique answer or that learners are expected to apply their general knowledge to a 'novel' situation, one that formally may not be 'in the syllabus'.

9. Calculate is used when a numerical answer is required. In general, working should be shown.

10. Measure implies that the quantity concerned can be directly obtained from a suitable measuring instrument, e.g. length, using a rule, or angle, using a protractor.

11. Determine often implies that the quantity concerned cannot be measured directly but is obtained by calculation, substituting measured or known values of other quantities into a standard formula.

12. Show is used when an algebraic deduction has to be made to prove a given equation. It is important that the terms

being used by learners are stated explicitly.

13. Estimate implies a reasoned order of magnitude statement or calculation of the quantity concerned. Learners should make such simplifying assumptions as may be necessary about points of principle and about the values of quantities not otherwise included in the question.

14. Sketch, when applied to graph work, implies that the shape and/or position of the curve need only be qualitatively correct. However, learners should be aware that, depending on the context, some quantitative aspects may be looked for, e.g. passing through the origin, having an intercept, asymptote or discontinuity at a particular value. On a sketch graph it is essential that candidates clearly indicate what is being plotted on each axis.
Sketch, when applied to diagrams, implies that a simple, freehand drawing is acceptable:
nevertheless, care should be taken over proportions and the clear exposition of important details

SPECIAL NOTE

Nomenclature
The proposals in 'Signs, Symbols and Systematics (The Association for Science Education Companion to 16–19 Science, 2000)' will generally be adopted.
Units, significant figures
Learners should be aware that misuse of units and/or significant figures, i.e. failure to quote units where necessary, the inclusion of units in quantities defined as ratios or quoting answers to an inappropriate number of significant figures, is liable to be penalised.
Calculators
An approved calculator may be used in all papers.
Geometrical Instruments
Learners should have geometrical instruments with them for Paper 1 and Paper 2.
Apparatus list
This list below details the apparatus expected to be generally available for examination purposes. The list is not exhaustive: in particular, items that are commonly regarded as standard equipment in a physics laboratory are not included. The apparatus listed should be available for each candidate:

- ammeter FSD 1 A or 1.5 A
- voltmeter FSD 1 V, 5 V
- cells and holders to enable several cells to be joined
- connecting leads and crocodile clips
- d.c. power supply – variable to 12 V
- metre rule
- converging lens with a focal length f = 15 cm
- low voltage filament bulbs in holders
- a supply of masses and holders
- newton meter/force meter
- plastic or polystyrene cup
- modelling clay (Plasticine)
- various resistors, including a variable resistor (rheostat)
- switch
- thermometer, –10 °C to +110 °C at 1 °C graduations
- wooden board
- glass or perspex block, rectangular and semi-circular
- measuring cylinder, 25 cm3, 100 cm3
- beaker, 250 cm3
- springs
- stopwatch
- ray box.