DEPARTMENT OF EDUCATION

CURRICULUM GUIDELINES

PHYSICS

GRADES – 10, 11, 12

2019 – 2024

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ACKNOWLEDGEMENTS

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INTRODUCTION

SCIENCE CURRICULA 2019 REVISED EDITIONS

The 1982 editions of the General Science and Health Science Curricula were designed to ensure teachers were provided with guidelines to impart common science information. The revised General Science Curriculum 1997 sought to introduce some knowledge of scientific practicals (scientific method and apparatus) as well as Caribbean Scientists and their work in a strand entitled "Science and Me".

In 2010, the General Science and Health Science Curricula were revised along with Biology and Physics Curricula developed. Their focus, as was that of the 2012 Chemistry and Combined Science Curricula developed, was on students developing scientific processing skills that are transferrable to everyday living. Learner outcomes were worded to ensure skills were being developed in an intentional manner. Additionally, the curricula required teachers to use alternative methods of assessment to assess students' knowledge, understanding and skills proficiency. These methods included students' oral, visual, musical and dramatic presentations, ICT publications as well as designing investigations. It was also recommended that teachers employ a form of "flipped classroom" when appropriate, allowing students to conduct their individual "research" or literature review as well as much of the collaboration in group projects to be done outside of lesson time.

The 2019 curricula seek to provide the learning environment in which students are moved from "learning about science" to "exploring science". This means, in part, that they are creating their learning from their experiences. This lofty goal is based on five pillars extracted from documents reviewed. They are:

- **Science concepts** – Minister Lloyd's Budget Speech 2017, Comparative Analyses of curricula of four territories, Profile of a 21st Century High School Graduate in The Bahamas, Public Perception Questionnaires, Shared Vision for Education 2030, UN Sustainable Development Goals (6)
- **Critical Thinking, Collaboration, Communication and Creativity** – 21st Century Learning Skills, Comparative Analyses, Profile of a 21st Century High School Graduate in The Bahamas
- **Innovation** - Minister Lloyd's Budget Speech 2017 emphasis on Science, Technology & Innovation; Profile of a 21st Century High School Graduate in The Bahamas,
- **Links** between Science and other disciplines, society and the environment - Minister Lloyd's Budget Speech 2017, Comparative Analyses, Profile of a 21st Century High School Graduate, STREAM Education in OAS Training 2018
- **Responsibility** (scientific values, attitudes & habits of mind) - Comparative Analyses, Profile of a 21st Century High School Graduate in The Bahamas

Key science concepts with local examples and applications along with the inclusion of contemporary, high interest topics are included.

The 2010 & 2012 curricula included development of Critical Thinking, Collaboration, Communication and Creativity in the skills highlighted. The same is true for the 2019 curricula, and in some cases, with greater emphasis. Similarly, the 2010 & 2012 curricula included "uses scientific and technological principles to make products" as a skill. In the 2019 curricula, students' recognition and use of the relationships among science, technology, innovation, society and the environment are highlighted.

Students' use of visual and performing arts, ICT applications, mathematical concepts and skills to perform recommended activities as well as their inclusion in alternative methods of assessment in the 2010 & 2012 curricula, are continued in the 2019 curricula. The introduction of STREAM Education in the 2019 curricula will strengthen students' transference of knowledge and skills among disciplines. As a result, it is expected that students' will develop a holistic concept of education (their learning) rather than compartmentalizing it with an end result of greater learning.

The new "pillar" of the 2019 curricula is students developing scientific attitudes, values and habits of mind. Those identified are: Curiosity, Skepticism, Positive attitude to failure, Tolerance of other's views, Open to new ideas, Cooperation, Daring to try, Perseverance, Flexibility/adaptability, Questioning and Posing Problems, Applying Past Knowledge to New

Situations, Taking Responsible Risks, Thinking Independently, Remaining Open to Continuous Learning, Develop analytical thinking and practical problem solving techniques, Generate new ideas explaining everyday technological applications of science; evaluating associated personal, social, economic and environmental implications and making decisions based on the evaluation of evidence and arguments.

In short, the 2019 curricula focus on student activities and teachers' methods of instruction that will foster students' peaked interest and curiosity to pursue further knowledge about the content.

Introduction to the PHYSICS CURRICULUM

Students, who have obtained Grades A - C in BJC Examinations inclusive of General Science and Mathematics and are desirous of pursuing science studies at the tertiary level, will begin the three-year course of study that is outlined in the Physics Curriculum 2019, in Grade 10.

The science concepts/content, student activities and methods of instruction in the curriculum are intended to challenge and prepare more able students with an interest in science for tertiary studies. It is therefore important that the curriculum assists students in taking responsibility for their learning and performance. In addition to completing curricular projects (including STREAM and robotics) students will be encouraged to participate in science competitions, as well as mentoring programmes that that support the curriculum as they may become available.

The Scope and Sequence Content is a matrix which outlines the topics (content) and depth (scope) as well as the order (sequence) in which they are taught. This matrix is useful for quick reference. By contrast, the Scope of Work is the section of the Curriculum which provides detailed guidance for the teachers to plan their lessons. Each grade level in the Scope of Work was designed to be completed in 27 teaching weeks (most schools have 3- 50 minute periods).

It is important to note that the Physics Curriculum 2019 to a great extent, retains the information in the Physics Curriculum 2010 with revisions made. This attests to the quality of work done by the writers of that document namely: Susan Allie, Vernal Brathwaite, Arlec Farley and Sharon Stuart.

