MINISTRY OF EDUCATION

Republic of Ghana

TEACHING SYLLABUS FOR PHYSICS
(SENIOR HIGH SCHOOL 1-3)

Enquiries and comments on this syllabus should be addressed to:

The Director
Curriculum Research and Development Division (CRDD)
P. O. Box 2739
Accra, Ghana.

Tel: 0302-683668
0302-683651

SEPTEMBER, 2010

RATIONALE FOR TEACHING PHYSICS

Physics, as a discipline, deals with the nature of matter and energy, their interactions and measurements. The study of Physics has had, and continues to have, a big impact on the world community. The ideas, skills and attitudes derived from the study of physics are being widely applied in various scientific and technological developments. As an example, development in renewable energy is serving the world profoundly and it is hoped that it will become more available in Ghana to complement other sources for meeting the energy needs of the country. The specific example of renewable energy is solar, that transforms in appropriate forms such as electrical energy for operating simple equipment, and machinery, and for domestic use. The principles and applications of physics cut across the various spectrum of everyday life activities like walking, lifting objects, seeing and taking photographs.

GENERAL AIMS.

The aims of the Senior High School Physics programme are to:

i. provide, through well designed studies of experimental and practical physics, a worthwhile hands on educational experience to become well informed and productive citizens.
ii. enable the Ghanaian society function effectively in a scientific and technological era, where many utilities require basic physics knowledge, skills and appropriate attitudes for operations.
iii. recognise the usefulness, utilization and limitations of the scientific methods in all spheres of life.
iv. raise the awareness of inter-relationships between physics and industry, Information, and Communication Technology (ICT), Agriculture, Health and other daily experiences.
v. develop in students, skills and attitudes that will enable them to practise science in the most efficient and cost effective way.
vi. develop in students desirable attitudes and values such as precision, honesty, objectivity, accuracy, perseverance, flexibility, curiosity and creativity.
vii. stimulate and sustain students' interest in physics as a useful tool for the transformation of society.

SCOPE OF CONTENT

This syllabus builds upon the foundation laid in the Junior High School Integrated Science at the Basic level and SHS Integrated Science. The topics have been selected to enable the students acquire the relevant knowledge, skills and attitudes needed for tertiary level education, other institutions, apprenticeship and for life. The syllabus embodies a wide range of activities such as projects, experiments, demonstrations and **scientific inquiry skills** designed to bring out the resourcefulness and ingenuity of the physics student.

PRE-REQUISITE SKILLS AND ALLIED SUBJECTS

A good knowledge of Science and Mathematics at the Junior High School or its equivalent, and proficiency in reading and communication in English are necessary for effective study of Physics at the Senior High School level. Students offering Physics are advised to take Chemistry and Elective Mathematics in addition.

ORGANIZATION OF THE SYLLABUS

The syllabus has been structured to cover three years of SHS programme. Each year's work consists of a number of sections with each section comprising a number of units. There are seven main sections. These are;

SECTION ONE: INTRODUCTORY PHYSICS AND PROPERTIES OF MATTER

In this section the importance of Physics in everyday life is discussed. Certain topics in basic mathematics to enhance the study of Physics are to be discussed. Some phenomena associated with properties of matter are to be explained using the kinetic theory.

SECTION TWO: MECHANICS

In this section the types of motion are discussed. These include rectilinear motion, circular motion and oscillatory motion. The effects of force on motion and on matter are to be discussed in this section. The nature of energy, the conversion and conservation of energy are to be treated with special emphasis on the **ways of harnessing renewable energy resources.**

SECTION THREE: THERMAL PHYSICS

In this section, heat and temperature are to be discussed. The study of temperature, its measurement and the effect of temperature changes are to be discussed. The quantity of heat given out or absorbed and the physical changes due to heat transfer are also to be discussed. Natural modes of heat transfer, are to be discussed with special emphasis on **black body radiation.**

SECTION FOUR: WAVES

The general characteristics of wave motion including that of light and sound waves are to be discussed in this section. The utilization of electromagnetic waves, especially that of **microwaves** in communication and industry and application of sound waves are given special emphasis. **Fiber optics** and **lasers** which have wide applications in industry and medicine are new topics introduced in the elective physics syllabus with special emphasis on how they can be utilized.

SECTION FIVE: ELECTRICITY AND MAGNETISM

Special emphasis is given to the study of magnets since magnets play a major role in instrumentation and machinery. The utilization of electromagnetic fields in the **generation and storage of electricity** and in **electromagnetic relay** are given special emphasis in this syllabus. The phenomenon of **thermoelectric effect** and its application is also to be treated in this section.

SECTION SIX: ATOMIC AND NUCLEAR PHYSICS

The characteristics of the atom and that of the nucleus are to be discussed in this section. The concept of photoelectric effect and its applications, the x-rays and the peaceful uses of nuclear energy are to be discussed in this section.

SECTION SEVEN: ELECTRONICS

From primary one to Senior High School, electronics has been introduced into Natural Science and Integrated Science with hands on activities. In this section, another dimension of electronics is to be treated to include the characteristics and applications of semi-conductor diode and transistors electronic **switching and integrated circuit (I.C)**

The structure of the syllabus is as follows:

STRUCTURE OF THE PHYSICS SYLLABUS

YEAR ONE	YEAR TWO	YEAR THREE
Section 1 : Introductory Physics and properties of matter (Pg) Unit 1: Introduction to Physics and physical quantities Unit 2: Physical quantities **Section 2 : Mechanics (Pg)** Unit 1: Kinematics Unit 2: Dynamics Unit 3: Forces Unit 4: Pressure **Section 3: Thermal Physics (Pg)** Unit 1: Temperature and its measurement **Section 4 : Waves (pg)** Unit 1: Reflection of light from plane and curved mirrors Unit 2: Refraction of light Unit 3: Basic Fiber optics **Section 5: Electricity and Magnetism (pg)** Unit 1: Electrostatics Unit 2: Capacitors **Section 6: Atomic and Nuclear Physics(pg)** Unit 1: Models of the atom and atomic structure **Section 7: Electronics(pg)** Unit 1: Semi conductor P-N Junction diode	**Section 1: Introductory Physics and properties of matter (Pg)** Unit 1: Concept of matter **Section 2: Mechanics (Pg)** Unit 1: Energy Unit 2: Circular motion and Gravitation Unit 3: Oscillatory motion **Section 3: Thermal Physics (pg)** Unit 1 : Thermal properties of matter and Calorimetry **Section 4: Waves(pg)** Unit 1: Thin lenses and optical instruments Unit 2: Wave motion Unit 3: Sound **Section 5: Electricity and Magnetism (pg)** Unit 1: Direct current circuit analysis Unit 2: Magnets Unit 3: Electromagnetism **Section 6 : Atomic and Nuclear Physics(pg)** Unit 1: Photoelectric effect and wave particle duality Unit 2: Thermionic emission, cathode rays and x-rays **Section 7: Electronics(pg)** Unit 1: Bipolar Junction Transistor (BJT)	**Section 1: Introductory Physics and properties of matter (Pg)** Unit 1: Some properties of matter **Section 2: Mechanics (pg)** Unit 1 : Deformation of solids **Section 3: Thermal Physics (pg)** Unit 1: Heat transfer **Section 4: Waves(pg)** Unit 1: Introduction to Laser **Section 5: Electricity and Magnetism(pg)** Unit 1: Electromagnetic Induction Unit 2: Alternating Current (A.C.) theory **Section 6: Atomic and Nuclear Physics (pg)** Unit 1: The nucleus and nuclear energy **Section 7: Electronics(pg)** Unit 1: Digital electronics and Integrated Circuits(I.C)

PERIOD ALLOCATION PER WEEK

A total of six periods per week is allocated to the teaching of Physics in each year, with each period consisting of forty minutes. The teaching periods are divided as follows:

YEAR	PRACTICALS	THEORY	TOTAL
1	2	4	6
2	2	4	6
3	2	4	6

Note **:** (1). Teachers should ensure that students are adequately prepared in the theory before each practical class.
(2). Teachers should also ensure that practical classes are started in SHS1 alongside the theory classes.
(3). Three (3) periods can be allocated for practical classes and five (5) periods for theory classes if the timetable in the school allows for that form of arrangement.

SUGGESTIONS FOR TEACHING THE SYLLABUS

The syllabus is presented in a teaching sequence. However, the teacher may change the teaching order in a particular year provided the linkage between the sections and the respective units is maintained and the syllabus for the year completed by the end of each year. It is important that classroom teaching be supplemented with field trips wherever appropriate.

Besides the above advice, the teacher's attention is drawn to some new concepts that have been introduced in this syllabus to help improve instructional delivery and learning. Read this section very carefully and relate the information to your own teaching methods and skills.

General Objectives:

General Objectives have been listed at the beginning of each Section. The general objectives specify the skills and behaviours students should acquire by the end instruction in the units of a section. Read the general objectives very carefully before you start teaching the section. After teaching all the units of the section, go back and read the general objectives again to be sure you have covered the objectives adequately in the course of your teaching.

Sections and Units:

The syllabus has been planned on the basis of Sections and Units. Each year's work is divided into sections. A section consists of a fairly homogeneous body of knowledge within the subject. Within each section are units. A unit consists of a more related and homogeneous body of knowledge and skills.

Columns
The syllabus is structured in five **columns**: Units, Specific Objectives, Content, Teaching and Learning Activities and Evaluation. A description of the contents of each column is as follows:

Column 1 - Units: The units in Column 1 are divisions of the major topics of the section. You are expected to follow the unit topics according to the linear order in which they have been presented. However, if you find at some point that teaching and learning in your class will be more effective if you branched to another unit before coming back to the unit in the sequence, you are encouraged to do so.

Column 2 - Specific Objectives: Column 2 shows the Specific Objectives for each unit. The specific objectives begin with numbers such as 1.3.5 or 2.1.1. These numbers are referred to as "Syllabus Reference Numbers". The first digit in the syllabus reference number refers to the section; the second digit refers to the unit, while the third digit refers to the rank order of the specific objective. For instance, 1.3.5 means: Section 1, Unit 3 (of Section 1) and Specific Objective 5. In other words, 1.3.5 refers to Specific Objective 5 of Unit 3 of Section 1. Similarly, the syllabus reference number 2.1.1 simply means Specific Objective number 1 of Unit 1 of Section 2. Using syllabus reference numbers provide an easy way for communication among teachers and other educators. It further provides an easy way for selecting objectives for test construction. For instance, that Unit 2 of Section 2 has five specific objectives: 2.2.1 - 2.2.5. A teacher may want to base his/her test items/questions on objectives 2.2.3 and 2.2.4 and not use the other three objectives. In this way, a teacher would sample the objectives within units and within sections to be able to develop a test that accurately reflects the importance of the various skills taught in class.

You will note also that specific objectives have been stated in terms of the student i.e., *what the student will be able to do after* instruction *and learning in the unit*. Each specific objective therefore starts with the following, "The student will be able to." This in effect, means that you have to address the learning problems of each individual student. It means individualizing your instruction as much as possible such that the majority of students will be able to master the objectives of each unit of the syllabus.

Column 3 - Content: The "content" in the third column of the syllabus presents a selected body of information that you will need to use in teaching the particular unit. In some cases, the content presented is quite exhaustive. In some other cases, you could add more information to the content presented. In a few cases the content space has been left blank for you to develop.

Column 4 -Teaching and Learning Activities (T/L): T/LA activities that will ensure maximum student participation in the lessons are presented in column 4. Avoid rote learning and drill-oriented methods and rather emphasize participatory teaching and learning, and also emphasize the cognitive, affective and psychomotor domains of knowledge in your instructional system wherever appropriate. You are encouraged to re-order the suggested teaching and learning activities and also add to them where necessary in order to achieve optimum student learning. As we have implied already, the major purpose of teaching and learning is to make students able to apply their knowledge in dealing with issues both in and out of school. A suggestion that will help your students acquire the habit of analytical thinking and the capacity for applying their knowledge to problems is to begin each lesson with a practical problem. Select a practical problem for each lesson. The selection must be made such that students can use knowledge gained in the previous lesson and other types of information not specifically taught in class. At the beginning of a lesson, state the problem, or write the problem on the board. Let students analyze the problem, suggest solutions etc., criticize solutions offered, justify solutions and evaluate the worth of possible solutions. There may be a number of units where you need to re-order specific objectives to achieve such required effects. The emphasis is to assist your students to develop analytical thinking and practical problem solving techniques.

Column 5 - Evaluation: Suggestions and exercises for evaluating the lessons of each unit are indicated in Column 5. Evaluation exercises can be in the form of oral questions, quizzes, class assignments, essays, structured questions, project work etc. Try to ask questions and set tasks and assignments that will challenge your students to apply their knowledge to issues and problems as we have already said above, and that will engage them in developing solutions, and positive scientific attitudes as a result of having undergone instruction in this subject. The suggested evaluation tasks are not exhaustive. You are encouraged to develop other creative evaluation tasks to ensure that students have mastered the instruction and behaviours implied in the specific objectives of each unit. For evaluation during class lessons, determine the mastery level you want students to achieve in their answers and responses. If for instance, you take 80% as the mastery level, ensure that each student's answer to questions asked in class achieve this level of mastery.

