**ORDINARY LEVEL PHYSICS**

**Code 580**

1. **Introduction**

Science education should reflect the changing needs of students and the growing significance of science for strategic development in an emerging economy. The Ordinary level Syllabus is designed to incorporate the following components:

* science for the enquiring mind, or pure science, to include the principles, procedures and concepts of the subject as well as its cultural and historical aspects;
* the applications of science and its interface with technology;
* Science which is concerned with issues (social and economic) of concern to citizens.

The three components are integrated within the syllabus, with the first component having about 80% weighting. The remaining 20% is allocated to the other two components in the ratio 3:1.

The syllabus is suitable for a three-year course of physics lasting about 204 hours, following introductory courses in science and Mathematics. It is hoped that the course will be taught in the spirit of investigation, that is, they should be practically and experimentally based. It is expected that the candidates will be involved in practical work complimented by demonstrations whenever possible. This will entail the schools making some of their own equipment and candidates carrying out school based projects.

1. **Aim and Assessment Objectives of the Syllabus.**

**2.1 Aims**

The general aim of education is to contribute towards the development of all aspects of the individual. The three-year course of physics is presented within this general aim, with a particular emphasis on the preparation of students for the requirements of further education or training, for employment and for their role as participative, enterprising citizens. The course aims to provide continuity with and progression from the course programme in the lower levels (Form I to Form2).

The course programme, in contributing to a high quality education, emphasises the importance of:

* a spirit of inquiry, critical thinking, problem solving, self-reliance, initiative and enterprise,
* preparation for further education, for adult and working life,
* life-long learning.
  1. **Assessment Objectives (AO)**

The syllabus will be assessed under the headings: knowledge, comprehension, and higher abilities. All material within the syllabus is examinable. Candidates will be expected to have an understanding of the applications listed in the syllabus. However, details of any application not listed in the syllabus will be given in the question.

The assessment objectives of the syllabus are:

**2.2.1. AO1 Knowledge,** which includes the ability to recall

* basic physical principles, scientific terminology,
* facts, laws, definitions, concepts, theories;
* conventions, symbols, units;

**2.2.2 AO2Comprehension,** which includes the ability to:

* express a mathematical law in verbal terms,
* use a known formula to calculate a physical quantity,
* describe an experimental technique,
* read information from a graph,
* extract appropriate data from a table,
* make straightforward deductions from extracted data,
* express experimental results in graphical form,
* explain the physics principles behind the design of apparatus with which the student is familiar,
* explain simple phenomena in terms of the laws of physics.

**2.2.3. AO3 Higher Abilities,** which include the ability to:

* solve problems (verbally, mathematically and graphically) and drawing conclusions (theoretical and practical)
* explain simple effects with which the student is unfamiliar,
* solve numerical problems involving two or more stages, where the laws involved are not immediately obvious,
* interpret graphs involving, for example, measurement of slope of a straight line or a curve,
* drawing theoretical conclusions from non-standard graphical results,
* relate scientific concepts to issues in everyday life.

1. **Examination Structure**

**3.1 Weighting of Assessment Objectives**

|  |  |
| --- | --- |
| **Assessment Objectives** | **Weighting of Assessment Objectives** |
| Knowledge | 30 % |
| Comprehension | 40 % |
| Higher Abilities | 30 % (of which 20 % is Application and 10% Analysis) |

**3.2 Scheme of Assessment**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Paper** | **Mode of assessment** | **Weighting** | **Number of questions** | **Level of difficulty** | **Duration** |
| 1 | MCQs | 40 % | 50 questions: 15 Knowledge, 20 Comprehension, 15 (10 Application and 5 Analysis) Higher abilities | \* 60%  \*\* 30%  \*\*\* 10% | 1 ½ hours |
| 2 | Essay | 50 % | Section 1: 6 compulsory short questions (40 marks)  Section 2: 3 pairs of alternative questions (60 marks) | \* 50%  \*\* 40%  \*\*\* 10% | 1 hour  1 ½ hours |
| 3 | SBA | 10% | A project based on two or more topics provided yearly by the GCE Board  Assessments : through project manual  Internal and external evaluation | 50%  50% |  |