The Scope and Sequence Content table outlines the topics to be covered, the depth and the order in which they will be taught. In the 2010 Curriculum, the topics appeared almost in a linear format where a major topic was taught completely before another followed. This modular format, while fashioned on the BGCSE Syllabus, is more appropriate for educational systems where high school students study a major topic as a course for one semester. Their final assessment for that course is also done in the semester. There is no further assessment on that course. However, in the educational system in The Bahamas, there is a final assessment at the end of the third year of studying a subject. Hence, the 2019 Scope and Sequence Content table shows topics shows eleven (11) strands (major/overarching topics) which have related topics/sub-topics spread over the three-year period. This arrangement not only supports the document being a spiral curriculum but assists students in preparing for a final examination based on three-years' work. Teachers outside the public school system who find it difficult to follow the new format may use the modular approach.

SCOPE AND SEQUENCE CONTENT

Major Topic	Grade 10	Grade 11	Grade 12
Physics in Everyday Life	Introduction, Branches of Physics	Physicists and Their Contributions	Careers in Physics
Measurements	Physical Quantities and Units , SI units	Unit conversion	Unit conversion
Types of quantities	Scalars and vectors Graphic addition of parallel and antiparallel vectors	Graphic addition of non-parallel vectors	Components of vectors, algebraic addition of vectors
Motion -	Displacement, velocity, speed, acceleration (1-Dimensional Motion)	Motion Graphs Distance-time graphs Velocity-time graphs	Kinematics Equations/ Projectile motion – two dimensional motion
Forces	Types of forces, Sum of co-linear forces, Turning effect of a force, Principle of moments, Pressure	Hooke's law, Newton's Laws Equilibrium of forces, Centre of mass Toppling; Definition of momentum, Impulse as change in momentum Centripetal force /uniform circular motion	Equilibrium of forces and Torques Principle of momentum conservation. 1-D collisions
Energy	Forms of Energy, Potential energy, Kinetic energy, Energy conversion	Conservation of mechanical energy Definition of power, Renewable energy	Work, Energy Power = Fv
Matter and Thermal Effects	States of matter, Kinetic theory Temperature, Methods of heat transfer, Sinking and floating, Density, Archimedes principle	Thermal expansion, Anomalous expansion of water, Specific heat Latent heat, Calorimetry	Barometer, Ideal Gas laws Heat transfer in thermosyphon solar water heater Applications (Solar collectors, Greenhouse effect etc.)
Waves (Electromagnetic and Mechanical)	Wave parameters, Types of waves Sound as a wave (Loudness, pitch, Timbre); Light as a wave (Spectrum) Rectilinear propagation of light (Shadows, pin hole camera)	Reflection, refraction of sound Reflection and refraction of light Critical angle, Thin Lenses, Ray Diagrams Electro-magnetic waves and applications	Interference Diffraction
Electricity and Magnetism	Electrostatics, Charging by friction Charging by induction, Electric fields Capacitance, Current , Cells, Ohm's law Permanent magnets, Domain theory Magnetic fields	DC and AC currents, DC Circuits Components and diagrams, Parallel and series resistors (2 resistors), Non-Ohmic conductors, Electromagnets, The solenoid Force on current carrying wire Hand rules	Parallel and series combinations. Power, Electromagnetism, Motors Electromagnetic Induction/ Generators Faraday's law, Lenz's law, Transformers Power transmission, Electricity in The Home

SCOPE AND SEQUENCE CONTENT

Modern physics and Astrophysics	The atom, The nucleus, Radioactivity Radioactive emissions	Radioisotopes, Half-life and decay rates Thermionic emissions, Cathode Ray Oscilloscope, The Solar System, Classification of Stars	nuclear energy- nuclear fission, nuclear fusion, Newton’s Law of Universal Gravitation, Kepler’s First Law of Planetary Motion, Space Exploration
Electronics	Logic Gates and Truth tables	Logic circuits	Diodes, rectifiers

While similar in content and scope, when compared to the Physics Curriculum 2010 Curriculum, the Physics curriculum 2019 differs in the following ways:

Aggregation of skills sets which cover all 17 process skills, and includes the 4Cs, innovating, habits of the mind and attitudes, with an emphasis on problem-solving and critical thinking as follows:

(a) **Planning (creativity**) [forming hypotheses; forming a question/identifying problem; conducting research (literature review), identifying resources; brainstorming; identifying variables; formulating plans; making predictions]

(b) **Conducting and Recording** [selecting correct and safely using of apparatus and materials; making observations; measuring accurately and recording in appropriate units, generating, collecting, organizing and recording data, identifying anomalous readings, acknowledging sources of information gathered from research]

(c) **Analyzing & interpreting (critical thinking)** [Evaluating reliability of data from research,

(d) Processing (calculations) data from investigations, identifying sources of experimental error or predisposition, analyzing data; identifying patterns and relationships; evaluating hypothesis & predictions in light of the data; formulating conclusions based on analysis of the data; justify conclusions, solutions to a problem)

(e) **Communicating** [Using clear, accurate graphs, using of appropriate symbols, numbers and units of measurement, using appropriate data tables with clear recordings; using correct terminology; using scientific models; giving effective oral presentations with accurate information, clear and varied intonation whether in speech, song, poem, rap, giving effective visual presentations with accurate information, clear and visually appealing whether in flyer, poster, trifold display, PowerPoint Presentation; giving effective dramatic presentations with accurate information and representation as well as audience appeal whether in skit or video movie; writing clearly, concise, sequential and accurate reports]

(f) **Collaborating –** [brainstorming, designing project or plan an investigation, conduct investigations, analysing in cooperative groups for problem-solving activities, peer review; projects, visual and dramatic presentations]

(g) **Problem Solving** [critical thinking, analyzing, proposing solutions, explaining everyday technological applications of science, developing analytical thinking and practical problem solving techniques; Generating new ideas]

(h) **Innovating** [Identifying cause and effect, stability & change, developing analytical thinking and practical problem solving techniques; generating new ideas;; evaluating associated personal, social, economic and environmental implications and making decisions based on the evaluation of evidence and arguments.