PROFILE DIMENSIONS

A 'dimension' is a psychological unit for describing a particular learning behaviour. More than one dimension constitutes a profile of dimensions. A specific objective as follows: The student will be able to describe...etc. contains an action verb "describe" that indicates what the student will be able to do after teaching

and learning have taken place. Being able to "describe" something after the instruction has been completed means that the student has acquired "knowledge". Being able to explain, summarize, give examples etc. means that the student has understood the lesson taught. Similarly, being able to develop, plan, construct etc. means that the student can "apply" the knowledge acquired in some new context. You will note that each of the specific objectives in this syllabus contains an "action verb" that describes the behaviour the student will be able to demonstrate after the instruction. "Knowledge", "Application" etc. are dimensions that should be the prime focus of teaching and learning in schools. Instruction in most cases has tended to stress knowledge acquisition to the detriment of other higher level behaviours such as application, analysis etc. Each action verb indicates the underlying profile dimension of each particular specific objective. Read each objective carefully to know the profile dimension toward which you have to teach.

Lastly, please bear in mind that the syllabus cannot be taken as a substitute for lesson plans. It is therefore, necessary that you develop a scheme of work and lesson plans for teaching the units of this syllabus.

DEFINITION OF PROFILE DIMENSIONS

As already stated, profile dimensions describe the underlying behaviours for teaching, learning and assessment. In Physics, the three profile dimensions that have been specified for teaching, learning and testing are:

Knowledge and Understanding	30%
Application of Knowledge	40%
Practical and Experimental Skills	30%

Each of the dimensions has been given a percentage weight that should be reflected in teaching, learning and testing. The weights, indicated on the right of the dimensions, show the relative emphasis that the teacher should give in the teaching, learning and testing processes. The focus of this syllabus is to get students not only to acquire knowledge but also be able to understand what they have learnt and apply them practically. Combining the three dimensions in your teaching will ensure that Physics is taught not only at the factual knowledge level but that students will also acquire the ability to apply scientific knowledge to issues and problems, and will also acquire the capacity for practical and experimental skills that are needed for scientific problem solving. The explanation of the dimensions and the key action verbs associated with each profile dimension are as follows:

Knowledge and Understanding (KU)

Knowledge — The ability to:
Remember, recognize, retrieve, locate, find, do bullet pointing, highlight, bookmark, network socially, bookmark socially, search, google, favourite, recall, identify, define, describe, list, name, match, state principles, facts and concepts. Knowledge is simply the ability to remember or recall material already learned and constitutes the lowest level of learning.

Understanding — The ability to:
Interpret, explain, infer, compare, explain, exemplify, do advanced searches, categorize, comment, twitter, tag, annotate, subscribe, summarize, translate, rewrite, paraphrase, give examples, generalize, estimate or predict consequences based upon a trend. Understanding is generally the ability to grasp the meaning of some material that may be verbal, pictorial, or symbolic.

Application of Knowledge (AK)

The ability to use knowledge or apply knowledge, as implied in this syllabus, has a number of learning/behaviour levels. These levels include application, analysis, innovation or creativity, and evaluation. These may be considered and taught separately, paying attention to reflect each of them equally in your teaching. The dimension "Applying Knowledge" is a summary dimension for all four learning levels. Details of each of the four sub levels are as follows:

Application	The ability to: Apply rules, methods, principles, theories, etc. to concrete situations that are new and unfamiliar. It also involves the ability to produce, solve, operate, demonstrate, discover, implement, carry out, use, execute, run, load, play, hack, upload, share, edit etc.
Analysis	The ability to: Break down a piece of material into its component parts, to differentiate, compare, deconstruct, attribute, outline, find, structure, integrate, mash, link, validate, crack, distinguish, separate, identify significant points etc., recognize unstated assumptions and logical fallacies, recognize inferences from facts etc. Analytical ability underlies discriminate thinking.
Innovation/Creativity	The ability to: Put parts together to form a new whole, a novel, coherent whole or make an original product. It involves the ability to synthesize, combine, compile, compose, devise, construct, plan, produce, invent, devise, make, program, film, animate, mix, re-mix, publish, video cast, podcast, direct, broadcast, suggest an idea or possible ways, revise, design, organize, create, and generate new ideas and solutions. The ability to create or innovate is the highest form of learning. The world becomes more comfortable because some people, based on their learning, generate new ideas, design and create new things.
Evaluating	The ability to: Appraise, compare features of different things and make comments or judgement, contrast, critique, justify, hypothesize, experiment, test, detect, monitor, review, post, moderate, collaborate, network, refractor, support, discuss, conclude, make recommendations etc. Evaluation refers to the ability to judge the worth or value of some material based on some criteria and standards. We generally compare, appraise and select throughout the day. Every decision we make involves evaluation. Evaluation is a high level ability just as application, analysis and innovation or creativity since it goes beyond simple knowledge acquisition and understanding.

A number of examination questions at the secondary school level begin with the word "Discuss". Discuss belongs to the evaluation thinking skill and implies the ability to analyze, compare, contrast, make a judgement etc. The word "discuss" asks for a variety of thinking skills and is obviously a higher order thinking behaviour. Students consequently do poorly on examination questions that start with "Discuss". For this reason, and also for the reason that discussion of issues, discussion of reports etc., are some of the major intellectual activities students will be engaged in, in work situations and at higher levels of learning after they have left secondary school, it will be very helpful if you would emphasize discussion questions etc. both in class and in the tests you set.

PRACTICAL AND EXPERIMENTAL SKILLS (PES)

The Practical and Experimental Skills involve the demonstration of the inquiry processes in science and refer to skills in planning and designing of experiments, observation, manipulation, classification, drawing, measurement, interpretation, recording, reporting, and conduct in the laboratory/field. Practical and Experimental Skills refer to the psychomotor domain.

A summary of the Practical and Experimental Skills (PES) required for effective practical scientific work are the following:

1. Make observation, raise questions and formulate hypothesis.
2. Design and conduct investigations.
3. Analyze and interpret results of scientific investigations
4. Communicate and apply the results of scientific investigation

Make observation, raise questions and formulate hypothesis: The students should be able to

Observe the world around them from a scientific perspective.

Pose questions and form hypothesis based on personal observation, scientific articles, experiments and knowledge.

Read, interpret and examine the credibility and validity of scientific claims in different sources of information such as scientific articles, advertisements or media stories.

Design and conduct investigations: The students should be able to

- Articulate and explain the major concepts being investigated and the purpose of an investigation.
- Select required materials, equipment and conditions for conducting an experiment.
- Identify independent and dependent variables.
- Write procedures that are clear and replicable.
- Employ appropriate methods for accurately and consistently
  - making observations
  - making and recording measurements at an appropriate level of position
  - collecting data in an organized way.
- Properly use instruments, equipment and materials (such as scales, metre rule, stop watches) including: set-up, (if required) technique, maintenance and storage.
- Follow safety guidelines

Analyze and interpret results of scientific investigations: The students should be able to:

- Present relationships between variables in appropriate forms:
  - represent data and relationships between variables in charts and graphs
  - use appropriate technology and other tools
- Use mathematical operations to analyze and interpret data results.
- Identify reasons for inconsistent results, such as sources of error or uncontrolled conditions, and access the reliability of data.
- Use results of an experiment to develop a conclusion to an investigation that addresses the initial questions and supports or refutes the stated hypothesis.
- State questions raised by an experiment that may require further investigation.

Communicate and apply the results of scientific investigation: The students should be able to

Develop descriptions and explanations of scientific concepts that an investigation focuses on.

Review information, explain statistical analysis and summarize data collected and analyzed from an investigation.

Explain diagrams and charts that represent relationships of variables.

Construct a reasoned argument and respond appropriately to critical comments and questions.

Use language and vocabulary appropriately: speak clearly and logically and use appropriate technology and other tools to present findings.

Use and refine scientific models that stimulate physical processes or phenomena.

***ATTITUDES*:** For success in any endeavour, the individual needs to cultivate attitudes relevant to that area of endeavour. The learning of Physics should aim at acquisition of the following attitudes by students:

i. Curiosity:	-the inclination or feeling toward seeking informing about how things work in a variety of fields
ii. Perseverance:	-the ability to continuously pursue an investigation until results are achieved.
iii. Flexibility in ideas:	-tolerance and willingness to change opinion in the face of more plausible evidence.
iv. Respect for evidence:	-willingness to collect and use data in one's investigation and also have respect for data collected by others and respect for the scientific conclusions others have arrived at.
v. Reflection:	-the habit of critically reviewing ways in which an investigation has been carried out to detect possible faults and other ways in which the investigation could be improved upon.

The action verbs and the definitions provided in the explanations of the three profile dimensions should help you to structure your teaching such as to achieve the effects needed. Select from the action verbs provided for your teaching, in evaluating learning before, during and after the instruction. Use the action verbs also in writing your test questions. This will ensure that you give your students the chance to develop good thinking skills, and the capacity for excellent performance in Integrated Science and in examinations. Check the weights of the profile dimensions to ensure that you have given the required emphasis to each of the dimensions in your teaching and assessment.

FORM OF ASSESSMENT

It must be emphasized again that it is important that both instruction and assessment be based on the profile dimensions of the subject. In developing assessment procedures, select specific objectives in such a way that you will be able to assess a representative sample of the syllabus objectives. Each specific objective in the syllabus is considered a criterion to be achieved by the student. When you develop a test that consists of items or questions that are based on a representative sample of the specific objectives taught, the test is referred to as a "Criterion-Referenced Test". In many cases, a teacher cannot test all the objectives taught in a term, in a year etc. The assessment procedure you use i.e. class tests, home work, projects etc. must be developed in such a way that it will consist of a sample of the important objectives taught over a period.

The example given on page 3 xi and xii shows an examination consisting of three papers, Paper 1, Paper 2, Paper 3 and School Based Assessment. Paper 1 will usually be an objective-type paper; Paper 2 will consist of structured questions or essay questions, essentially testing "Application of Knowledge", but also consisting of some questions on "Knowledge and Understanding". Paper 3 will be the practical test paper, and School Based Assessment will be based on all three dimensions as indicated. The distribution of marks for the objective test items, essay type questions and the practical questions in the three papers and in the School Based Assessment should be in line with the weights of the profile dimensions already indicated and as shown in the last column of the table.

SCHEME OF WEST AFRICAN SCHOOL CERTIFICATE (WASSCE) EXAMINATION

There will be two papers both of which must be taken for a total mark of 160.

PAPER 1 (50 marks)

It will be a practical test lasting 2 ¾ hours comprising three questions out of which candidates will be expected to answer any two to secure the maximum mark of 50. Each question of this paper will have two parts: A and B**.**

i. **Part A** will be an experiment for *21 marks*. Candidates will be required to state the precautions taken in the experiment during the examination and the reason for taking such precautions.
ii. **Part B** will consist of two structured questions that are related to the experiment for *4 marks*.

PAPER 2 : (110 marks)

It will consist of two sections A and B and will last for 2 ¾ hours.

Section A will comprise 50 multiple choice objective questions drawn from common areas (i.e. area common to all Member Countries) of the syllabus. It will last for 1¼ hours for 50 marks.

Section B will last for 1½ hours and will comprise of two parts, I and II.

Part I. will consist of ten short structured questions drawn from the portions of the syllabus peculiar to Ghana. Candidates will be expected to answer five questions for 15 marks.

Part II will comprise *five essay type* questions drawn from the common areas of the syllabus. Candidates will answer three questions for 45 marks.

PAPER 3 (50 marks)

It will be alternative to Paper 1 for private candidates. It will be a test of practical work lasting 2 ¾ hours for 50 marks.

Paper 1 will be the Practical Test Paper

Paper 2A will be an objective type paper

Paper 2B will consist of structured questions or essay questions, essentially testing Application of Knowledge but also consisting of some questions on Knowledge and Understanding.

School Based Assessment will be based on all three dimensions as indicated. The distribution of marks for the objective test items, essay type questions and practical question in the three papers and in the School Based Assessment should be in line with the weights of the profile dimensions indicated and as shown in the last column of the table that follows:

PAPER 3 ALTERNATIVE TO PRACTICAL TEST will consist of 3 practical questions and students are required to answer any two questions. In the examination structure which follows, Paper 1 is marked out of 50. Paper 2A is marked out of 50. Paper 2B is marked out of 60, Paper 3 is marked out of 50, and School Based Assessment is allotted 68 marks, giving a total of 200 marks. The last row shows the weight of the marks allocated to each of the four test components. The three papers are weighted differently. Paper 2 is a more intellectually demanding paper and is therefore weighted more than Papers 1 and 3.

DISTRIBUTION OF EXAMINATION PAPER WEIGHTS AND MARKS

DIMENSIONS	PAPER 2		PAPER 2B	SCHOOL BASED ASSESSMENT	TOTAL MARKS	% WEIGHT OF DIMENSION
	2A	2B				
Knowledge and Understanding	-	40	20	30	90	40
Applying Knowledge	-	10	40	19	69	30
Practical and Experimental Skills	50	-	-	19	69	30
Total Marks	50	50	60	68	228	-
% Contribution of Papers	22	22	26	30	-	100

You will note that Paper 1 has a contribution of 22% to the total marks; Paper 2 has a contribution of 48% to the total marks; and School Based Assessment has a contribution of 30% the total marks. The numbers in the cells indicate the marks to be allocated to the items/questions that test each of the dimensions within the respective test papers.