1. **Cross Curricula Demands of the Subject**

**Mathematical Requirements. Candidates should be able to:**

1. add, subtract, multiply and divide;
2. use averages, decimals, fractions, percentages, ratios and reciprocals;
3. recognise and use standard notation;
4. use direct and inverse proportion;
5. manipulate positive, whole number indices;
6. draw and interpret charts and graphs from given data,
7. select suitable scales and axes for graphs;
8. use the relationship between length, surface area and volume and their units on metric scales;
9. use usual mathematical instruments (ruler, compasses, protractor, set square);
10. understand the meaning of angle, curve, circle, radius, diameter, square, parallelogram, rectangle and diagonal;
11. solve equations of the form y = mx + c for any one term when the other three are known;
12. be conversant with the trigonometric functions (sine, cosine, tangent);
13. Apply Pythagoras’s Theorem.
14. Use calculators.
15. **Syllabus Content**
16. **MECHANICS**

| **Topic** | | **Notes** | **Attainment Targets** |
| --- | --- | --- | --- |
| **1.0 FORCES** | | | |
| * 1. **Physical**   **quantities** | | * **The magnitude of physical quantity is written as the product of the number and the unit** | **Candidates will be assessed on their ability to:**  **Show an understanding that physical quantities consist of a numerical magnitude and a unit.** |
| * 1. **Vectors and**   **Scalars** | | * Distinction between vector and scalar quantities. | **Candidates will be assessed on their ability to:**   1. Define vectors and scalars quantities 2. Name examples of vector and scalar quantities 3. Do appropriate calculations (addition, subtraction, resolution of vectors in a plane only) |
| * 1. **Types and**   **characteristics of forces** | | * Contact and non-contact forces. | **Candidates will be assessed on their ability to:**   1. Define each force. 2. Know the importance of each force in everyday life. 3. Calculate *W = mg.* 4. Differentiate between weight and mass. 5. Appreciate that drag increases with speed. 6. Draw free-body diagrams |
| * 1. **Newton’s laws of Motion** | | * Statement of the three laws. * Force and momentum, definitions and units. Vector nature of forces to be stressed. * F = ma as a special case of Newton’s second law. | **Candidates will be assessed on their ability to:**   1. State each law. 2. Describe a demonstration of each law. 3. Apply the knowledge of each law to explain real life situations, e.g. in seat belts, rocket travel, sports, air-bags, etc. 4. Do calculations on F = ma, and momentum. |
| **1.5 Moments** | | * Moment of force; Couple. * Conditions for equilibrium. | **Candidates will be assessed on their ability to:**   1. Define moments and couples. 2. Describe simple experiments with a number of weights. 3. Do appropriate calculations involving co-planar parallel forces only. 4. Name and describe everyday situations where torques and couples and used, e.g. opening a tap, handle bars on bicycles, moving coil galvanometers, simple motors. 5. State conditions for static and dynamic equilibrium. |
| **2.0 MOTION** | | | |
| **2.1 Linear**  **Motion** | * Units of mass, length and time (definition of units not required). * Distance, Displacement, speed, velocity, acceleration: definitions and units. * Equations of motion (Derivation not required). | | **Candidates will be assessed on their ability to:**   1. State units of mass, length and time. 2. Describe simple experiments for measuring of velocity and acceleration. 3. Apply knowledge of concepts in everyday situations like sports and moving objects. 4. Use distance-time and velocity-time graphs. 5. Describe experiments to measure acceleration of free fall, g. 6. Do appropriate calculations using the equations of motion. |
| **2.2 Conservation**  **of Linear**  **Momentum** | * Linear momentum. Principle of conservation of Linear momentum | | **Candidates will be assessed on their ability to:**   1. Define linear momentum. 2. Do simple calculations using ***p =*** *m****v***. 3. State the principle of conservation of linear momentum. 4. Describe experiments to demonstrate principle of conservation of linear momentum. 5. Describe real-life situations where the principle applies, e.g. collisions, explosions, acceleration of space crafts, water jets, etc. 6. Do appropriate calculations (problems involving change of mass need not be considered). |
| **3.0 ENERGY** | | | |
| **3.1 Forms of**  **Energy** | * What is Energy * Forms of energy. * PE = mgh and * Elastic potential energy (qualitative treatment only). * Conversions from one form of energy to another. Principle of conservation of energy. | | **Candidates will be assessed on their ability to:**   1. Define energy. 2. Name forms of energy. 3. State different sources of energy. 4. Distinguish between renewable and non-renewable energy sources. 5. Describe energy conversions in stretching of springs, rubber bands and threads. 6. Do appropriate calculations. 7. State the principle of conservation of energy. |
| **3.2 Work** | * What is Work? | | **Candidates will be assessed on their ability to:**   1. Define work and state its units. 2. Do simple calculations involving force and displacement (in the same direction only). |
| **3.3 Machines** | * Simple machines; Lever; Pulley; Inclined plane. * Mechanical Advantage (MA), Velocity Ratio (VR) and efficiency. | | **Candidates will be assessed on their ability to:**   1. Define machines. 2. State advantages of using machines. 3. Define MA, VR, and Efficiency. 4. Explain why a machine is not 100% efficient. 5. Describe simple experiments using each machine. 6. Do appropriate calculations. 7. Describe the use of various machines at building sites. |
| **3.4. Power** | * Power. * Units of power. | | **Candidates will be assessed on their ability to:**   1. Define power and state its units. 2. Estimate the average power developed by e.g. a person running upstairs person repeatedly lifting weights, etc. 3. Appreciate the power ratings of devices e.g. light bulbs, motors, etc. 4. Do appropriate calculations. |
| **4.0 properties of matter** | | | |
| **4.1 Density** | * Density and its units. | | **Candidates will be assessed on their ability to:**   1. Define density and state its units. 2. Appreciate the use of materials of different densities in engineering works. 3. Describe experiments to measure the density of regular and irregular objects using any appropriate method. 4. Do appropriate calculations. |
| **4.2 Pressure** | * Pressure and its units. * Pressure in liquids and gases. * Pressure difference expressed as | | **Candidates will be assessed on their ability to:**   1. Define pressure and state its units. 2. Understand the effects of force and area on pressure. 3. Describe experiments to demonstration atmospheric pressure e.g. the collapsing-can experiment. 4. Appreciate the relationship between pressure and weather. 5. Understand the influence of length and density of liquid column on pressure. 6. Appreciate the transmission of pressure in fluids. 7. Do calculations using the relationship, Δp = ρgh |
| **4.3. Hooke’s**  **Law** | * Stretching of springs rubber bands and threads. | | **Candidates will be assessed on their ability to:**   1. State Hooke’s law. 2. Describe situations in which the law applies. |