- **Attitudes** [***Curiosity***, ***Skepticism***, Positive attitude to failure, Tolerance of other’s views, Open to new ideas, Cooperation, Daring to try]
- **Habits of Mind** [perseverance, flexibility/adaptability; questioning and posing problems; applying past knowledge to new situations; taking responsible risks; thinking independently; remaining open to continuous learning]

(i) **Deletions**

To avoid isolated learning and to provide adequate time for students to complete the curriculum using a skilled based approach, the following deletions have been made:

- Bernouille’s principle and its applications
- Galvanometers

(ii) **Modifications**

The Physics content has been re-sequenced into 11 strands or major topics, aspects of each will be progressively gleaned by students over the three year period in an effort to allow students to sequentially build on prior knowledge after the requisite or foundational understanding of concepts have been assimilated. To this end, topics that require significant critical thinking and problem solving are appropriately sequenced to allow students to become more and more adept at analysis and problem solving.

SCOPE OF WORK
GRADE: 10
UNIT: PHYSICAL QUANTITIES AND UNITS

TOPIC: HISTORY (SCIENTISTS/PERSONALITIES) & CAREERS **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe the importance of one aspect of the work of a named Physicist.	See columns to the right.	• Research contributions of scientists to the field of Physics • Create timelines	Internet Library	Rubric for assessing oral presentations.
• Describe the meaning and importance of Physics and careers including emerging careers which rely on the study of physics.	Physics is the study of matter and energy and their inter-relations with each other. Careers in which an understanding of forces are needed include engineering, architecture, medicine, dentistry, physiotherapy, athletic coaching and gym management.	• Conduct research of various careers that use Physics. • Use a graphic organizer or another visual aid to describe careers which rely on the study of Physics.	Internet Library	Rubric for assessing visual (aids) presentations.

SCOPE OF WORK
GRADE: 10
UNIT: PHYSICAL QUANTITIES AND UNITS

TOPIC: LINEAR SCALES **DURATION: 1 WEEK**

<table>
<tr><th>LEARNER OUTCOMES</th><th>CONTENT</th><th>ACTIVITIES</th><th>RESOURCES</th><th>METHOD OF ASSESSMENT</th></tr>
<tr>
<td>• Interpret scales on measuring instruments.

• Use appropriate instruments to measure quantities to degree of accuracy and precision allowed by the instrument. Rulers, measuring cylinder, stop watches, clock, thermometer, triple beam balance, digital balance, spring balance, Vernier caliper, micrometer screw gauge, ammeter, voltmeter.

• Tabulate measurements with appropriate column/ row headings (physical quantity, units).</td>
<td>A scale consists of a zero and marked divisions that enable us to measure a physical quantity. A linear scale is one in which the divisions are equal. An example of a linear scale is the scale on a ruler. The scale divisions are equally spaced. Not all scales are linear, however. In this course, we shall be using mainly instruments with linear scales.

The cm rule (or metre rule)
The scale on this rule starts from a zero. (Make sure students identify the zero mark.) Each cm is divided into 10 equal divisions. Thus, each of these small divisions is 0.1 cm.

Precision of a measurement
The precision of an instrument is the smallest sub-division on the instrument. Thus, the precision of the cm rule is 0.1 cm.

Table headings should contain the physical quantity being measured (e.g length), the quantity symbol (L) and the unit in which the quantity is being measured (cm). Notice the slash (called a solidus) between the quantity symbol and the unit symbol.
Note: Either the bracket or the solidus could be used, but there is a need to be consistent.</td>
<td>• Displaying linear and non-linear scales
By using actual instruments in the lab. Or diagrams and pictures from textbooks (e.g. Physics for CSEC, by Farley and Trotz).

• Determining the area of a Bahamian dollar using a cm ruler
Name
Date
Area of a Bahamian Dollar

Purpose: To find the area of a Bahamian dollar
Results
<table>
<tr><th>No.</th><th>Length L/cm</th><th>Width W/cm</th></tr>
<tr><td>1</td><td></td><td></td></tr>
<tr><td>2</td><td></td><td></td></tr>
<tr><td>3</td><td></td><td></td></tr>
<tr><td>4</td><td></td><td></td></tr>
<tr><td>5</td><td></td><td></td></tr>
<tr><td>Av.</td><td></td><td></td></tr>
</table></td>
<td>Linear and non-linear scales
(Instruments and/or pictures that have these)

Ruler calibrated in cm to 0.1 cm
(e.g. metre rule or geometry set rule)
Bahamian dollar</td>
<td>Rubric for assessing use of materials and equipment correctly and safely.

Results recorded to 0.1 cm precision.</td>
</tr>
</table>

SCOPE OF WORK
GRADE: 10
UNIT: PHYSICAL QUANTITIES AND UNITS

TOPIC: LINEAR SCALES

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Express numbers in a measurement to given significant figures.	Significant figures and precision When recording a measurement, careful attention should be paid to instrument precision. Measurements on the cm rule are made to the nearest 0.1 cm. Thus, readings in cm should be recorded to one decimal place such as 4.6 cm or 9.0 cm, but not 9 cm or 9.00 cm. The number of figures in a reading, starting from the first non-zero digit to the last digit (zero or non-zero) are called **significant figures** in a measurement. The three rules for determining how many significant figures are in a number are: 1. Non-zero digits are always significant. 2. Any zeros between two significant digits are significant. 3. A final zero or trailing zeros in the decimal portion ONLY are significant. **Rules for using significant figures with measured values** 1. Addition and subtraction rule The answer takes the least number of decimal places. Thus, 4.6 + 2.02 = 6.6, and not 6.62. Also, 4.6 + 2.87 = 7.5, and not 7.47. 2. Multiplication and division rule The answer takes the least number of significant figures. Thus, 2.87 x 4.3 = 12, and not 12.341.	**Calculations** Using the cm ruler (or metre rule) 1. The object being measured (the dollar in this case) is as close as possible to the scale on the rule; 2. One end of the object is against the zero mark on the scale; 3. Their eyes are directly above the point on the object and the scale mark when taking a reading (this reduces the error of *parallax* in the reading – see, for example, *Physics for CSEC*, by Farley and Trotz); and 4. Take several readings each of the length and width, at various positions just in case the dollar is not uniform.	**Ruler calibrated in cm to 0.1 cm** (e.g. metre rule or geometry set rule) **Bahamian dollar**	The correct number of significant figures.