The last but one column shows the total marks allocated to each of the dimensions. Note that the numbers in this column are additions of the numbers in the cells and they agree with the profile dimension weight indicated in the last column.

Of the total marks of 228, 90 marks (equivalent to 40% of the total marks), are allocated to Knowledge and Comprehension. 69 marks, equivalent to 30% of the total marks are allocated to each of Application of Knowledge and Practical and Experimental Skills. The weights of each of the three dimensions are indicated in the last column of the table. The ratio of theory to practical in physics is 70:30.

Item Bank: Obviously the structure of assessment recommended in this syllabus will need a lot of work on the part of the teacher. In preparation for setting examination papers, try to develop an item bank. The term “item bank” is a general term for a pool of objective items, a pool of essay questions or a pool of practical test questions. As you teach the subject, try to write objective test items, essay questions, structured essay questions and practical test questions to fit selected specific objectives which you consider important to be tested. If you proceed diligently, you will realize you have written more than 100 objective test items, and more than 30 essay questions in a space of one year. Randomly select from the item bank to compose the test papers. Select with replacement.

This means, as items/questions are selected for testing, new ones have to be written to replace those items/questions already used in examinations. Items and questions that have been used in examinations may also be modified and stored in the item bank. An important issue in the preparation for a major examination such as the WASSCE, is the issue of "test wiseness". To be "test wise" means that the student knows the mechanics for taking a test. These mechanics include writing your index number and other particulars accurately and quickly on the answer paper; reading all questions before selecting the best questions to answer; apportioning equal time to each question or spending more time on questions that carry more marks; making notes on each question attempted before writing the answer; leaving extra time to read over one's work; finally checking to see that the personal particulars supplied on the answer sheet are accurate. Some good students sometimes fail to do well in major examinations because of weakness in the mechanics of test taking; because they are not test wise. Take your students through these necessary mechanics so that their performance in major examinations may not be flawed by the slightest weakness in test taking.

GUIDELINES FOR SCHOOL BASED ASSESSMENT

A new School Based Assessment system (SBA) will be introduced into the school system in 2011. The new SBA system is designed to provide schools with an internal assessment system that will help schools to achieve the following purposes:

- Standardize the practice of internal school-based assessment in all Senior High Schools in the country
- Provide reduced assessment tasks for subjects studied at SHS
- Provide teachers with guidelines for constructing assessment items/questions and other assessment tasks
- Introduce standards of achievement in each subject and in each SHS class
- Provide guidance in marking and grading of test items/questions and other assessment tasks
- Introduce a system of moderation that will ensure accuracy and reliability of teachers' marks
- Provide teachers with advice on how to conduct remedial instruction on difficult areas of the syllabus to improve class performance.

The arrangement for SBA may be grouped in categories as follows. Laboratory work, Projects, Group Work and End of Term Examinations

1. Laboratory Work:
   Students will be required to keep laboratory notebook. It is of utmost importance that records be neatly and accurately kept by both student and teacher.

2. Projects/Field Work: These are tasks assigned to students to be completed over an extended time.

   These will involve the following:
   i) Practical work
   ii) Experiment
   iii) Investigative study (including case study)

   A report must be written for each project undertaken.

3. Mid-Term Test: The mid-term test following a prescribed format will form part of the SBA

4. Group Exercise: This will consist of written assignments or practical work on a topic(s) considered important or complicated in the term's syllabus

5. End-of-Tem Examination: The end-of-term test is a summative assessment system and should consist of the knowledge and skills students have acquired in the term. The end-of-term test for Term 3 for example, should be composed of items/questions based on the specific objectives studied over the three terms, using a different weighting system such as to reflect the importance of the work done in each term in appropriate proportions. For example, a teacher may build an End-of-Term 3 test in such a way that it would consist of the 20% of the objectives studied in Term 1, 20% of objectives studied in Term 2 and 60% of the objectives studied in Term 3. The end-of-term 3 test should therefore sample the knowledge and skills acquired over the three school terms in appropriate proportions.

GRADING PROCEDURE

To improve assessment and grading and also introduce uniformity in schools, it is recommended that schools adopt the following WASSCE grade structure for assigning grades on students' test results.

Grade A1:	80 - 100%	-	Excellent
Grade B2:	70 - 79%	-	Very Good
Grade B3:	60 - 69%	-	Good
Grade C4:	55 - 59%	-	Credit
Grade C5:	50 - 54%	-	Credit
Grade C6:	45 - 49%	-	Credit
Grade D7:	40 - 44%	-	Pass
Grade D8:	35 - 39%	-	Pass
Grade F9:	34% and below	-	Fail

In assigning grades to students' test results, you are encouraged to apply the above grade boundaries and the descriptors which indicate the meaning of each grade. The grade boundaries i.e., 60-69%, 50-54% etc., are the grade cut-off scores. For instance, the grade cut-off score for B2 grade is 70-79% in the example. When you adopt a fixed cut-off score grading system as in this example, you are using the criterion-referenced grading system. By this system a student must make a specified score to be awarded the requisite grade. This system of grading challenges students to study harder to earn better grades. It is hence a very useful system for grading achievement tests.

Always remember to develop and use a marking scheme for marking your class examination scripts. A marking scheme consists of the points for the best answer you expect for each question, and the marks allocated for each point raised by the student as well as the total marks for the question. For instance, if a question carries 20 marks and you expect 6 points in the best answer, you could allocate 3 marks or part of it (depending upon the quality of the points raised by the student) to each point , hence totaling 18 marks, and then give the remaining 2 marks or part of it for organisation of answer. For objective test papers you may develop an answer key to speed up the marking.

SENIOR HIGH SCHOOL – YEAR 1

SECTION 1
INTRODUCTORY PHYSICS AND PROPERTIES OF MATTER

General Objectives: *The student will*

appreciate the importance of Physics in everyday life.
appreciate the importance of making accurate measurements of physical quantities and their applications in science and technology
appreciate some phenomena associated with properties of matter.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 INTRODUCTION TO PHYSICS	The students will be able to: explain the importance of Physics outline some basic mathematical concepts.	 Importance of Physics. Basic mathematical concept	Let students: Discuss the importance of the study of Physics. Discuss the branches of Physics. Discuss some basic mathematical concepts,e.g Basic trigonometry, Pythagoras theorem, indices ,conversion of units, significant figures, scientific notation and coordinate geometry.	 Evaluate trig. Ratios such as SOH, CAH, TOA, by relating it the Pythagoras theorem. Find angle of elevation and angle of inclination
UNIT 2 PHYSICAL QUANTITIES	distinguish between basic (fundamental) and derived physical quantities and their units. explain uses of dimensional analysis in terms of the relationship between basic and derived quantities. measure with various measuring instruments	Basic (Fundamental) Quantities. Derived Quantities. Dimensional analysis and its uses in Physics. Measuring Instruments: metre rule, vernier calliper, micrometer screw gauge, beam balance, spring balance, stop watches/clocks (digital and analogue), electronic balance, thermometer	Discuss the basic (fundamental) and derived quantities and their corresponding S. I. units. Use dimensions to verify the dimensional correctness of a given equation. Use dimensional analysis to derive the relationship between quantities. Discuss the use of the measuring instruments listed in the content. Take accurate measurements of selected objects using each of the instruments listed in the content.	List five basic and six derived quantities and their corresponding S.I units. Compare the accuracy in measuring the diameter of a wire with micrometer screw gauge and vernier calipers.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2(CONT'D) **PHYSICAL QUANTITIES**	The students will be able to: identify scalars and vectors from a list of physical quantities distinguish between density and relative density	Scalar and vector quantities Vector representation. Addition and resolution of vectors Density and Relative density	Let students: Discuss scala r and vector quantities. Use force board to determine the resultant of two forces. Determine the resultant of two vectors by graphical method and by calculation. Determine the density of solids (regular and irregular). Determine the density and relative density of a liquid.	What are the dimensions of the following physical quantities: force, density, pressure, work and power?

SENIOR HIGH SCHOOL – YEAR 1

SECTION 2

MECHANICS

General Objectives: The student will

recognize the various types of motion, the laws which govern them and their applications.
recognize the various forms in which forces affect the state of a body and their applications.
appreciate the various forms of energy and energy resources and the ways to harness the renewable sources of energy.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **KINEMATICS**	The students will be able to: 2.1.1 list and describe the various types of motion. 2.1.2 distinguish between distance and displacement, speed and velocity, average velocity and instantaneous velocity. 2.1.3 derive the equations of uniformly accelerated motion. 2.1.4 interpret graphical representations of linear motion.	Types of motion: rectilinear, circular, spin/ rotational, oscillatory, random and translational motions. Distance, displacement, speed, velocity, acceleration, uniform velocity, instantaneous velocity and average velocity. Equations of uniformly accelerated motion. Motion of free fall due to gravity. Displacement-time graph, velocity-time graph	Let students: Demonstrate the different types of motion such as the following; i. tie a pendulum bob and whirl in a circle. ii. use pendulum to demonstrate oscillatory motion. iii. chalk particles to demonstrate random motion. Discuss using appropriate examples to distinguish between: distance, displacement, speed, velocity, acceleration, uniform velocity, instantaneous velocity and average velocity. Measure displacement, velocity, and acceleration of a moving object. Derive equations of uniformly accelerated motion. Use equations to solve problems of uniformly accelerated motion. Discuss motion of free fall due to gravity. Draw and interpret graphs to illustrate uniformly accelerated motion. Use displacement -time graphs to determine velocity. use velocity-time graph to determine: i. distance covered ii. acceleration iii. the instantaneous velocity at a given time.	Use an inclined plane to find the acceleration of a body down the plane. A bus starts from rest and accelerates uniformly at $2ms^{-2}$ for 10s. It maintains the maximum speed attained for further 10s and decelerates at $1ms^{-2}$ gradually to rest. 1. draw the velocity-time graph 2. use velocity-time graph to determine a. the maximum velocity attained b. the time taken c. the total distance covered d. the average velocity.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **KINEMATICS (CONT'D)**	The students will be able to: 2.1.5 investigate the motion of a battery-powered toy car.	Let students: Plotting of a displacement- time graph	Observe the motion of a battery-powered toy car moving in a straight line. Make measurement of distances in some time intervals. Draw a displacement-time graph. Repeat for different surfaces. Analyze the motion and draw conclusions. Present a group report. **NOTE:** Observe students go through the skills of observing, measuring time and distance, collecting data, interpreting data, inferring, communicating and drawing conclusions.	A car moves at $30ms^{-1}$ whiles the velocity of a bus is $40ms^{-1}$. Find the velocity of the bus relative to the car when the two vehicles are moving i. in the same directions ii. in opposite directions iii. in perpendicular directions.
	2.1.6 explain the concept of relative velocity.	Relative velocity.	Discuss the concept of relative velocity. Use the concept of relative velocity to explain the motion between two vehicles moving in: the same direction opposite directions perpendicular directions.	Explain why the police insist that passengers should wear seat belts when cars are in motion.
UNIT 2 **DYNAMICS**	2.2.1 state Newton's three laws of motion and explain the concept of inertia.	Newton's Laws of motion. Inertia.	Discuss the Newton's laws of motion and relate them to practical examples such as the reaction of passengers when a car suddenly stops or moves. Explain the concept of Inertia.	State Newton's laws of motion and deduce the expression F = ma A car of mass 2000kg is accelerating at $2ms^{-2}$. What force is exerted by the engine?
	2.2.2 explain force and relate force to momentum and acceleration.	Force. Momentum. Impulse of a force.	Brainstorm to bring out the meaning of force. Use Newton's laws of motion to derive an expression for force. Explain the term Impulse.	Why should a gun recoil when a bullet is fired from it?
	2.2.3 explain the concept of conservation of linear momentum.	Conservation of linear momentum.	Discuss the law of conservation of linear momentum. Discuss the recoil of a toy gun when fired. Use a timing device and trolley to verify the law of conservation of momentum..	A bullet of mass 20g is fired horizontally into a suspended wooden block of mass 180g with a velocity of $100ms^{-1}$. Calculate the common velocity with which the embedded wooden block moves.
	2.2.4 differentiate between elastic and inelastic collisions.	Elastic and inelastic collisions.	Discuss elastic and inelastic collisions. The discussion should include perfectly elastic and perfectly inelastic collisions, **Note:** stress that for a perfectly elastic collision the relative speed of approaching objects is equal to the relative speed of their separation.	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 **FORCES**	The students will be able to: 2.3.1 distinguish between different types of forces. 2.3.2 define friction and explain the laws of friction. 2.3.3 explain viscosity and describe the forces acting on a body falling through a fluid 2.3.4 explain upthrust describe the moment of a force in terms of its turning effects. State the principle of moments of a body in equilibrium. distinguish between couple and torque determine the relative density of a metal using the principle of moments	Types of forces: -contact forces -field forces Friction Laws of friction Coefficient of static and dynamic friction. Viscosity. Forces acting on a body falling through a fluid Terminal velocity Upthrust , Archimedes principle and Law of floatation Turning effect of forces. Principle of moments. Couple and Torque Application of the principle of moments.	Let students: Discuss contact forces and field forces. Brainstorm to bring out the meaning of friction. Discuss the laws of friction. (The discussion should include the coefficient of static and dynamic friction). Discuss the methods by which friction can be reduced. Brainstorm to bring out the meaning of viscosity. Compare the viscosity of different types of liquids Discuss the term terminal velocity. Discuss the forces acting on an object at terminal velocity. Brainstorm to bring out the meaning of upthrust. Perform an experiment to verify Archimedes Principle. Determine the relative densities of solids and liquids using Archimedes principle. Discuss the operation of a hydrometer and a submarine. Discuss the turning effect of forces. Demonstrate how to find the centre of gravity of a lamina. Discuss the moments of a force about a point. Discuss the principle of moments. Verify the principle of moments using a lever (metre and knife edge) and standard masses. Discuss the conditions necessary for a body to be in equilibrium. Determine the mass of metre rule using the principle of moments. Determine an unknown mass using the principle of Moments. Discuss the difference between couple and torque. Design and carry out an experiment to determine the relative density of a metal. Indicate the application of the principle of moments. Present a report.	Differentiate between contact forces and field forces and give two examples of each type. Describe the forces involved in the following i. grating cassava ii. blending of vegetables iii. weaving a sisal rope Explain why submarine canfloat on the surface of water and sink in water. Give four examples of the turning effect of forces in everyday life. A uniform metre rule is balanced by hanging a 30g mass at 90cm mark. If the pivot is at the 30cm mark, calculate the mass of the metre rule. a. State the principle of moments. b. A load of 200g is placed at the 10cm mark of a uniform metre rule and balances with the pivot at the 35cm mark. Calculate the mass of the rule.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 (CONT'D) FORCES **UNIT 4 PRESSURE**	The students will be able to: define pressure. explain how pressure changes with depth in a fluid. Explain atmospheric pressure. describe the transmission of pressure in fluids describe some applications of atmospheric pressure. describe the effect of change in pressure on the volume of a fixed mass of gas at constant temperature	Pressure Pressure in fluids. P=hρg Atmospheric pressure Simple barometer Manometer Transmission of pressure in fluids Pascal's principle Hydraulic press Hydraulic brakes on vehicles Applications of atmospheric pressure : - siphon - water pumps - syringes Effect of pressure on volume of a gas. Boyle's law	Let students: **NOTE:** Assist students to demonstrate the following inquiry skills: designing experiments, measuring, observing, controlling variables, collecting data, interpreting data, communicating and drawing conclusions. Brainstorm to bring out the meaning of pressure. Discuss how pressure changes with depth in a fluid. Brainstorm to bring out the meaning of atmospheric pressure. Explain how the height of a liquid column may be used to measure the atmospheric pressure. Discuss the use of a manometer in the measurement of pressure difference. Discuss the transmission of pressure in fluids. Discuss the transmission of pressure in hydraulic systems with particular reference to hydraulic brakes on vehicles and hydraulic press. Discuss the operations of instruments listed in the content based on the atmospheric pressure. Discuss the effect of pressure on the volume of a fixed mass of gas at constant temperature. Discuss Boyle's law.	Define pressure. Calculate the pressure at a point 50m below the surface of water. [$g=10ms^{-2}$, density of water=$1000kgm^{-3}$] State Pascal's principle. Explain the principle of operation of a hydraulic press. The pressure of a fixed mass of gas of volume $60cm^3$ is doubled at constant temperature. Calculate the new volume.