**MECHANICS: Experiments**

1. Measurement of velocity and acceleration e.g. that of a student doing the 100 m relay race on a level terrain.
2. To show that **a**α**F**.
3. Measurement of g by any direct method.

**4**. Verification of the principle of conservation of momentum.

**5**. Investigation of the laws of equilibrium for a set of co-planar forces.

1. **HEAT**

| **Topic** | **Notes** | **Attainment Targets** |
| --- | --- | --- |
| **5.0 TEMPERATURE** | | |
| **5.1 Concept of Heat and Temperature** | * Concept of heat. * Temperature and its units. * Scales of temperature. | **Candidates will be assessed on their ability to:**   1. Define heat and state its units. 2. Define temperature and state its units. 3. Apply different temperature scales (Celsius and Kelvin) 4. Convert temperatures from Celsius to Kelvin and vice-versa. |
| **5.2 Thermometric Properties** | * Liquid length (or volume) in a glass thermometers only. | **Candidates will be assessed on:**   1. The thermometric property of a substance. 2. The length of a liquid in glass varies with temperature. |
| **5.3. Thermometers** | * Construction and use of liquid-in-glass thermometers. | **Candidates will be assessed on their ability to:**   1. Appreciate the need for calibrated thermometers to measure temperature. 2. Read-off the numerical values of the fixed points in the Celsius scale of temperature. 3. Calibrate a thermometer using the fixed points. 4. Calculate an unknown temperature from the length of the liquid column. 5. Appreciate the differences between a clinical and a normal laboratory thermometer. |
| **5.4 Heat Capacity;**  **Specific Heat**  **Capacity.** | * Heat capacity and specific heat capacity solid and liquid. | **Candidates will be assessed on their ability to:**   1. Define heat capacity and specific heat capacity. 2. State units of each term. 3. Distinguish between heat capacity and specific heat capacity. 4. Appreciate use of materials with high and low heat capacities. 5. Do calculations using Q = mcΔθ. 6. Describe experiments to measure the specific heat capacity of a metal or liquid and state any assumptions made. |
| **5.5 Latent Heat; Specific Latent Heat** | * Usesof latent heat and specific latent heat (qualitative treatment only). | **Candidates will be assessed on their ability to:**   1. Define latent heat and specific latent heat. 2. State the units of each term. 3. Distinguish between latent heat and specific latent heat. 4. Appreciate the cooling effect due to loss of latent heat. 5. Compare the energy content of specific latent heat with that of specific heat capacity of the same material. |
| **5.6 Heat Transfer** | * Conduction; Convection; Radiation | **Candidates will be assessed on their ability to:**   1. Define conduction, convection and radiation. 2. Describe experiments to show the conductivity of different materials. 3. Thermal expansion. 4. Explain the principle of the bimetallic strip. 5. Appreciate the bulk movement of particles of the fluid in convection. 6. Explain the phenomena of land and sea breezes in terms of convection. 7. Appreciate the effects of surface area, surface nature and temperature on the rate of radiation. 8. Name devices that convert radiant energy into other forms of energy. |