PHYSICS CURRICULUM
SCOPE OF WORK
GRADE: 10
UNIT: PHYSICAL QUANTITIES AND UNITS

TOPIC: LINEAR SCALES

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
		• **Challenge: (In-class)** Show students a quarto sheet of paper (or any other object) and let them estimate its length in cm. • **Challenge: (Home activity)** Students measure the thickness of a Bahamian one-cent coin.	 Bahamian pennies	Closeness of prediction to actual length. **Accuracy of measurement** Credit for methodology measuring the height of 10 coins stacked together and dividing by 10.

PHYSICS CURRICULUM
SCOPE OF WORK
GRADE: 10
UNIT: PHYSICAL QUANTITIES AND UNITS

TOPIC: S.I. SYSTEM OF UNITS **DURATION: 1 WEEK**

<table>
<tr><th>LEARNER OUTCOMES</th><th>CONTENT</th><th>ACTIVITIES</th><th>RESOURCES</th><th>METHOD OF ASSESSMENT</th></tr>
<tr>
<td>Use equipment correctly and safely.

Match base quantities and units.</td>
<td>Physical quantities and units
Aspects we measure, such as mass, length, time, speed and temperature, are called physical quantities.

The International System (S.I.)
Fundamental quantities and units
In the International System, all physical quantities are based on a small set of physical quantities called fundamental or base quantities. Seven of these base quantities are listed below, together with their unit names and unit symbols.

(Note the rule for writing unit names and unit symbols: All unit names are written with common letters, whether named after a person or not. Unit symbols begin with a capital letter only if the unit is named after a person.)

<table>
<tr><th>Fundamental (base) quantity</th><th>Fundamental (base) unit</th><th>Unit symbol</th></tr>
<tr><td>Mass</td><td>kilogram</td><td>Kg</td></tr>
<tr><td>Length</td><td>Metre</td><td>M</td></tr>
<tr><td>Time</td><td>second</td><td>S</td></tr>
<tr><td>Temperature</td><td>Kelvin</td><td>K</td></tr>
<tr><td>Current</td><td>Ampere</td><td>A</td></tr>
<tr><td>Amount of Substance</td><td>Mole</td><td>mol</td></tr>
<tr><td>Luminous Intensity</td><td>Candela</td><td>Cd</td></tr>
</table>
</td>
<td>• Familiarization with fundamental units

Students handle:
○ A 1-kg mass
○ A metre stick
○ A thermometer to measure room temperature (mention that the thermometer measures temperature in degrees Celsius;
○ to get the temperature in kelvins we add 273 to the Celsius reading)
○ A clock with seconds-hand or a stopwatch (digital or analogue) to get an idea of one second.

• Measuring in fundamental units
(Lab records need not be done for these)</td>
<td>The following equipment

Various masses – up to 1 kg
Metre rule
Thermometer (degrees Celsius)
Clock or watch capable of reading in seconds</td>
<td>Rubric for assessing correct use of equipment.

Base quantities and units correctly matched.</td>
</tr>
</table>

PHYSICS CURRICULUM
SCOPE OF WORK
GRADE: 10
UNIT: PHYSICAL QUANTITIES AND UNITS

TOPIC: S.I. SYSTEM OF UNITS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Derive the units for derived quantities.	Derived quantities and units Speed is distance (length) divided by time. Speed is called a derived quantity, since it is a combination of two base quantities (length and time). The S.I. unit for speed is metres per second (m/s). Most of the quantities to be used in this course will be derived quantities. Some of them are named after scientists. For example, force is a combination of mass, length and time. The S.I. unit symbol for force is kg.m/s^2. This unit for force is called a newton (N).	Suggested activities include measuring the following: - the length of the room - the mass of a student (using a bathroom scale; if the scale is in lb, note that 1 kg = 2.2 lb) - the time taken for the teacher to do a certain walk (e.g. the teacher actually walks from one corner to another in the room) - the temperature of this room in degrees Celsius and in kelvin	Bathroom scale Metre rule Thermometer (degrees Celsius) Stop watch or clock capable of reading in seconds	Rubric for assessing processing data.
Convert between units.	**Conversions** Frequently we need to convert a multiple or a sub-multiple unit to a S.I. unit. This is usually because the S.I. is a coherent system – if we work problems in S.I., the answer automatically turns out in S.I. Furthermore, physical constants that we need in our calculations are usually given in S.I. units. Here two typical examples of conversions. These conversions involve the following prefixes:	**Practice in converting units:** cm to m m to cm kg to g g to kg mm to m m to mm		Rubric for assessing processing data.