SENIOR HIGH SCHOOL- YEAR 1

SECTION 3

THERMAL PHYSICS

General Objectives: The student will

1. understand the concept of heat, its relationship with temperature and its effects on substances.
2. appreciate the principles involved in the measurement of temperature.
3. recognise heat as a form of energy and how it can be measured .
4. be aware of the various modes of heat transfer.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **TEMPERATURE AND ITS MEASUREMENT**	The students will be able to: 3.1.1 explain temperature and heat. 3.1.2 outline the steps and principles involved in the measurement of temperature. 3.1.3 describe the features and uses of different types of thermometers.	Temperature. Heat. Thermometric property. Upper and lower fixed points Temperature scales: (Celsius, Fahrenheit and Kelvin scales). Types of thermometers:	Let students: Discuss to bring out the meaning of the concept of temperature. Discuss to distinguish between heat and temperature. Discuss thermometric property and associated characteristics. Discuss the Celsius, Fahrenheit and Kelvin scales of temperature and the relationship between them. Discuss the determination of the lower and upper fixed points in the measurement of temperature. Discuss the processes involved in establishing the Celsius scale and the Kelvin scale. Discuss the main features, uses and limitations of the listed thermometers. Liquid-in-glass thermometers, (Clinical, Laboratory and Six- Max and Min thermometers), Resistance thermometer, Thermocouple thermometer , Constant volume gas thermometer and Pyrometer	Distinguish between heat and temperature. The length of a liquid column in a glass tube reads 2cm, 25cm and 15cm respectively if the bulb is placed in ice, steam and hot liquid. Calculate the temperature of the hot liquid. Describe how you would determine the upper fixed point of a liquid-in-glass thermometer.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (COND'T) TEMPERATURE AND ITS MEASUREMENT	The students will be able to: 3.1.4 plot a cooling curve of a liquid.	Cooling curve	Let students: Observe the temperature of a hot water as it cools at minutes intervals for about 15minutes.Tabulate your results and plot a graph of temperature against time. Draw a smooth curve through the points. Analyse the graph and present a report. **NOTE:** Observe students go through the skills of observing, measuring, controlling variables, collecting data, interpreting data, communicating and drawing conclusions.	State four advantages that mercury has over alcohol as a thermometric liquid. Explain why water is not suitable as a thermometric liquid.

SENIOR HIGH SCHOOL- YEAR 1

SECTION 4

WAVES

General Objectives: The student will

1. understand that waves transmit energy as they travel through media or vacuum.
2. become aware of the properties and transmission of light in various media and their applications.
3. appreciate the principles underlying the production, transmission and applications of sound.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **REFLECTION OF LIGHT FROM PLANE AND CURVED MIRRORS.**	The students will be able to: 4.1.1 describe reflection of light from plane surfaces. 4.1.2 state and verify the laws of reflection. 4.1.3 locate and describe the image formed in a plane mirror and its characteristics. 4.1.4 distinguish between diverging and converging mirrors. 4.1.5 trace light rays to locate the positions of the images formed by spherical mirrors and describe their characteristics.	Reflection of light from plane surfaces. Laws of reflection. Image formed in a plane mirror. Converging mirrors and diverging mirrors. (Spherical mirrors). Formation of images in spherical mirrors and their characteristics.	Let students: Discuss reflection of light from plane surfaces. Trace the path of a ray reflected from the surface of a plane mirror using optical pins and measure angle of incidence (i) and angle of reflection (r). Discuss regular and irregular reflection. Discuss the laws of reflection. Discuss the characteristics of image formed in the plane mirror. Construct a periscope and discuss its application. Discuss the general formula. $n = \frac{360}{\theta}$ Where **n** = total number of images seen in two mirrors inclined at an angle **θ**. Observe and discuss diverging and converging mirrors as segments of a hollow sphere. Use ray box or optical pins to determine the position and characteristics of images formed in spherical mirrors. Use mirror formula and magnification formula to solve simple problems.	Use optical diagram to locate the image of a point object in a plane mirror. Find the number of images formed by an object placed between two plane mirrors inclined at 30^0. How many images are formed in two parallel mirrors? Compare converging and diverging mirrors in terms of : i. Image formation ii. Magnification.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D) **REFLECTION OF LIGHT FROM PLANE AND CURVED MIRRORS.**	The students will be able to: 4.1.6 determine the focal length of a converging mirror.	Determination of the focal length of a converging mirror.	Let students: Perform an experiment to determine the focal length of converging mirror using any appropriate method. Present a report on your work.	An object is placed 20cm in front of a converging mirror of focal length 15cm.Determine the position of the image.
	4.1.7 explain the uses of spherical mirrors.	Uses of spherical mirrors.	**NOTE:** Observe students go through the skills of observing, measuring, controlling variables, collecting data, interpreting data, communicating and drawing conclusions. Discuss the uses of spherical mirrors with examples.	Why is a diverging mirror used as a driving mirror?
UNIT 2 **REFRACTION OF LIGHT**	4.2.1 explain the term refraction and state the laws of refraction.	Refraction at plane surfaces. Laws of refraction.	Discuss the concept of refraction and the terms used. Discuss the laws of refraction.	In an experiment to determine the refractive index of a glass in the form of a rectangular prism, the angle of incidence, and the angle of refraction were 30^0 and 19.5^0 respectively. Determine the refractive index of the material of the glass.
	4.2.2 explain refractive index.	Refractive Index.	Discuss refractive index. Trace rays through a rectangular prism. Measure and compare the angle of incidence and the angle of refraction. Relate lateral displacement to the angle of incidence and angle of refraction. Discuss refractive index in terms of real and apparent depth. Discuss refractive index in terms of the speed of light in different media.	
	4.2.3 design and carry out an experiment to determine the refractive index of rectangular glass block.	Determination of the refractive index of rectangular glass block.	Perform an experiment to determine the refractive index of rectangular glass block using appropriate method. Present a report on your work. **NOTE:** observe students go through the following inquiry skills: designing experiments, measuring, collecting data, interpreting data, controlling variables, communicating and drawing conclusion.	Describe an experiment to determine the refractive index of a rectangular glass block.
	4.2.4 trace rays of light through a triangular prism to determine its refractive index.	Refraction through triangular prism. - angle of the prism (A) - angle of incidence (i) - angle of refraction (r) - angle of emergence (e) - angle of deviation (D)	Discuss the path of rays of light through a triangular prism. Use appropriate graph to show the relationship between the measured angles and deduce the minimum deviation. Perform an experiment to determine the refractive index of a triangular prism using appropriate method. Present a report on your work.	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D) **REFRACTION OF LIGHT**	The students will be able to:	$n = \frac{\text{Sin}\left(\frac{A + D_{min}}{2}\right)}{\text{Sin}\left(\frac{A}{2}\right)}$	Let students: **NOTE:** observe students go through the following inquiry skills: measuring, collecting data, interpreting data, controlling variables, communicating and drawing conclusions.	One method of determining the refractive index of a transparent solid is to measure the critical angle when the solid is in air. If the critical angle is found to be 40.5^0 what is the refractive index of the solid
	4.2.5 explain the concepts critical angle and total internal reflection.	Critical angle (C) and total internal reflection. $n = \frac{1}{\text{Sin } C}$	Discuss critical angle and total internal reflection.	Explain the following terms: (i) critical angle (ii) total internal reflection.
	4.2.6 describe some applications of total internal reflection.	Applications of total internal reflection: refracting prism, binoculars, mirage.	Discuss some applications of total internal reflection.	
UNIT 3 **BASIC FIBER OPTICS**	4.3.1 explain the concept of fiber optics.	Fiber optics.	Discuss what is meant by fiber optics.	Explain what is meant by fiber optics and outline the principle involved in transmission of light using optical fiber.
	4.3.2 describe an optical fiber and the principle of its operation.	Optical fiber: Structure. Mode of operation.	Discuss an optical fiber. Draw the cross section of an optical fiber showing the core, cladding layer, buffer layer and the jacket.	
	describe the applications of fiber optics.	Applications of fiber optics	Discuss the principle of operation of an optical fiber. Discuss the applications of fiber optics in areas such as communication, e.g. Local Area Networks (LANs), medicine, sensing devices, carrying laser beams.	Outline three applications of fiber optics.