**HEAT: Experiments**

1. Calibration of a thermometer using the laboratory mercury thermometer as a standard.
2. Measurement of specific heat capacity, e.g. of water *or* a metal by a mechanical *or* electrical method.
3. **ELECTRICITY**

| **Topic** | **Notes** | **Attainment Targets** |
| --- | --- | --- |
| **6.0 ELECTRICITY** | | |
| **6.1 Charges** | * Types of charge. * Electrification by contact; friction. * Conductors and insulators. * Unit of charge (coulomb). * Electrification by induction. * The leaf electroscope. * Force between charges. | **Candidates will be assessed on their ability to:**   1. Recall that two types of charge (positive and negative) exist. 2. Understand that electric charges are separated when certain materials are rubbed against one another. 3. Explain that polythene becomes negatively charged when rubbed with cloth. 4. Recall that Perspex/cellulose acetate becomes positively charged when rubbed with cloth. 5. Explain the charging of objects in terms of properties of negatively charged electrons which move and bound positively charged particles. 6. Compare the relative conductive or insulative properties of a wide range of materials. 7. Define the coulomb. 8. Describe how equal and opposite charges can be induced on a conducting body. 9. Appreciate two charged objects which repel each other are similarly charged but that a charged object attracts objects which carry zero net charge as well as those which carry an opposite charge. 10. Describe experimentally how to distinguish between positively charged, negatively charged and uncharged bodies. 11. Appreciate the uses of a charged leaf electroscope in identification of types of charge, present of charge bodies and distribution of charge and potential on a conductor (structure and method of charging of electroscope not required). 12. Understand that the force between charged objects is stronger when the charged objects are close and when the charged objects arefar apart. (Qualitative treatment of Coulomb’s law.) 13. Explain everyday observations of static electricity e.g. dust on television screens, static charges on dry clothes. 14. Explain industrial hazards due to static electricity, such as in fuelling aircrafts; in flour mills, electric sparks and prevention of such hazards. 15. Understand the role charge place in lightening and their prevention. |
| **6.2 Electric Current** | * Electric current * e.m.f. * Sources of e.m.f. and electric current * Conduction in metals. | **Candidates will be assessed on their ability to:**   1. Define electric current. 2. Recall that a current in a metal wire consists of a flow of electrons. 3. Associate a current of 1 ampere with a flow of charge of 1 coulomb per second. 4. Recall and use the relationship Q = It in simple calculations. 5. Understand that the volt is a joule per coulomb. 6. Understand what is electromotive force (e.m.f) 7. Recall sources of e.m.f. like the mains, simple cells, dry batteries, lead-acid accumulators, car batteries, thermocouples. 8. Understand what potential difference is. 9. Distinguish between the transfer of chemical or mechanical energy per unit charge to electrical energy in cells and generators (their e.m.f.), and the transfer of electrical energy per unit charge to internal energy or other forms of energy (potential difference). 10. State and use the relationship W = QV in energy transfer calculations involving individual devices in a closed circuit. 11. Recall and use the relationship P = IV in energy transfer calculations involving individual devices in a closed circuit. |