SCOPE OF WORK
GRADE: 10
UNIT: PHYSICAL QUANTITIES AND UNITS

TOPIC: S.I. SYSTEM OF UNITS

<table>
<tr><th>LEARNER OUTCOMES</th><th>CONTENT</th><th>ACTIVITIES</th><th>RESOURCES</th><th>METHOD OF ASSESSMENT</th></tr>
<tr>
<td>Convert between units.</td>
<td>
<table>
<tr><td>Prefix</td><td>Prefix symbol</td><td>Prefix value</td></tr>
<tr><td>milli</td><td>m</td><td>1/1000 (or 0.001 or 10^{-3})</td></tr>
<tr><td>centi</td><td>c</td><td>1/100 (or 0.01 or 10^{-2})</td></tr>
<tr><td>Kilo</td><td>k</td><td>1000 (or 10^{3})</td></tr>
</table>

<u>Example 1</u>
Convert 24.3 cm to m.
Solution: cm = c x m (just like ab = a x b)
Therefore, 24.3 cm = 24.3 x 0.01 x m
= <u>0.243 m</u>

<u>Example 2</u>
Convert 24.3 g to kg.
Solution: to “multiply by 1”. Since we are interested in kg, we choose 1 = kg/kg.
$24.3\text{ g} = 24.3\text{ g} \times \frac{\text{kg}}{\text{kg}} = \frac{24.3\text{ kg}}{\text{k}} = \frac{24.3\text{ kg}}{1000}$
= <u>0.243 kg</u>
</td>
<td>

Challenge: Group activity in class
Estimate, using S.I. base units, the width of this room the mass of the teacher the time taken by a student to recite the alphabet the temperature of the human body in degrees Celsius and in kelvins.
Challenge: At-home activity
(This must be written up)
Determine the time taken between successive pulse beats.

</td>
<td></td>
<td>Rubric for assessing processing data.</td>
</tr>
</table>

SCOPE OF WORK
GRADE: 10
UNIT: PHYSICAL QUANTITIES AND UNITS

TOPIC: MEASURING INSTRUMENTS **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
MAKING MEASURING INSTRUMENTS Make simple measuring instruments using chosen standards for comparison- balance, roller wheel.	**Measuring wheel** Instrument for measuring length	**Challenge: (At-home activity)** **Making a measuring wheel** The wheel should be calibrated such that one complete turn (the circumference) is known and divided up into 10 equal parts. A handle (e.g. a stiff piece of wire or a wooden rod) could be attached for convenience of use. (Even a bicycle could be used.) Students use the wheel to measure distances along the floor or on the ground.	**Students obtain resources from home**	**Testing the performance of the instrument in class**
	Mass balance For measuring mass either in grams or in units such as coin masses **Spring balance** For measuring force in newtons or in units such as coin weights	**Challenge: (At-home activity)** **Making a mass balance** **Making a spring balance** Students can check textbooks or the internet for ideas. They can either calibrate their balances in grams or in terms of "standard" masses or weights such as those of coins.		**Testing the performance of the instruments in class**
	Map perimeter measurer Instrument for measuring distances around a map of an island.	**Challenge: (At-home activity)** **Making a map perimeter measurer** Students make something, the simpler the better, for measuring the map distance around the edge of an island.	**A map of an island**	**Testing the performance of the device in class**

SCOPE OF WORK
GRADE: 10
UNIT: PHYSICAL QUANTITIES AND UNITS

TOPIC: MEASURING INSTRUMENTS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Relate scales on measuring instruments to scales on graphs	**Using measuring cylinders**	**Determining the volume of a small bottle** Students use a measuring cylinder in this experiment. They figure out in groups how to do this and are allowed their own methods. They write a simple lab report. The report would be similar to the sample shown earlier, but could include a "diagrams" section and a simply written "method" section. The diagram(s) should be two-dimensional and the method could include any special precautions they took. They can also include a "discussion" section in which they point out possible sources of error.	**Measuring cylinders** **Small bottles**	**Lab report** Practical Assessment: selection and use of materials; identifying and holding variables constant; measuring, recording and processing data; formulating conclusions and communicating information
	A graphing exercise	**Graphing** Students carefully add water into a measuring cylinder, 10 teaspoons at a time, say. They make a table of number of total number of teaspoons and corresponding volumes of water in the cylinder. Then they plot a graph of volume (y-axis) against number of teaspoons (x-axis).	**Plastic teaspoons**	**Lab report including graph** **Processing information** Using graph to - infer the volume of, say, 36 teaspoons-ful of water. - predict the number of teaspoons corresponding to a volume larger than the largest volume (by extrapolating the graph)

SCOPE OF WORK
GRADE: 10
UNIT: PHYSICAL QUANTITIES AND UNITS

TOPIC: MEASURING INSTRUMENTS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Research how precision timing is done e.g. swimming, track races, use of multiflash photography.	**Using timing devices (analogue and digital)**	• **Determining the volume of a stone by displacement** (The stone could be placed in the cylinder containing water or in a displacement can filled with water and the cylinder placed under the overflow spout of the displacement can.) • **Measuring the period of a pendulum of length 1.00 m.** (Students must let the pendulum swing through a small angle. Students should write a simple lab report and include a diagram of the pendulum arrangement. The diagram should be two-dimensional.) • **Challenge:** Teacher can demonstrate a cell-phone camera or a video camera and ask students how it can be used to measure how long it takes for an object (e.g. a stone) to fall a distance of 1 m?	Stones Displacement cans Measuring cylinder Simple pendulum apparatus Watch capable of reading in seconds	Practical Assessment: selection and use of materials; identifying and holding variables constant; measuring, recording and processing data; formulating conclusions and communicating information Practical Assessment: selection and use of materials; identifying and holding variables constant; measuring, recording and processing data; formulating conclusions and communicating information Oral reports by student along with in-class demonstration

SCOPE OF WORK
GRADE: 10
UNIT: PHYSICAL QUANTITIES AND UNITS

TOPIC: MEASURING INSTRUMENTS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
		• **Student research and reporting** Students research how precision timing is done e.g. swimming, track races, use of multi-flash photography. They report their findings to the class.		**Oral reports by students**
Measure frictional force	**Using balances (analogue and digital)**	• **Measuring frictional force** Using a spring balance, students measure the force of friction between the lab desk surface and a block of wood. The must first zero the balance or note the zero error.	**Spring balances**	Practical Assessment: selection and use of materials; identifying and holding variables constant; measuring, recording and processing data; formulating conclusions and communicating information
Measuring mass	Check this link for a tutorial on how to use a triple beam mass balance: http://www.ohaus.com/products/education/weblab/TBBentry.html	• **Determining the mass of a stone** Students use mass balances (analogue or digital) to determine this. They must first zero the balances.	**Mass balances**	Practical Assessment: selection and use of materials; measuring, recording and processing data; formulating conclusions and communicating information
	Using electrical instruments (This will be covered under current electricity)			