SENIOR HIGH SCHOOL- YEAR 1

SECTION 5

ELECTRICITY AND MAGNETISM

General Objectives: The student will

1. be aware that electrical charges can be stored in electrostatic field.
2. understand the laws governing direct current circuits and their applications.
3. appreciate the nature and properties of magnets and their applications.
4. recognise the effects of electromagnetic fields on conductors and current-carrying conductors.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **ELECTROSTATICS**	The students will be able to: 5.1.1 classify materials as conductors, insulators, and semi-conductors. 5.1.2 outline the methods of charging materials. 5.1.3 describe the distribution of charges on a pear-shaped and spherical conductors. 5.1.4 explain the action of charges at sharp points. 5.1.5 explain Coulomb's law for point charges 5.1.6 explain the concepts of an electric field and electric field intensity	Conductors, insulators, and semi-conductors. Methods of charging materials – friction, contact, induction, and conduction. Distribution of charges on surfaces of conductors. Action of charges at sharp points. Coulomb's law Electric Field. Electric field intensity $E = F/Q$ $E = Q/4\pi \varepsilon_o r^2$	Let students: Discuss the properties of conductors, insulators and semi-conductors. Classify given materials into conductors, insulators, and semi-conductors. Demonstrate the various methods of charging materials. Explain the charge distribution on pear shaped and spherical conductors. Discuss the action of charges at sharp points. Discuss the structure and functioning of lightning conductors. Discuss Coulomb's law. Solve problems involving the use of Coulomb's law. Discuss electric field in terms of electric lines of force. Discuss the electric field intensity as force per unit charge.	Give two examples each of: (i) conductors (ii) semi-conductors (iii) insulators. Briefly describe how a conductor can be charged positively by induction. Calculate the force between two charges 50µc and 10µc when they are placed 50cm apart in a vacuum. $(4\pi \varepsilon_o)^{-1} = 9.0 \times 10^9 Nm^2c^{-2}$

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D)	The students will be able to:		Let students:	
ELECTROSTATICS	5.1.7 explain electric potential and potential difference.	Electric potential $V=Q/4\pi\varepsilon_o r$ Potential difference.	Discuss electric potential and use the expression to solve simple problem. Discuss potential difference.	A charge particle carrying a charge of 2.5uC experiences a force of 20N at a point in an electric field.Calculate the field intensity at that point.
	5.1.8 deduce the relationship between the potential gradient and the electric field intensity.	Electric field intensity. Potential gradient.	Deduce the relationship between potential gradient and electric field intensity.	Find the electric potential at a point which is 120cm from a charge of +200µC.
UNIT 2 **CAPACITORS**	5.2.1 describe the structure and operation of capacitors.	Capacitors: structure operation	Discuss the structure and operation of the parallel plate capacitor. (The discussion should include types of capacitors based on the dielectric material used).	Two positive charges +10µC and + 20µC are separated by a distance of 3m in a vacuum. Find the position where the electric field intensity is zero
	explain capacitance.	Capacitance (i) $C = Q/V$, (ii) $C = \frac{\varepsilon A}{d}$	Discuss capacitance in terms of the charge and potential difference across it. Discuss capacitance in terms of the area, displacement between plates, and permittivity of the dielectric.	The electric field intensity between two charged parallel plates is $1.5x10^3$N/C. The plates are 0.08m apart. What is the potential difference between the plates?
	describe the charging and discharging process of a capacitor.	Charging and discharging of a capacitor	Discuss the charging and discharging of a capacitor. Discuss wave forms of the charging and discharging of capacitor. .	Calculate the capacitance of parallel plate capacitor; if the area of overlapping plate is $50cm^2$, and the distance between the plates is 5mm, dielectric constant is 6.7. ($\varepsilon_o=8.85x10^{-12}C^2/Nm^2$)
	derive the formulae for the capacitance of the series and parallel arrangements of capacitors.	Arrangement of capacitors in series and parallel.	Discuss the arrangement of capacitors in series, and in parallel.	
	derive the expression for energy stored in a charged capacitor.	Energy stored in a charged capacitor.	Discuss energy stored in a charged capacitor.	Three capacitors of capacitances 1µC, 2µC and 3µC, are connected in series and parallel. A 50V battery is connected in turn across the arrangement. Determine, for each arrangement, (a) the effective capacitance (b) the charge on each capacitor.
	describe the behaviour of a capacitor in d.c. and a.c. circuits.	Behaviour of capacitor in a d.c. circuit. Behaviour of capacitor in an a.c. circuit.	Discuss the behaviour of a capacitor in a d.c. circuit. Discuss the behaviour of a capacitor in an a.c. circuit. Discuss the uses of capacitors e.g. filtering, timing devices, sequential and clock circuits, digital measurement instrumentation.	

SENIOR HIGH SCHOOL- YEAR 1

SECTION 6

ATOMIC AND NUCLEAR PHYSICS

General Objectives: The student will:

1. develop an understanding of the structure of the atom.
2. appreciate the structure of the nucleus.
3. be aware of the peaceful application of nuclear energy.
4. be aware of the importance of photoelectric effect.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **MODELS OF THE ATOM AND ATOMIC STRUCTURE**	The students will be able to: 6.1.1 describe the models of the atom. 6.1.2 explain the existence of quantized energy levels in an atom. 6.1.3 describe the types of spectra and their uses.	Models of the atom: Thompson's model. Rutherford's model. Bohr's model. Energy quantization. Energy level diagrams. Line spectra. Ionization Potential and ionization energy. Excited states and excitation energy. Types of atomic spectra(line, band, continuous) and their uses.	Let students: Discuss the various models of the atom, high-lighting on the limitations of each model. (The discussion should include Rutherford's alpha scattering experiment). Discuss the existence of energy levels in an atom. Discuss the transition of electrons between energy levels. Draw energy level diagrams and use them to determine energy changes between the levels. Discuss ground state, excited state, excitation energy, ionization potential and ionization energy. Discuss the various types of atomic spectra and their uses.	Describe Rutherford's alpha scattering experiment and explain the observations, deductions and the conclusion. Explain briefly what is meant by (I) ground state (ii) first excited state (iii) ionization energy. What are the main characteristics of line spectrum? Explain briefly how line spectra are used to identify elements.

SENIOR HIGH SCHOOL- YEAR 1

SECTION 7

ELECTRONICS

General Objectives: The student will:

1. appreciate the characteristics of the P-N junction diode and their applications in electronics .
2. understand the characteristics of the bipolar transistors and their applications.
3. appreciate the use of digital electronics in electronic switching and integrated circuits.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **ELECTRONIC SEMI-CONDUCTOR P-N JUNCTION DIODE**	The students will be able to: 7.1.1 distinguish among conductors, semi-conductors and insulators. 7.1.2 distinguish between Intrinsic and extrinsic semi-conductors and their productions. 7.1.3 describe the formation and action of P-N junction diode.	Conductors, semi-conductors and insulators. Energy bands. Intrinsic and extrinsic semi-conductors: P-N junction formation. Forward and reverse bias of P-N junction diode. current - voltage (I-V) characteristics.	Let students: Discuss and distinguish conductors, semi-conductors and insulators. Discuss the band theory explanation for electrical conduction in conductors, semi-conductors and insulators. Discuss the terms extrinsic and intrinsic semi-conductors. Discuss the production of P-type and N-type semi conductors. (The discussion should include doping, acceptor and donor atoms, majority and minority charge carriers). Discuss the formation of a P-N junction. Discuss the characteristics of P-N junction diodes. Discuss forward and reverse biasing of P-N junction diodes. Discuss the current – voltage characteristics of P-N junction diode.	a. What is a semi-conductor? b. Explain the mode of charge movement in a (i) a semi-conductor (ii) metallic conductor Why does the conductivity of an intrinsic semi-conductor increase as temperature increases? Explain the production of P-type and N-type semi-conductors. Explain the following terms as used in semi-conductors: (i) donor (ii) acceptor (iii) majority carriers (iv) minority carriers.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D) **ELECTRONICS SEMI-CONDUCTOR P-N JUNCTION DIODE**	The students will be able to: 7.1.4 describe the types of P-N junction diodes and their uses. 7.1.5 describe the half wave and full wave rectification of alternating current(a.c) and explain the smoothing or filter capacitor action.	Types of P-N junction diodes: - Rectifier diodes - Signal diodes - Light emitting diodes (LED) - Zener diodes - Photo diodes Rectification: half and full wave. Use of reservoir capacitor for peak d.c. voltage storage.	Let students: Discuss the types of diodes as listed in the content. Discuss the uses of the various types of P-N junction diodes. Discuss the half wave and full wave rectification of a.c. Discuss the reservoir capacitor in peak voltage development and storage. **PROJECT** Using some electronic devices, student should design and construct a half-wave rectification circuit. Group report should be presented.	In a bridge rectifier circuit containing 4 diodes, one of the diodes breaks down so that an open circuit occurs at that point. Describe and explain the shape of the output wave form for a sinusoidal a.c input.

SENIOR HIGH SCHOOL – YEAR 2

SECTION 1

INTRODUCTORY PHYSICS AND PROPERTIES OF MATTER

General Objective: The student will

appreciate the importance of physics in everyday life.
appreciate the importance of making accurate measurements of physical quantities and their applications in science and technology.
appreciate some phenomena associated with properties of matter.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **CONCEPT OF MATTER**	The students will be able to: define matter . explain the particulate nature of matter. explain the phases of matter	 Matter. Kinetic theory of matter Brownian motion Phases of matter : solids, liquids and gases	Let students: Explain the concept of matter. Discuss the kinetic theory of matter. Discuss Brownian motion. Discuss the three phases of matter as outlined in the content. Explain plasma.	Explain why solids are rigid. Explain the Brownian motion.

SENIOR HIGH SCHOOL- YEAR 2

SECTION 2

MECHANICS

General Objectives: The student will:

1. recognize the various types of motion and the laws which govern them and their applications.
2. recognize the various forms in which forces affect the state of a body and their applications.
3. appreciate the various forms of energy ,energy resources and the ways to harness the renewable sources of energy.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **ENERGY**	The students will be able to: 2.1.1 list and describe the various forms of energy. 2.1.2 describe energy conversion and transformation. 2.1.3 describe the energy sources in the Earth's system. 2.1.4 carry out simple projects to harness energy from the Sun and Biomass	Forms of energy: Potential Energy Kinetic Energy Heat Energy Light Energy Electrical Energy Nuclear Energy Solar Energy Conversion and conservation of energy. Law of conservation of Energy. Renewable and Non-Renewable energy sources Harnessing energy from renewable energy sources	Let students: List and discuss different forms of energy. Demonstrate that an object may have energy due to its position or motion. Solve simple problems using expressions for potential energy and kinetic energy. Give examples of conversion of energy from one form to another. Discuss the conservation of mechanical energy. Apply the principle of energy conservation to solve simple problems. Discuss the law of conservation of energy. Discuss the energy sources in the Earth's system. Discuss how electricity or other forms of energy may be obtained from renewable sources. **PROJECTS:** 1. Design and construct a means to collect and store solar energy. Take appropriate measurements.(visit any resource centre for the materials) 2. Build a digester. Use waste agricultural products to produce methane gas for use in cooking. Describe how electricity can be generated from the gas produced. Write a report.	A ball of mass 4kg is pushed off the edge of a table that is 2.0m above the floor. Find the speed of the ball as it strikes the floor. [take g=10ms^{-2}] State the law of conservation of energy. Give two examples to illustrate your answer. What is meant by the following terms? (a). renewable energy (b). biomass (c). solar energy

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D) **ENERGY**	The students will be able to: 2.1.5 describe the effect of the use of both renewable and non-renewable sources of energy on the environment and carbon cycle. 2.1.6 explain the concept of work and power.	Global warming: Greenhouse effect. Work Power	Let students: Discuss the effect of the use of both renewable and non-renewable sources of energy on the environment and carbon cycle. Discuss Greenhouse effect and the role it plays in determining the earth's temperature. Discuss the concept of work in terms of the product of force and distance moved in the direction of the force Discuss how work done can be expressed as change in mechanical energy. Discuss the concept of power as work done per unit time.	What is meant by the following terms? (a). renewable energy (b). biomass (c). solar energy List the advantages and disadvantages of two primary energy sources which are non renewable renewable What are the main environmental implications of using the following energy sources: Fossil fuel, Nuclear fuel, Solar devices, Wind energy, Hydroelectric power, Biomass? What must the power output be of an elevator motor that can lift a mass of 10000kg and give the elevator a constant speed of $5ms^{1}$? [$g=9.81ms^{-2}$]
UNIT 2 **CIRCULAR MOTION AND GRAVITATION**	2.2.1 explain angular displacement, angular velocity and angular acceleration. 2.2.2 explain centripetal force.	Angular displacement, angular velocity and angular acceleration. Centripetal force. Centripetal acceleration.	Discuss to bring out the definition of angular displacement, angular velocity and angular acceleration. Discuss the relationship between speed and angular velocity. State the expression for centripetal acceleration and relate it to centripetal force.	Define the following terms: angular displacement angular velocity angular acceleration. Derive an expression for the angular velocity of a body moving at a constant speed V in the circle of radius r. An object of mass 2.0kg tied to a string is whirled round in a horizontal circle of radius 0.5m with a constant speed of $6.0ms^{-1}$ Calculate i. the angular velocity ii. tension in the string.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D) **CIRCULAR MOTION AND GRAVITATION**	The students will be able to: 2.2.3 explain the applications of circular motion. 2.2.4 explain gravitational field and state Newton's universal law of gravitation. 2.2.5 explain the term satellites and distinguish between artificial and natural satellites. 2.2.6 explain gravitational potential and escape velocity.	Applications of circular motion i. banking of roads ii. centrifuge iii. conical pendulum iv. negotiating a bend Gravitational field. Gravitational field strength $g = \frac{F}{M}$ Newton's Universal law of gravitation. $F = G\frac{(M_1M_2)}{r^2}$ $g(r_e)^2 = GM_e$ Natural and artificial Satellites. Parking orbit, geostationary satellites and period of revolution of a satellite. Gravitational potential. $V = -\frac{GM}{r}$ Escape Velocity. $v = \sqrt{2gr_e}$	Let students: Discuss circular motion and explain the listed applications. (See list in Content) Discuss the gravitational field. Discuss Newton's universal law of gravitation. Discuss the relationship between acceleration due to gravity(g) and universal gravitational constant (G), and deduce the mass of the earth, M_e Solve simple problems involving the gravitational law. Discuss to bring out the meaning of satellites. Compare artificial and natural satellites. Discuss the period of revolution and the speed of a satellite. Outline the uses of artificial satellites. Derive and discuss the gravitational potential. Discuss escape velocity. Calculate the escape velocity of a rocket from the earth's gravitational field.	Explain the uses of the following. banking of roads centrifuge. Distinguish between universal gravitational constant and acceleration due to gravity. Determine the acceleration due to gravity at a height of 1,200km.(Radius of the Earth = 6.4×10^6m, Acceleration due to gravity on the earth's surface;g= $9.81ms^{-2}$) Outline some uses of artificial satellites. Define the following terms i. artificial satellites ii. parking orbit iii. period of a satellite. A body on the Earth surface is 500kg and is given a velocity such that it just leaves the Earth gravitational field. Find its velocity. [$g=9.81ms^{-2}$, $r_e=6.4 \times 10^6$m].