|  | * Resistance * Effects of electric current * Domestic circuits * High Tension Transmission | 1. Define resistance and state its units. 2. Recall and use Ohm’s law in simple calculations. 3. Appreciate the effects of length and cross-sectional area on the resistance of a given conductor. 4. Understand that resistance may vary with temperature. 5. Use values of current, potential difference and resistance in simple problems. 6. Be familiar with series and parallel arrangements of resistors. 7. Calculate the combined resistance of two or more resistors in series. 8. Calculate the combined resistance of two resistors in parallel. 9. Calculate the combined resistance of three or four resistors placed in series and parallel in a single circuit. 10. Understand the effects of d.c. and a.c. in wires, filament lamps and (non-inductive) coils. 11. Appreciate the heating effect of an electric current. 12. Explain the advantage of transmitting electrical energy at high voltage. 13. Calculate power dissipation in simple cases. 14. Calculate energy consumption in simple cases, including energies quoted in kilowatt-hours at home. 15. Select fuses of appropriate values for various electrical appliances. 16. Appreciate the need for good electrical contact in house wiring circuits. 17. Appreciate the need for good earthing in house wiring. 18. Compare linear and ring circuits in house wiring (diagram of circuits not required). 19. Appreciate the need for safety precautions in electrical installations. 20. Calculate simple cost of electrical consumption at home. |
| **7.0 ELECTROMAGNETISM** | | |
| **7.1 Magnets** | * Types of magnets * Magnetic properties of a dipole magnet. | **Candidates will be assessed on their ability to:**   1. State differences between magnetic properties of iron and steel. 2. Appreciate that magnetic poles exist in pairs. 3. Recall that magnets repel and attract other magnets, and also attract magnetic substances. 4. List the uses of magnets. |
| **7.2 Magnetic Fields** | * Field lines * Magnetic flux pattern * Properties of field lines | **Candidates will be assessed on their ability to:**   1. Describe experiments to identify the poles of a magnetic dipole. 2. Understand the terms: magnetic field line, or magnetic line of force and magnetic flux pattern. 3. Draw magnetic flux pattern. 4. Know how to use permanent magnets to produce desired magnetic flux pattern over a small region. 5. Understand how the Earth’s magnetic field is used in navigation (i.e. using magnetic compasses). |
| **7.3 Current in a Magnetic Field** | * Magnetic effects of a steady current. * Force on current-carrying conductor in a magnetic field. | **Candidates will be assessed on their ability to:**   1. Identify that magnetic field are produce when current flows in a conductor. 2. Appreciate the magnetic effect of an electric current. 3. Sketch and understand magnetic flux patterns for a straight wire, a flat circular coil and a solenoid, each carrying a current and for a strong permanent dipole magnet. 4. Appreciate that there is a force on a current-carrying conductor placed in a magnetic field as long as the conductor is not parallel to the field. 5. Appreciate that there is a force on a charged particle when it moves in a magnetic field as long as its motion is not parallel to the field. 6. Recall that the force on a current-carrying conductor in a magnetic field increases with the strength of the field and with the current. |
| **7.4 Electromagnetic Induction**  **7.5 Alternating Current** | * Electromagnetic induction. Faraday’s law. * Lenz’s law. * Variation of voltage and current with time. * Concept of mutual induction and self induction. * Structure and principle of operation of a transformer. | **Candidates will be assessed on their ability to:**   1. Understand that magnetism is induced in some materials when they are placed in a magnetic field. 2. Describe the construction of electromagnets. 3. State the uses of electromagnets. 4. Sketch and recognise the magnetic flux patterns for a straight wire, carrying a current perpendicular to the plane of a uniform field. 5. List the factors that affect induced current in conductor placed in a changing magnetic field. 6. Describe experiments to demonstrate that induced current increases when the rate of change of magnetic field lines increases. 7. Understand that a changing magnetic flux through a circuit causes an e.m.f. to be induced in the circuit. 8. Appreciate electromagnetic induction as an energy transfer process. 9. Be familiar with the structure and functioning of the transformer. 10. Appreciate the factors which affect the efficiency of a transformer. 11. Relate the turn ratio of an ideal transformer to the ratio of the input and output voltages. 12. Differentiate between direct current and alternating current. |