SCOPE OF WORK
GRADE 10
UNIT: PHYSICAL QUANTITIES AND UNITS

TOPIC: SCIENTIFIC NOTATION **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Use the scientific notation to express numbers.	**Scientific notation (standard form)** Scientists often use this form of notation - to indicate the significant figures in a measured value - to simplify calculations - to make very large and very small values understandable Scientific notation consists of a number from 1 to less than 10 multiplied by 10 raised to a power. Example 1 466.2 cm = 4.662×10^{2} cm Example 2 17.0 cm = 1.70×10^{1} cm (Note: we must include the zero after the 7 since it represents a significant figure in the measurement.) Example 3 0.000600 m = 6.00×10^{-4} m	Practice writing measurements in using scientific notation		Writing numbers correctly using scientific notation.

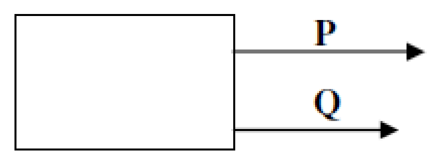
SCOPE OF WORK
GRADE: 10
UNIT: FORCES

TOPIC: FORCES AS VECTORS **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
FORCES • measure force using spring balance	**Using the spring balance** See "Activities" column on the right.	**1 Measuring forces** Students will have had experience in using the spring balance in Activity 6, *Using Other Measuring Instruments* under the topic *Physical Measurements and Units.*		
Forces as Vectors • Illustrate on diagrams, all forces acting on an object.	**Forces as vectors** Since force has both magnitude and direction, force is a <u>vector</u> quantity. **Representing forces by drawing** We can represent a force by a directed line segment drawn to scale.	**2 Practice exercises in vector representation of forces** Students draw, on graph paper, using a scale of 1 cm ≡ 10 N **(using the x-y system)** • a force F_1 = 50 N, pointing in the +x-direction (in this and other examples, the vector need not be drawn from the origin or even from the y-axis) • a force F_2 = 70 N, pointing in the +y-direction • a force F_3 = 86 N, pointing in the –y-direction • a force F_4 = 65 N, pointing in the -x-direction • a force F_5 = 50 N, pointing in a direction 65_o anti-clockwise from the +x-direction **(using the E-W-N-S- system)** • a force F_6 = 90 N, pointing at an angle of 70_o clockwise from north.	Graph paper Ruler Protractor	**Correct representation of vectors**

SCOPE OF WORK
GRADE: 10
UNIT: FORCES

TOPIC: FORCES AS VECTORS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Construct and interpret force diagrams. **Determine the resultant of forces.**	**Sketching Forces Acting On Objects** Students should be made aware of the following: • The weight of an object always acts vertically downward. • When an object presses against a surface, the surface presses back on the object with a normal contact force. • The force of tension along a tight string acts along the string and points away from the object to which the string is attached. • The force of friction on an object acts opposite to the direction of motion of the object as the object rubs against another object. **Resultant** The resultant of two (or more) forces is the single force that has the same effect as the other forces combined. If the resultant of forces on an object is **not zero**, the object will move (accelerate), because there is a net force. If the resultant of forces on an object **is zero**, the object will either not move, or move with zero acceleration (i.e. move at constant speed).	**3 Sketching Forces Acting On Objects** Students identify and sketch the forces on the following: • A book resting on a horizontal surface. • A box being pulled horizontally along a rough floor by a cord inclined at an acute angle to the horizontal. • A box sliding down a rough inclined plane. • A basketballer moving upwards in the air. • A pendulum bob when the string is at the maximum angle. **4 Resultant of parallel forces**  Students exert parallel forces, P and Q, on a block (using spring balances to measure the forces) to just barely move the block. Then they exert a single force, F, to just barely move the block.	**The following resources will help students visualize the forces** Book and table Box and cord Box and inclined plane Basketballer jumping upwards Simple pendulum Block Spring balances	**Correctly identifying, sketching and labeling forces** **Correct adding of parallel and anti-parallel forces and stating units**

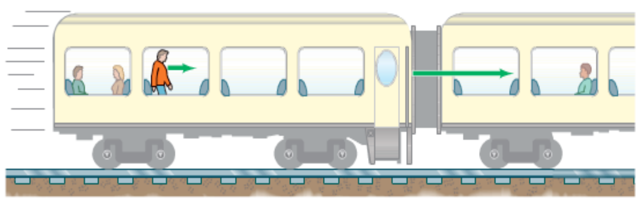
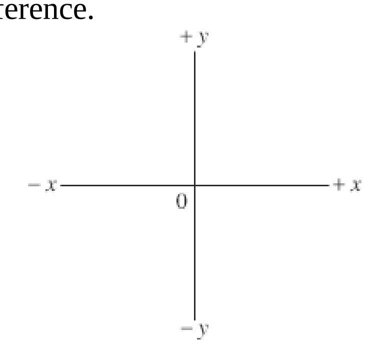
SCOPE OF WORK
GRADE: 10
UNIT: FORCES