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 **OSCILLATORY MOTION**	The students will be able to: 2.3.1 describe oscillatory motion. 2.3.2 describe and illustrate simple harmonic motion (SHM). 2.3.3 investigate the relationship between the period of oscillation and; i. Length of a simple pendulum ii. Mass of a loaded spring Mass of a loaded cantilever iv. Length of a bifilar suspension. 2.3.5 describe the velocity, acceleration and energy of a body exhibiting simple harmonic motion. 2.3.6 interpret graphical representation of simple harmonic motion.	Oscillatory motion. Simple Harmonic Motion (SHM) - simple pendulum - loaded spiral spring - loaded test tube in a water - bifilar suspension - cantilever Experiments on simple harmonic motion. Velocity, acceleration and energy of a body exhibiting simple harmonic motion Graphical representation of simple harmonic motion. $y = a\sin\omega t$.	Let students: Discuss oscillatory motion. Define and describe simple harmonic motion and give examples as listed in content. Perform experiments to determine the relationships between the period of oscillation and : i. Length of a simple pendulum ii. Mass of a loaded spring iii. Mass of a loaded cantilever iv. Length of a bifilar suspension. Deduce the acceleration due to gravity from the relationship between period and length of a simple pendulum. **NOTE:** observe students go through the skills of measuring, controlling variable, collecting, interpreting data, analyzing, communication, and drawing conclusions. Discuss the velocity, acceleration and energy of a body exhibiting simple harmonic motion. Sketch graphs to illustrate simple harmonic motion and establish the link between simple harmonic motion and uniform circular motion.	a. Define simple harmonic motion, amplitude and frequency. b. An object moving in simple harmonic motion has amplitude of 0.02m and frequency 40Hz. Calculate i) The period of oscillation. ii) The acceleration at the middle and the end of an oscillation. iii) The velocities at the corresponding positions. Describe an experiment to determine acceleration due to gravity using simple pendulum

SENIOR HIGH SCHOOL- YEAR 2

SECTION 3

THERMAL PHYSICS

General Objectives: The student will:

1. understand the concept of heat, its relationship with temperature and its effects on substances.
2. appreciate the principles involved in the measurement of temperature.
3. recognise heat as a form of energy and how it can be measured.
4. become aware of the various modes of heat transfer.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **THERMAL PROPERTIES OF MATTER AND CALORIMETRY**	The students will be able to: 3.1.1 explain the concept of heat. 3.1.4 explain thermal expansion of solids, liquids and gases 3.1.2 explain heat capacity and specific heat capacity and describe the methods for measuring them. 3.1.3 explain the concept of melting, boiling, evaporation and latent heat	Heat. Thermal expansion. Types of expansivity: linear, area and volumetric Heat capacity. Specific heat capacity method of mixtures Newton's law of cooling cooling curve method electrical method. Melting, boiling, evaporation and latent heat	Let students: Discuss heat as a form of energy. Discuss thermal expansion of solids, liquids and gases. Determine linear, area and volumetric expansivity. Define and discuss heat capacity and specific heat capacity. Discuss Newton's law of cooling. Use method of mixtures, cooling curve method and electrical method to determine the specific heat capacities of solids and liquids. Perform experiments to determine the specific heat capacities of liquids and solids using the methods outlined above. Distinguish between boiling and evaporation Discuss melting and latent heat	Explain the anomalous expansion of water. Define linear expansivity. Distinguish between heat capacity and specific heat capacity. A body of mass 2kg is heated from $20^{o}C$ to $30^{o}C$ in 40s. Find the average power supplied. (Specific heat capacity of water is 4200J Kg^{-1} K^{-1}). List the similarities and differences between boiling and evaporation.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1(CONT'D) **THERMAL PROPERTIES OF MATTER AND CALORIMETRY**	The students will be able to: 3.1.4 explain the concept of specific latent heat. 3.1.5 explain the effect of change in the temperature on the volume of a fixed mass of gas at constant pressure.	 Specific latent heat (of fusion and vaporization). Effect of temperature on volume of a gas Charles' law	Let students: Determine the specific latent heat of fusion and vaporization using, i. method of mixtures ii. electrical method. Perform an experiment to determine the latent heat of fusion of ice by the method of mixtures. Present a report. **NOTE:** assist students go through the skills of observing, measuring, problem solving, interpreting data and drawing conclusions. Discuss the effect of temperature on the volume of fixed mass of gas at constant pressure. Discuss Charles' law.	 Describe an experiment to determine the specific latent of fusion of ice. Calculate heat energy required to change 2kg of ice from solid to liquid at 0^{o}C. (specific latent heat of fusion of ice is $3.4x10^{5}$J Kg^{-1})

SENIOR HIGH SCHOOL- YEAR 2

SECTION 4

WAVES

General Objectives: The student will:

develop an understanding that waves transmit energy as they travel through media or vacuum.
be aware of the properties and transmission of light in various media and their applications.
appreciate the principles underlying the production, transmission and applications of sound.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 ***THIN LENSES AND*** ***OPTICAL INSTRUMENTS***	Students will be able to: 4.1.1 describe types of lenses 4.1.2 explain focal length and the power of lenses and discuss the images formed by lenses. 4.1.3 determine the focal length of a converging lens	Types of lenses Focal length and power of a lens Formation of images using converging and diverging lenses. Determination of the focal length of a converging lens.	Let students: Discuss the types of lenses. Discuss focal length and the power of a lens. Discuss images formed by lenses. Use ray diagrams to locate positions of images formed by converging and diverging lenses. Use the lens and linear magnification formulae to solve simple problems. Perform experiments to determine the focal length of a converging lens using: i. Newton's formula method ii. Lens formula method iii. Displacement method iv. Magnification method Write a report on each experiment. **NOTE:** Assist students go through the skills of observing, measuring, controlling variables, collecting data, interpreting data, communicating and drawing conclusions.	Calculate the power of a diverging lens of focal length 25cm.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D) ***THIN LENSES AND OPTICAL INSTRUMENTS***	The students will be able to: 4.1.4 explain visual angle and angular magnification.	Visual angle and angular magnification.	Let students: With sketches, discuss visual angle and angular magnification.	
	4.1.5 explain the structure and operation of some optical instruments.	Optical Instruments: Simple camera, the human eye, microscopes and telescopes.	Discuss the use of optical instruments listed in the content. Compare the structure and function of the human eye and the camera. Draw a ray diagram to show how a single lens forms an image in the magnifying glass(simple microscope).	Compare the formation of image in the human eye and a camera.
	4.1.6 explain defects of vision.	Defects of vision and their corrections.	Discuss the defects of vision and their corrections.	
	4.1.7 describe the defects of lenses and their corrections.	Near point and Far point Defect of lenses: Chromatic aberration and Spherical aberration.	Discuss the terms Near point and Far point. Discuss the defects of lenses and their corrections.	What are the defects of vision? With ray diagrams, show how two of the defects can be corrected.
UNIT 2 **WAVE MOTION**	4.2.1 describe a wave motion and explain its measurable properties.	Production of waves. Measurable properties:- displacement ,amplitude , frequency ,phase wavelength ,velocity, phase difference, period	Discuss the concept of wave motion. Demonstrate wave motion by means of slinky spring ropes and ripple tanks. Discuss the relationship between the measurable properties (as listed in content). Illustrate crest and trough of a wave profile.	Define the following terms: amplitude, phase, period and crest The velocity of sound in air is $340ms^{-1}$ .Calculate (i) the wavelength when the frequency is 256Hz (ii) the frequency when the wavelength is 0.85m.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D) **WAVE MOTION**	The students will be able to: 4.2.2 classify waves. 4.2.3 use the progressive wave equation to solve simple problems. 4.2.4 explain the properties of waves	Classification of waves: transverse longitudinal stationary progressive electromagnetic mechanical Progressive wave equation: $y = A\sin(\omega t \pm \frac{2\pi x}{\lambda})$ Properties of waves: Reflection, refraction, diffraction, interference , Superposition of waves, Coherence and Polarization	Let students: Distinguish between transverse and longitudinal waves. Distinguish between stationary and progressive waves. Distinguish between electromagnetic and mechanical waves. Discuss the use of the progressive wave equation. Use the ripple tank to demonstrate the properties of waves. discuss the following: i. reflection and refraction of waves. ii. diffraction of waves. iii. principle of superposition of wave. iv. interference of waves. v. polarization of waves and its application in polaroids. vi. discuss the term coherence.	Distinguish between progressive and stationary waves,and give one example of each. The displacement y of a progressive wave is given by $y=4\sin(100\pi t-20x)$,y in mm,x in metres.Find the (i) amplitude (ii) frequency (iii) wavelength (iv) speed of the wave.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D) ***WAVE MOTION***	The students will be able to:		Let students:	
	4.2.5 describe the main features and uses of electromagnetic waves.	Electromagnetic waves: Gamma rays X-ray Ultra violet Visible Infrared Microwaves Radio waves	Discuss electromagnetic waves. Use a chart to show the orders of the magnitude of wavelengths of the principal radiations from radio waves to gamma rays. Describe the various uses of electromagnetic waves.	List in order of increasing frequency the kinds of waves that make up the electromagnetic spectrum. Name one use for each.
UNIT 3 **SOUND**		Production, nature and transmission of sound.		Describe an experiment to show that sound needs a material medium for its transmission.
			Demonstrate the production of sound by different vibrating sources. Discuss the longitudinal nature of sound. Experiment to establish that sound travels through material medium. Discuss the reflection and the refraction of sound. (The discussion should include the formation and uses of echo). Discuss the order of magnitude of the speed of sound in different media(solid, liquids and gases).	
		-infra sonic, audio sonic (audible) and ultrasonic.		
	4.3.1 describe the production and nature of sound by vibrating sources.	Vibration in strings : Laws of vibration in a stretched string	Discuss the frequency ranges of infrasonic, audible and ultrasonic sound waves and their uses. Discuss .forced vibration, harmonics and overtones. Discuss to bring out the vibration of strings in violin, guitar, piano, and harp. Use the sonometer box to demonstrate the dependence of frequency on length, tension and linear density.	A wire whose mass per unit length is 10^{-3} kg m^{-1} is stretched by a load of 4kg over the two bridges of a sonometer 1m apart. If it is plucked at the midpoint determine the wave- length of its fundamental vibration.[g=10ms^{-2}]
	4.3.2 describe the frequency ranges of sound. 4.3.3 demonstrate the modes of vibrations in a stretched string.		Perform an experiment to show the dependence of frequency on the length of the vibrating string on a sonometer box. Present a report on your work. **NOTE:** observe students go through the following scientific inquiry skills: observing, measuring controlling variables, collecting data interpreting data, communicating and drawing conclusions.	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 (CONT'D)	The students will be able to:		Let students:	
SOUND	4.3.4 demonstrate the modes of vibration in pipes and explain end correction and resonance.	Vibration of air in open and closed pipes. Resonance. End correction.	Demonstrate types of sound given by open and closed pipes. Discuss end correction. Discuss resonance. Perform an experiment using a resonance tube to measure the speed of sound in air. Present a report on your work. **NOTE:** observe students go through the skills of observing, measuring, controlling variables, collecting data, interpreting data, communicating and drawing conclusions.	Describe an experiment to determine the speed of sound in air using a resonance tube.
	4.3.5 outline the characteristics of musical notes.	Music and noise. Pitch, loudness and quality (Timbre).	Discuss the differences between music and noise. Discuss the characteristics of a musical note.	Explain what is meant by Doppler effect.
	4.3.6 explain the concept of Doppler effect of sound.	Doppler effect.	Discuss Doppler effect. Use whistle, moving car or siren to demonstrate Doppler effect. **NOTE**: Only qualitative treatment is required.	Two tuning forks A and B are sounded together producing beats with a frequency of 10Hz. If a small piece of plasticine is fixed to fork B, the beat frequency decreases. If fork A has a frequency of 300Hz, what is the original frequency of B?
	4.3.7 describe beats and explain its production and applications.	Beats.	Discuss beats. Use two tuning forks of nearly equal frequency to demonstrate beats. Use beats to tune musical Instruments.	