**ELECTRICITY: Experiments**

1. Verification of Joule’s law (as Δθα I2).
2. To investigate the variation of current (*I* ) with pd (*V* ) for:
   1. metallic conductor
   2. filament bulb
   3. copper sulphate solution with copper electrodes
   4. Semiconductor diode.
3. **MODERN PHYSICS**

| **Topic** | **Notes** | **Attainment Targets** |
| --- | --- | --- |
| **8.0 MODERN PHYSICS** |  |  |
| **8.1. The**  **Electron**  **Electronics** | * The electron as the indivisible quantity of charge. * Reference to mass and location in the atom. * Semiconductors. * Semiconductor devices. | . **Candidates will be assessed on their ability to:**   1. Identify an electron as one of the basic components of an atom. 2. Recognise that an electron carries the basic quantity of charge, Q=Ne. 3. Distinguish between a conductor, a semiconductor and an insulator in terms of charge flow. 4. Distinguish a pure (intrinsic) semiconductor from an extrinsic semiconductor. 5. Distinguish an n-type from an p-type s/c 6. State the function of rectification using diodes e.g. in a radio sets. |
| **8.2 The Nucleus** | * Structure of the atom. * Structure of the nucleus. * Radioactivity. Concept of half-life. Isotopes. Radioisotopes. * Nuclear energy. Principles of fission and fusion. Mass-energy conservation in nuclear reactions. * Ionising radiation and health hazards. | 1. Appreciate the Bohr Model of the atom. 2. Recall the relative sizes of atoms and nuclei. 3. Recall the relative masses and charges of electrons and nucleons. 4. Appreciate that the nucleus is made up of protons and neutrons. 5. Be familiar with the nucleon number/proton number notation for an atom, e.g. 6. Make calculations involving the changes in nucleon number and proton number resulting from the emission of given radioactive particles. 7. Understand that some nucleus emit particles such as α, β, and γ. 8. Recall the nature of alpha particles, beta particles, and gamma radiations. 9. Identify α, β, and γ radiations from their penetration, ionisation ability and deflection in magnetic and electric fields. 10. Understand the use of GM tubes to detect the radiations. (Structure of the GM tube will not be tested.) 11. Understand the use of diffusion cloud chambers to detect the radiations. (Structure of the cloud chamber will not be tested.) 12. Explain the meaning of half-life. 13. Appreciate the random nature of radioactive decay. 14. Appreciate the concept of background radiation. 15. Allow for background radiation in handling count rates. 16. Be aware of safety precautions concerned with the handling of radioactive materials, including half-life of radioactive materials. 17. Appreciate the neutron: proton ratio as a guide to the stability of a nucleus. 18. Describe the uses of radioisotopes in medical imaging, medical therapy, food preservation, agriculture, carbon dating, smoke detectors, industry, etc. and appreciate how these uses relate to their properties. 19. Differentiate between fission and fusion. 20. Interpret nuclear reactions. 21. Appreciate the general health hazards involved in the use of ionising radiations, e.g. X-rays, nuclear radiations. 22. Appreciate that the effect of ionising radiations on humans depends on the type of radiation, the activity of the source, and the type of tissue irradiated. |
| **9.0 WAVES** |  |  |
| **9.1 Properties of**  **Waves** | * Longitudinal and transverse waves. Frequency; Amplitude; Wavelength; Velocity. * The wave equation, c=fλ. | **Candidates will be assessed on their ability to:**   1. Show an understanding of how waves are produced. 2. Display understand of waves as a form of energy. 3. Be familiar with wave pulses and continuous waves produced on springs/slinkies and in ripple tanks and with their energy transfer properties. 4. Interpret graphs of displacement against time for both wave pulses and sinusoidal continuous waves. 5. Define speed, frequency, wavelength and amplitude of a wave. 6. Appreciate graphs of displacement against distance for both wave pulses and (sinusoidal) continuous waves. 7. Recall the relationship  for both mechanical and electromagnetic waves. 8. Use the relationship  for both mechanical and   electromagnetic waves.   1. Differentiate between waves that are transverse and those that are longitudinal. |