TOPIC: FRICTION AND DRAG **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
FRICTION AND DRAG • Demonstrate that an object falling through a fluid achieves terminal velocity.	**Friction** One of the factors that contributes to inefficiency in machines is the force of friction due to solid parts rubbing against each other. An activity to measure frictional force is given under *Physical Measurements and Units*, Topic 4 : *Usin Other Measuring Instruments*, Activity 6. **Drag** Drag is a force, like friction, that opposes motion. Drag is experienced when an object moves through a fluid (e.g. a boat moving through water, or a plane moving through the air). Drag increases with speed, and therefore, when an object falls through a fluid, it reaches a constant speed (called terminal speed) when the force of drag is equal to the force of gravity (we neglect the upthrust force for a small object).	**Drag** Students design and conduct an investigation to determine the terminal velocity of a small ball bearing falling through two different types or grades of oil in a measuring cylinder. Students can also investigate how terminal velocity varies with area of falling paper "parachutes".	Types or grades of oil Measuring cylinder Stop-clock Ruler Tissue	**Lab report**

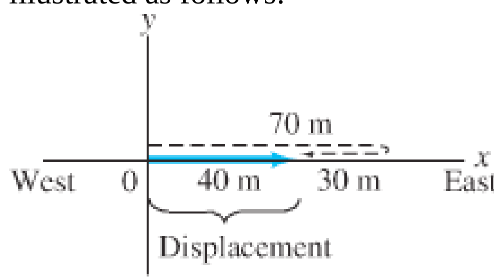
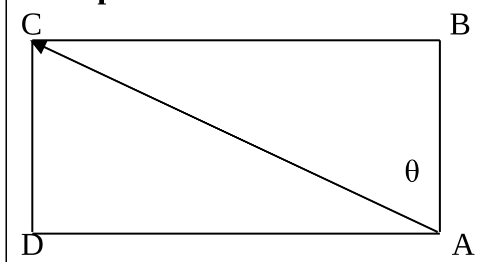
SCOPE OF WORK
GRADE: 10
UNIT: KINEMATICS IN ONE DIMENSION (STRAIGHT LINE MOTION)

TOPIC: DISPLACEMENT, VELOCITY AND ACCELERATION **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
The study of the motion of objects and the related concepts of force and energy is called **mechanics.** Mechanics is often divided into two sections: **kinematics,** which describes how objects move and **dynamics**, which deals with forces and their relation primarily to the motion . **1 REFERENCE FRAMES AND DISPLACEMENT** • Measurements of position, distance or speed are always made with respect to a **reference frame.**	**Reference Frames**  For example, a train is travelling at 50 km/h with a man walking at 5 km/h towards the front. This 5 km/h is the man's speed with respect to the train as the frame of reference. With respect to the ground the man's speed is 50 km/h + 5 km/h = 55 km/h. It is always important to specify frame of reference when referring to a person's speed. In everyday life the earth is usually the frame of reference.	**Coordinate Axes** In Physics we use the **coordinate axes** to represent a frame of reference. 	**Graph paper** Have students find various coordinates on the xy plane (coordinate axes)	

SCOPE OF WORK
GRADE: 10
UNIT: KINEMATICS IN ONE DIMENSION (STRAIGHT LINE MOTION)

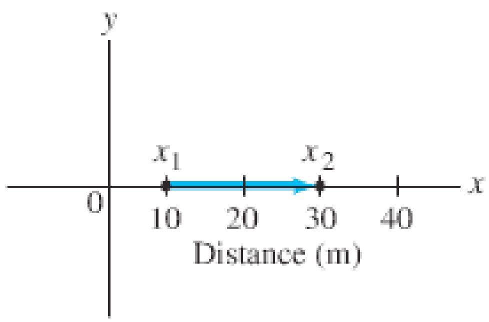
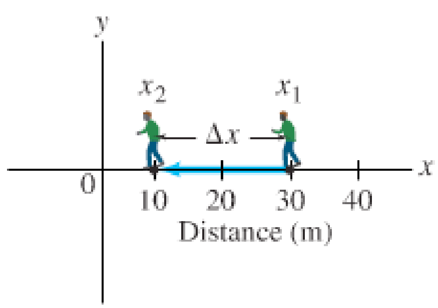
TOPIC: DISPLACEMENT, VELOCITY AND ACCELERATION

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
2 POSITION. DISTANCE AND DISPLACEMENT • distinguish between position and displacement	**Position, distance and displacement** For one-dimensional motion the **position** of an object is given by its x-coordinate (or the y-coordinate if its motion is vertical). The distinction between distance and displacement can be illustrated as follows:  Imagine a person walking 70 m East then turning around and walking 30 m West. The total **distance** travelled is 100 m, but the displacement is only 40 m from the starting point. Thus, **displacement** is the change in position of an object or how far the object is from its starting position. Displacement is a vector quantity and can be represented by arrows in diagrams. In the above example the blue arrow represents the displacement vector, whose magnitude is 40 m and whose direction is to the right. **Displacement** uses the symbol Δx. $\Delta x = x_2 - x_1$ (final position – initial position)	**1 Determining distance and Displacement**  Students move an object (e.g. an eraser) along the edge of a desk from A →B→C. They measure: (i) the distance travelled to the nearest cm (ii) the displacement (magnitude and direction – for direction, they measure the angle θ and state the direction in degrees clockwise from the direction AB).	**Distance and displacement (equipment)** - Student's desk or lab desk - Small object (e.g. eraser) - Metre rule (or cm ruler) - protractor **Speed and velocity (equipment)** - Clock or stopwatch (in addition to equipment listed above) **See also** *PHYSICS by GIANCOLI 6th edition pages 19-21*	**Questioning** - Defining scalar and vector quantity - Defining distance and displacement - Classifying distance and displacement as scalar and vector, respectively **Simple lab report** Correctly measuring and recording - distance - displacement (magnitude and direction) **Note:** Teachers are encouraged to insist on correct terminology in definitions in these very early lessons. This will help set the stage for straight thinking. "Definitions" like: 'speed is how fast something is going', or 'distance is how far something has travelled', should be discouraged.