SENIOR HIGH SCHOOL- YEAR 2

SECTION 5

ELECTRICITY AND MAGNETISM

General Objectives: The student will:

be aware that electrical charges can be stored in electrostatic field.
understand the laws governing direct current circuits and their applications.
appreciate the nature and properties of magnets and their applications.
appreciate the effects of electromagnetic fields on conductors and current-carrying conductors.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **DIRECT CURRENT CIRCUIT ANALYSIS**	The students will be able to: 5.1.1 list sources of electricity. 5.1.2 demonstrate thermoelectric effect 5.1.3 explain current, potential difference and electromotive force(emf). 5.1.4 state Ohm's law and explain the factors that affect the resistance of a conductor.	Sources of electricity: Primary and Secondary cells, Generators, solar cells, fuel cells. Thermocouple. Demonstration of thermoelectric effect. Current Potential difference(p.d) Electromotive force(emf) Ohm's law Resistance.	Let students: Discuss different sources of electricity. Discuss the defects of simple cells. Discuss the limitations in the applications of each source. Discuss the concept of internal resistance of accumulators. **PROJECT**: Design a thermocouple and demonstrate how it can be used to generate electricity. Brainstorm to bring out the meaning of current. Differenciate between emf and p.d. Discuss Ohm's law. Perform an experiment to verify Ohm's law. Present a report on your work. **NOTE:** Assist students to acquire the skills of measuring, collecting data, controlling variables, interpreting data, communicating and drawing conclusions.	(a) What is i Polarization, ii Local action, as applied to primary cells? iii. Explain how polarization and local action can be minimized. Describe how an accumulator is charged. (a) Define resistivity. (b) Calculate the resistance of a 2m wire with diameter 0.5mm and resistivity $1.5 \times 10^{-7} \Omega m$.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT1 (CONT'D) **DIRECT CURRENT CIRCUIT ANALYSIS**	The students will be able to: 5.1.4 determine the effective resistance of resistors in a circuit. 5.1.5 state Kirchhoff's laws of electrical network and explain them. 5.1.6 describe and explain the uses of a metre bridge. 5.1.7 describe the potentiometer and explain its uses.	Factors that affect resistance of conductor. Resistivity. Resistors in series and parallel. Potential divider. Kirchhoff's laws of electrical network. Metre bridge and its uses Potentiometer and its uses	Let students: Discuss the factors that affect the resistance of a conductor. Discuss thermistors as temperature dependent resistors. Discuss resistivity. Derive expressions for resistances in series and parallel. Arrange resistors in series and parallel and measure the effective resistance. Compare with calculated values. Discuss the use of potential divider. Discuss Kirchhoff's laws and illustrate the laws with appropriate diagrams. Describe the metre bridge as a practical form of the Wheatstone bridge and derive the balanced bridge equation. Perform experiments using metre bridge to determine resistance resistivity of a wire. **NOTE:** observe students go through the skills of observing, measuring, controlling variables, collecting data, interpreting data, communicating and drawing conclusions. Discuss the principle of a potentiometer. Discuss the applications of a potentiometer as a variable potential divider. Perform an experiment to determine the internal resistance of a cell using the potentiometer. Present a report on your work. **NOTE:** Assist students to acquire the following scientific inquiry skills: observing, measuring, controlling variables, collecting data, interpreting data, drawing conclusions and communicating result.	State Kirchhoff's laws. Draw diagrams to illustrate them. Describe an experiment to determine the resistivity of a wire using the metre bridge.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 **MAGNETS**	The students will be able to: 5.2.1 distinguish among a magnet, magnetic and non-magnetic materials. 5.2.2 describe magnetic field. 5.2.3 describe the processes involved in magnetization and demagnetization. 5.2.4 investigate the factors that affect the strength of a magnet produced by electrical method. 5.2.5 explain the concept of magnetic domains. 5.2.6 describe the uses of magnets and ferromagnetic materials.	Magnet, magnetic and non magnetic materials. Magnetic field. Magnetization. Demagnetization. Strength of magnets. Magnetic domains. Permeability. Paramagnetic, ferromagnetic and diamagnetic materials. Uses of magnets and ferromagnetic materials	Let students: Discuss magnets, magnetic and non-magnetic materials. Discuss the properties of magnets. Discuss to bring out the meaning of magnetic field (The discussion should include magnetic flux and magnetic flux density). Plot a magnetic field using a permanent magnet and a compass or iron filings. Perform experiments to make magnets by the following methods. i. single touch ii. double touch iii electrical. Discuss demagnetization methods. **PROJECT** Perform activities to investigate the effects of current, number of turns of coil and the dimensions of a steel bar on the strength of magnets produced by electrical method. Indicate the application(s) of the findings. Write a report. **NOTE:** Assist students go through the skills of observing, controlling variables, interpreting data, inferring, drawing conclusions and communicating results. Discuss magnetic domains. Discuss relative permeability. Discuss ferromagnetic, paramagnetic and diamagnetic materials and the effect of temperature on such materials. Discuss the use of magnets and ferromagnetic materials.	Outline the differences between magnetic and non-magnetic materials. Describe how you would magnetize a steel bar by electrical method. Temperature on ferromagnetic, paramagnetic and diamagnetic materials.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 **ELECTRO-MAGNETISM**	The students will be able to: 5.3.1 explain the concept of electromagnetic field. 5.3.2 list and explain the factors that affect the magnetic force on current-carrying conductor in a uniform magnetic field. 5.3.3 explain the forces set up between parallel current-carrying conductors in a uniform magnetic field. 5.3.4 describe the torque produced by a current-carrying rectangular coil in a uniform magnetic field.	Magnetic field created by electric current. Force on a current-carrying conductor in a magnetic field. $F = BIL\,Sin\theta$ Fleming's Left Hand Rule. Forces set up between parallel conductors carrying current in a magnetic field. Torque on rectangular current-carrying coil in a magnetic field.	Let students: Discuss the concept of electromagnetic field. Use compass or iron filings to demonstrate magnetic field lines of force around: i. a straight wire carrying a current. ii. a narrow circular coil carrying a current. iii. a solenoid carrying a current. Demonstrate the force exerted on a current-carrying conductor in a magnetic field. Discuss Fleming's left hand rule. Discuss the factors that affect the magnitude of the magnetic force on a current-carrying conductor in a magnetic field. Demonstrate the repulsive and attractive forces between parallel current-carrying conductors in a magnetic field. **Discuss the turning effect on a rectangular coil placed in a uniform magnetic field.**	With a well labeled diagram describe a magnetic field pattern created by a current through: i) a straight conductor ii) narrow circular coil. A straight conductor of length 0.5m is placed in a magnetic field of flux density 4 tesla and carrying a current of 2A. Determine the force exerted if the wire is i) at an angle of 30^o to the field ii) parallel to the field.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	
UNIT 3 (CONT'D) **ELECTRO-MAGNETISM**	The students will be able to: 5.3.5 describe the structure and action of electric motor and moving coil galvanometer. 5.3.6 describe the force exerted on a charged particle moving in electric and magnetic fields, and their applications. 5.3.7 describe electromagnetic switches.	Electric motor. Moving coil galvanometer. Force on a charged particle in a magnetic field. $F=Bqr\sin\theta$. Force on a moving charged particle in an electric field. $F=qE$. Force on a moving charged particle in a crossed field (Lorentz force). Electromagnetic switches (the relay).	Let students: Draw and discuss the operation of electric motor. Draw and discuss the principle of a moving coil galvanometer. Discuss the factors that affect the current sensitivity of the galvanometer. Discuss how a galvanometer can be adapted as an ammeter a voltmeter Discuss the force on a charged particle moving in a magnetic field. Discuss the force on a moving charged particle in an electric field. Discuss crossed field. Discuss the force on a moving charged particle in a crossed field. Discuss the force on moving charged particle in electric and magnetic fields, such as in T.V, mass spectrometer, cathode ray tube, cathode ray oscilloscope. Discuss the construction and application of relays.	Describe the action of an electric motor. How would you adapt a moving coil - galvanometer having a coil of resistance 5Ω and f.s.d 2mA as ammeter of f.d.s 3A.? A beam of electrons travels at $3.0X10^{6}ms^{-1}$ through a uniform magnetic field of $4.0X10^{-2}T$. Calculate the magnitude of force acting on each electron if the beam is at right angle to the magnetic field.

SENIOR HIGH SCHOOL- YEAR 2

SECTION 6

ATOMIC AND NUCLEAR PHYSICS

General Objectives: The student will:

1. understand the structure of the atom.
2. recognise the structure of the nucleus.
3. be aware of the peaceful uses of nuclear energy.
4. be aware of the importance of photoelectric effect.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **PHOTOELECTRIC EFFECT AND WAVE-PARTICLE DUALITY**	The students will be able to: 6.1.1 explain photoelectric effect. 6.1.2 outline Einstein's quantum theory explanation of photoelectric effect. 6.1.3 state and explain the laws of photoelectric effect. 6.1.4 describe applications of photoelectric effect	Photoelectric effect. Quantum theory explanation of Photoelectric effect. Einstein's photoelectric equation. Threshold frequency. Threshold wavelength. Work function. Laws of photoelectric effect. Applications of photoelectric effect.	Let students: Discuss photoelectric effect. Discuss Einstein' s quantum theory explanation of photoelectric effect. (Discussion should include the particle nature of light). Discuss Einstein's photoelectric equation. (Discussion should include explanation of work function, threshold frequency and threshold wavelength). Discuss the laws of photoelectric effect. Discuss the applications of photoelectric effect in TV, camera, etc.	What is photoelectric effect? Outline Einstein's quantum theory explanation of photoelectric effect A photo-emissive surface has a work function of $1.33X10^{-16}$ev. Calculate threshold frequency 1ev= $1.6X10^{-19}$J Planck's constant h=$6.6X10^{-34}$Js

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D) **PHOTOELECTRIC EFFECT AND WAVE-PARTICLE DUALITY** **UNIT 2** **THERMIONIC EMISSION, CATHODE RAYS AND X-RAYS**	The students will be able to: 6.1.5 explain the wave-particle Duality. 6.2.1 explain thermionic emission and describe its applications. 6.2.2 describe the nature, production and uses of cathode rays. 6.2.3 describe the nature and production of x-rays. 6.2.4 outline the properties, types and characteristics of x-rays. 6.2.5 explain the uses and hazards of x-rays.	Wave-particle paradox. De Broglie's hypothesis. Thermionic emission. Thermionic diodes. Cathode rays. Nature of x-rays. Production of x-rays. Properties, characteristics and types of x-rays (soft and hard). Line spectrum. Continuous spectrum. Uses of x-rays in: medicine agriculture industry Hazards of x-rays.	Let students: Discuss the dual nature of light. Discuss the dual nature of matter (with examples like electron diffraction and photoelectric effect). Discuss De Broglie's hypothesis. Discuss thermionic emission. Discuss the construction and mode of operation of thermionic diodes. Discuss some applications of thermionic emission. Discuss cathode rays and their production. Discuss some uses of cathode rays, such as in T.V. Discuss the nature of x-rays. Discuss the production of x-rays from an x-ray tube. Discuss the properties of x-rays. Discuss the types of x-rays. Discuss the variation of intensity of x-rays against the wavelength and its special features. Discuss the uses of x-rays. Discuss the hazards of x-rays and safety measures available.	What is meant by wave particle duality of matter? Mention one physical phenomenon in each case that can be explained in terms of the wave nature and the particle nature. Describe the construction and mode of operation of a thermionic diode. Describe the production of cathode rays. Describe the production of x-rays from an x-ray tube. Explain the following terms with respect to x-rays; i. intensity ii. hardness iii. quality State four hazards of x-rays.

SENIOR HIGH SCHOOL- YEAR 2

SECTION 7

ELECTRONICS

General Objectives: The student will:

1. appreciate the characteristics of the P-N junction diode and their applications in electronics .
2. understand characteristics of the bipolar t transistors and their applications.
3. appreciate the use of digital electronics in electronic switching and integrated circuits.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **BIPOLAR JUNCTION TRANSISTOR (BJT)**	The students will be able to: 7.1.1 describe the construction and action of the bipolar junction transistor. 7.1.2 describe transistor biasing. 7.1.3 describe the various transistor configurations and use of an N-P-N transistor as a small signal amplifier.	The bipolar junction transistor as N-P-N and P-N-P types. Transistor biasing. Transistor configurations (modes of connection): common base (C-B) common collector (C-C) common emitter (C-E) Transistor as an amplifier	Let students: Discuss the construction of N-P-N and P-N-P type transistors. Identify the parts and symbols of a transistor. Discuss various currents flowing in the transistor when it is in conduction. Discuss transistor biasing. Discuss various transistor configurations. Discuss N-P-N transistor as an amplifier.	Describe the mode of operation of an N-P-N transistor as an amplifier.

SENIOR HIGH SCHOOL – YEAR 3

SECTION 1

INTRODUCTORY PHYSICS AND PROPERTIES OF MATTER

General Objectives: The student will

1 appreciate the importance of making accurate measurements of physical quantities and their applications in science and technology.
2 appreciate some phenomena associated with properties of matter.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **SOME PROPERTIES OF MATTER**	The students will be able to: 1.1.1 discuss some properties of matter .	Properties of matter: - cohesive and adhesive forces - surface tension - capillary action	Let students: Discuss cohesive and adhesive force. Explain why water wets glass. Explain surface tension in terms of intermolecular forces. Demonstrate surface tension. Explain capillary action.	Distinguish between cohesive and adhesive forces. Explain why water wets glass. (a). What is surface tension? (b). State two methods by which the surface tension of a liquid can be reduced.