| **9.2 Wave**  **Phenomena** | * Reflection; Refraction; Diffraction; Interference. * Stationary waves. Relationship between inter-node distance and wavelength. * Diffraction effects. | **Candidates will be assessed on their ability to:**   1. Describe wave motion in strings, ropes, springs and ripple tanks. 2. Recall and use the equation . 3. Distinguish between transverse and longitudinal waves and give suitable examples. 4. Define the phenomena of reflection, refraction,   diffraction, and interference.   1. Use water waves to show reflection at a plane surface, refraction due to change of speed, and diffraction produced by wide and narrow gaps. 2. Production of stationary waves. 3. Harmonic and overtones. |
| **9.3Vibrations**  **and Sound** | * Wave nature of Sound: Reflection, refraction, diffraction, interference. * Speed of sound in various media. * Characteristics of notes. Amplitude and loudness, frequency and pitch, quality and overtones.Frequency limits of audibility. * Vibrations in strings. Stationary waves in strings. Relationship between frequency and length, frequency and mass per unit length, frequency and tension. | **Candidates will be assessed on their ability to:**   1. Describe the longitudinal nature of sound waves. 2. State the approximate range of audible frequencies. 3. Show an understanding that a medium is required in order to transmit a sound wave. 4. Describe an experiment to determine the speed of sound in air. 5. Relate the loudness and pitch of sound waves to   amplitude and frequency respectively.   1. Describe how the reflection of sound may produce an echo. 2. State the order of magnitude of the speed of sound in air, liquid and solid. 3. Construct a simple musical instrument e.g. flute and guitar. |
| **9.4 Light**  **9.5 Refraction** | * Laws of reflection. * Mirrors. * Laws of refraction. Total internal reflection. * Lenses. Converging and diverging lenses. Focal length. * Dispersion. * Electromagnetic Spectrum. | **Candidates will be assessed on their ability to:**   1. Represent the paths of narrow beams of light travelling in uniform media by rays. 2. Appreciate those objects that are seen because of the light from the object that enters the eye. 3. State the laws of reflection. 4. Appreciate that image of a point objects that is the point through which all rays from a point on the object pass or appear to pass after reflection or refraction. 5. Recall and use the relationship,   .   1. Describe an experiment to determine the refractive indexof glass using a glass block. 2. Appreciate the conditions for total internal reflection. 3. Be familiar with the refraction of light in everyday   phenomena e.g. the apparent depth of a swimming pool.   1. Appreciate the relationship between refractive index and wave speed for light. 2. Appreciate the bending of light in a prism. 3. Regard a lens as being made up of a number of part   prisms.   1. Draw ray diagrams to illustrate the meaning of principal foci, for converging and diverging lenses. 2. Understand what is meant by the focal length of a lens. 3. Draw ray diagrams to illustrate the formation of images bylenses e.g. converging lens used as a magnifying glass. 4. Describe how to measure the focal length of a converging lens by a distant object and by an auxiliary plane mirrormethods. 5. Describe experiments relating object and image distancesto object and image sizes for converging lenses. 6. Be familiar with the relationship . 7. Define critical angle. 8. Appreciate dispersion by a prism. 9. Be familiar with the relative positions of radiations on theelectromagnetic spectrum, in terms of wavelength andfrequency. 10. Describe methods of detection of UV and IR radiations. 11. Recall the properties of x-rays. 12. Be familiar with health hazards caused by high dosage of EM waves. |

**SOUND: Experiments**

1. Measurement of the speed of sound in air.
2. Investigation of the variation of fundamental frequency of a stretched string with length.

**LIGHT: Experiments**

1. Verification of Snell’s law of refraction.
2. Measurement of the refractive index of a liquid *or* a solid.
3. Measurement of the focal length of a converging lens.
4. **Textbooks**

The following books may be of use to candidates studying the Ordinary Level Physics syllabus. It is not intended to suggest that a candidate should attempt to consult all of the books but rather select a few of them for study.

1. Gilbert Rowell and Sydney Herbert 1995, *Physics*, Cambridge Low Price Editions.
2. Stephen Pople 2001, *Explaining Physics*, GCSE Edition, Oxford University Press.