SENIOR HIGH SCHOOL- YEAR 3

SECTION 2

MECHANICS

General Objectives: The student will

1. recognize the various forms in which forces affect the state of a body and their applications.
2. be aware of the various forms of energy and energy resources and the ways to harness the renewable sources of energy

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **DEFORMATION OF SOLIDS**	The students will be able to: 2.1.1 explain that a force may produce a change in the size and shape of a substance. 2.1.2 describe the types of forces that produce deformation. 2.1.3 explain the behaviour of elastic material under stress. 2.1.4 explain the terms stress, strain and Young's modulus.	Deformation: Elastic deformation Plastic deformation Types of forces: Tensile, compressive, shear and bulk force Hooke's law Elastic limit Yield point Young's modulus	Let students: Discuss the effects of forces on shape and size of substances. Discuss elastic and plastic deformations. Demonstrate the types of forces that produce deformation. Discuss Hooke's law, elastic limit and yield-point . Perform an experiment to determine the relationship between load and extension. Take measurements. Plot a load-extension graph. Discuss the features of the load-extension graph. **NOTE:** Assist students to acquire the following scientific inquiry skills: observing, measuring, controlling variables, collecting data, interpreting data, communicating and drawing conclusions. Discuss stress, strain and Young's modulus. Appreciate the use of stress-strain graph in analyzing and predicting the behaviour of materials under stress.	Use the sketch of the force – extension graph to explain the following: elastic limit, yield point proportional limit, plastic deformation, elastic deformation. The length of a wire 2m long and cross-sectional area $10^{-5}m^2$ is stretched by 1mm by a force of 40N in the elastic region. Calculate i. the strain ii. Young's modulus.

SENIOR HIGH SCHOOL- YEAR 3

SECTION 3

THERMAL PHYSICS

General Objectives: The student will:
understand the concept of heat, its relationship with temperature and effects on substances.
be aware of the principles involved in the measurement of temperature.
appreciate heat as a form of energy and how it can be measured and stored.
appreciate the various modes of heat transfer.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **HEAT TRANSFER**	The students will be able to: 3.1.1 explain the different modes of heat transfer. 3.1.2 investigate the effect of insulation on the rate of cooling of water. 3.1.3 describe a blackbody and explain blackbody radiation	Heat transfer - conduction - convection - radiation Effect of insulation on the rate of cooling. Black body. Black body radiation.	Let students: Discuss conduction, convection and radiation of heat. Demonstrate conduction of heat in a metal rod. Demonstrate convection current in water or air. Perform experiment to demonstrate radiation or absorption of radiant energy. Design and carry out an experiment to investigate the effect of insulation on the rate of cooling. Select suitable insulating material for each test. Take appropriate measurements. Produce graphs and draw appropriate conclusions. **NOTE:** Assist students to acquire the following scientific inquiry skills: designing experiments, observing, measuring, collecting data, interpreting data, inferring, communicating and drawing conclusions. Discuss black body using suitable illustration. Discuss black body radiation. **NOTE**: Wein's displacement law and Stefan- Boltzmann's law NOT required.	Explain the terms; conduction, convection and radiation of heat. Explain why the handle of a ladle is made of plastic or wood . With the aid of a diagram, describe a black body.

SENIOR HIGH SCHOOL- YEAR 3

SECTION 4

WAVES

General Objectives: The student will:

understand the principles associated with the production of laser.
appreciate the application of lasers and holography.
be aware of the properties and transmission of light in various media and their applications.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **INTRODUCTION TO LASER**	The students will be able to: 4.1.1 explain what is meant by laser. 4.1.2 describe the principles involved in the production of laser. 4.1.3 describe the types of lasers. 4.1.4 outline the applications of lasers. 4.1.5 describe laser safety.	 The laser. Laser production. Types of lasers. Applications of lasers. Laser safety.	Let students: Discuss what is meant by laser. Discuss the principles involved in the production of laser. Discuss the types of lasers. Discuss the applications of lasers in industry, scientific research, communication, medicine, military technology. Discuss the dangers involved in the use of lasers. Discuss safety measures to be taken when using lasers.	 Explain the term laser. Outline the principles involved in the production of lasers. Describe three applications of lasers.

SENIOR HIGH SCHOOL - YEAR 3

SECTION 5

ELECTRICITY AND MAGNETISM

General Objectives: The student will:

understand the concept of electromagnetic induction
appreciate that electrical charges can be stored in electrostatic field.
appreciate the principles of operation of dynamos, generators, inductors and transformers.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **ELECTROMAGNETIC INDUCTION**	The students will be able to: 5.1.1 explain the concept of electromagnetic induction. 5.1.2 state the laws of electromagnetic induction and describe the factors affecting the magnitude of the induced e.m.f 5.1.3 describe the principles of operation of a dynamo and a generator. 5.1.4 describe the structure of an inductor and explain its behaviour in d.c and a.c circuits.	Electromagnetic induction. Laws of electromagnetic induction Faraday's law Lenz law Factors affecting the magnitude of the induced e.m.f. Fleming's Right Hand Rule. Dynamo. Generator. Inductor. Self Inductance. Mutual inductance	Let students: Discuss and demonstrate electromagnetic induction. Discuss the laws of electromagnetic induction. Perform experiments to verify the laws of electromagnetic induction. Discuss the factors affecting the magnitude of the induced e.m.f. Discuss the direction of the induced current using Fleming's Right Hand Rule. Discuss the operations of a bicycle dynamo. Discuss the operations of a simple a.c. generator. Discuss the modification of an a.c. generator into d.c. generator. Discuss the structure of an inductor. Discuss and illustrate self inductance and mutual inductance. Discuss the behaviour of the inductor in d.c circuit. Discuss the behaviour of the inductor in a.c circuit.	a. State the laws of electromagnetic induction. b. Describe an experiment to demonstrate electromagnetic induction. Describe the operation of a simple a.c generator. Explain the term self inductance.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D) **ELECTROMAGNETIC INDUCTION**	The students will be able to: 5.1.5 explain that energy is stored in an inductor.	Energy stored in an inductor. $E = \frac{1}{2}LI^2$	Let students: Discuss the energy stored in an inductor. Solve problems involving energy stored in an inductor.	.
	5.1.6 explain Eddy current.	Eddy current.	Discuss Eddy current. Discuss how to minimize Eddy current. Discuss the applications of Eddy current in induction furnace, speedometer and in damping galvanometers.	Describe the factors that reduce the efficiency of a transformer and how they can be minimized.
	5.1.7 describe the structure, use and the principle of operation of a transformer.	The transformer. Power transmission.	Discuss the structure, uses and mode of operation of a transformer. Discuss the principle of operation of a transformer. Discuss the factors that affect the efficiency of a transformer and ways of improving its efficiency. Discuss why high voltage is transmitted over pylons over long distances.	
UNIT 2 **ALTERNATING CURRENT (A.C) THEORY**	5.2.1 describe the behavior of alternating current.	Alternating current , $I = I_o Sin 2\pi ft$ Alternating voltage, $V = V_o Sin 2\pi ft$	Discuss alternating current and explain the terms: Peak current I_o Peak voltage V_o Root mean square value of alternating current $\mathbf{I_{rms}}$. Root mean square value of alternating voltage $\mathbf{V_{rms}}$.	The mains voltage supply is 240V. Calculate the peak voltage. A p.d of 240V is established across a capacitor of 0.04μF. If the frequency is $50H_z$, calculate the current flowing.
	5.2.2 explain the a.c series connected circuit.	a.c series connected circuit: R-C, R-L, R-L-C series circuits Reactance Impedance $P = IV\cos\theta$	Use sketched graphs to explain the a.c. behaviour in: Capacitors, inductors and resistors and determine the relationship between voltage and current. Derive the formula for the impedance using vector or phasor diagrams. Discuss the conditions for resonance in a.c circuits. Discuss the application of resonance in selecting a particular frequency in radio reception and transmission.	An alternating voltage of 40V and frequency 50Hz is applied to a pure inductive coil of 5H in series with a resistance of 500Ω. Determine the magnitude of the current phase angle between the applied voltage and the current across the coil.
	5.2.3 explain the importance of power in a.c circuits	a.c power $P = IV\cos\theta$	Discuss power factor.	

SENIOR HIGH SCHOOL- YEAR 3

SECTION 6

ATOMIC AND NUCLEAR PHYSICS

General Objectives: The student will:

1. understand the structure of the nucleus.
2. understand radioactivity and nuclear instability.
3. appreciate the relationship between mass and energy.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **THE NUCLEUS AND NUCLEAR ENERGY**	The students will be able to: 6.1.1 describe the structure of the nucleus. 6.1.2 explain nuclear reactions and distinguish between radioactivity and stimulated/induced nuclear reaction	Structure of the nucleus: Nuclear reactions: Radioactivity Induced or stimulated nuclear reactions	Let students: Discuss to bring out the structure of the nucleus. Discuss proton number (atomic number) Z, nucleon number(mass number) A, nucleons, nuclides and isotopes. Discuss the causes of nuclear instability and how they emit radiation to become stable. Discuss the nature of radioactive emissions, (alpha particles, beta particles and gamma rays). Discuss the properties of the above emissions. Discuss alpha decay, beta decay and gamma decay. Discuss induced or stimulated emission. **NOTE**: If a stable nucleus undergoes a nuclear decay after being bombarded α- particle the resulting nuclear reaction is termed induced or stimulated nuclear reaction but **not** artificial radioactivity.	

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D) **THE NUCLEUS AND NUCLEAR ENERGY**	The students will be able to: 6.1.3 discuss the methods of detecting radioactive emissions 6.1.4 explain the terms half-life, activity and decay constant 6.1.5 explain the relationship between mass and energy. 6.1.6 outline the applications of radioactivity 6.1.7 distinguish between fission and fusion 6.1.8 explain the structure of a nuclear reactor and its applications 6.1.9 outline the hazards of radiation from nuclear waste and how to dispose of them	Detection of radioactive emissions Radioactive decay, half-life, activity and decay constant. Einstein's energy equation $E = mc^2$ Binding energy and binding energy per nucleon. Applications of radioactivity Nuclear fission and fusion The nuclear reactor Hazards from radiation and precautions to be observed for their disposal.	Let students: Discuss the use G-M counter and photographic plates to detect radioactive emissions. Discuss half-life, activity and decay constant. Discuss the relationship between mass and energy. Discuss binding energy and the significance of binding energy per nucleon. Discuss the applications of a radioactivity in medicine, agriculture, industry, archeological dating and research. Discuss the concept of nuclear fission and fusion reactions. Discuss the chain reaction. Discuss the structure of the nuclear reactor. The discussion should include moderator, control rods, coolants, heat exchangers, nuclear fuel. Discuss the peaceful applications of the nuclear reactor. Discuss the hazards of radiation and safety precautions to be observed for their disposal.	60hours after 80g of a radioactive isotope has been prepared only 5g remained .Calculate the half-life. Explain what is meant by the following in nuclear reactor i moderator Ii control rods ii coolants. List some hazards in the nuclear reactor and explain how to dispose of nuclear wast. Explain the hazards of radiation and the safety precautions to be observed for their disposal.

SENIOR HIGH SCHOOL- YEAR 3

SECTION 7

ELECTRONICS

General Objectives: The student will:

appreciate the use of digital electronics in electronic switching and integrated circuits.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **DIGITAL ELECTRONICS AND INTEGRATED CIRCUITS**	The students will be able to: 7.1.1 describe the use of basic transistor-transistor logic gates in contact less electronic switching.	Transistor-transistor logic gates: AND gate NAND gate OR gate NOR gate NOT gate	Let students: Discuss the characteristics of logic gates. Draw up the truth tables for each gate. Discuss the uses of logic gate.	Draw the truth table for AND gate
	7.1.2 describe the use of integrated circuits	Integrated circuits(I.C)	Discuss the use of integrated circuits.	Mention two uses of integrated circuits.

REFERENCES

Friedleander and Kennedy, *Nuclear and Radiochemistry*

Choppin, *Nuclear and Radioactivity*

Harvey, *Introduction to Nuclear Physics and Chemistry*.

Serway, R.A and Faughn, J.S, *College Physics*

Peter Asiedu & Henril Atta Baah-Yeboah, *Physics for Senior High School*

Robert Owusu, Peter Asiedu & Henric Atta Baah-Yeboah,
Practical Physics for Senior High School

Nelkon, M and Parker, *Advanced Level Physics*

Abbott, A.F, *Ordinary Level Physics*

Duncan, T; *Advanced Physics*

Joko J.D. & A. Oppong, *High School Physics*

Nelkon, M; *Principles of Physics*

www.focuseducational.com; Focus Educational Software

www.crocodile-clips.com, Crocodile Physics

www.crocodile-clips.com, Absorb Physics for GSCE

www.vplab.co.uk, Virtual Physics Laboratory