SCOPE OF WORK
GRADE: 10

UNIT: KINEMATICS IN ONE DIMENSION (STRAIGHT LINE MOTION)

TOPIC: DISPLACEMENT, VELOCITY AND ACCELERATION

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	 Δx = 30 m – 10 m = +20 m  Δx = 10 m – 30 m = -20 m **Teachers may wish to consider these:** • Although arrows can be drawn to represent vectors, vector addition etc. could probably be treated in more detail later on in the section FORCES.			

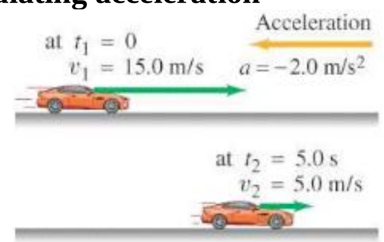
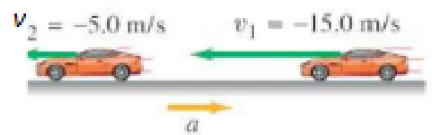
SCOPE OF WORK
GRADE: 10
UNIT: KINEMATICS IN ONE DIMENSION (STRAIGHT LINE MOTION)

TOPIC: **AVERAGE SPEED AND AVERAGE VELOCITY** **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
3 AVERAGE SPEED AND AVERAGE VELOCITY • distinguish between average speed and average velocity • manipulate and use the equation average speed and average velocity (It is important for students to keep track of S.I. units for each physical quantity.) **INSTANTANEOUS SPEED AND VELOCITY** **INTERPRETING TICKER TAPE CHARTS** • interpret ticker tape charts to describe motion and determine instantaneous speed, constant speed, average speed and uniform acceleration 9,14	**Average spee**d is the total distance divided by the time elasped. The S.I. unit symbol for speed is m/s, since speed is a distance (i.e. a length) divided by a time. The speedometer in motor vehicles measure your instantaneous speed either in miles per hour (mph) or kilometers per hour (km/h). Speed is a positive quantity with units and is therefore a *scalar* quantity. **Velocity** is used to tell us the magnitude (how fast the object is moving) as well as its direction and is therefore a vector quantity. **Average velocity =** displacement/ time Elapsed **Instantaneous velocity** is the average velocity during a very very small time interval **Instantaneous speed** is simply the magnitude of the instantaneous velocity	**2 Determining average speed and average velocity** Let students measure the time taken for the small object to be moved from A to C. They then calculate the following: (i) the average speed of the trip A→B→C; (ii) the average velocity of the trip A→B→C (they must state the magnitude and direction of the velocity). **3 Demonstration/discussion** The teacher walks around the perimeter of the classroom, returning to his/her starting position and asks students to time the walk. Students are challenged to determine (i) the distance walked (ii) the displacement (iii) the average speed (iv) the average velocity **4 Solving simple numerical problems based on equations** $s_{av} = d_{total} / t$ $v_{av} = \Delta x/\Delta t$	Stop watch **Ticker-tape equipment** **Textbooks:** *GCSE Physics*, by Tom Duncan, p …. *World of Physics* by John Avison, p … and *Physics for CSEC*, by Farley and Trotz, p 88-90.	**Questioning** - Defining average speed, instantaneous speed, average velocity - Classifying speed and velocity as scalar and vector, respectively **Calculating** Correctly calculating - speed - velocity (magnitude and direction)

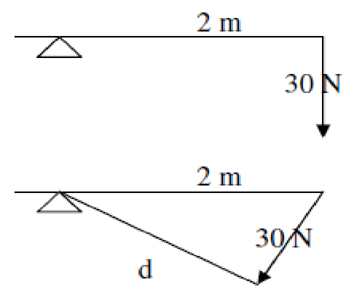
SCOPE OF WORK
GRADE: 10
UNIT: KINEMATICS IN ONE DIMENSION (STRAIGHT LINE MOTION)

TOPIC: ACCELERATION **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
4 ACCELERATION • define acceleration as rate of change of velocity.	**Acceleration** Acceleration is the rate of change of velocity with time. Acceleration is always in the direction of the net force acting on an object. Acceleration is a vector quantity. Acceleration = change in velocity / time In equation form, $a = \frac{v_2 - v_1}{t_2 - t_1}$ When t_1=0, t_2-t_1 simply becomes t. The S.I. unit for acceleration is (m/s)/s or m/s^2. The equation $a = (v_2 - v_1)/t$ can be rewritten as $v_2 = v_1 + at$ by a simple change of subject. Note that acceleration tells us velocity changes with time whereas velocity tells us how position changes with time. Also, when acceleration and velocity have the same sign, the speed of the object increases. Conversely, when acceleration and velocity have opposite signs, the speed of the object decreases.	**1 Demonstrating acceleration** A low-friction cart or a ball can be given an initial push along a horizontal board and then on the board inclined at about a 30^o angle. **2 Calculating acceleration**  $a = \frac{(5.0 - 15.0)\ m/s}{5.0\ s}$ $= -2.0\ m/s^2$  $a = \frac{(-5.0 - -15.0\}m/s}{5.0\ s}$ $= +2.0\ m/s^2$ When an object slows down it is **decelerating,** but deceleration doesn't mean that the acceleration is negative. Review examples on page 27 *PHYSICS by GIANCOLI 6th edition.* These can be taken from textbooks. However, the teacher must be careful to use examples that, initially at least, do not overwhelm the students.	**Equipment** - Low-friction cart or (ball) - Smooth board about 1 to 1.5 m in length **Textbook practice examples** *GCSE Physics* by Tom Duncan, p ….. *PHYSICS by GIANCOLI 6th edition pages 23-25*	**Defining** Students define acceleration **Deriving** Students deriving at least equation (i) **Numerical problem-solving** Students use a methodical approach in solving problems involving equations (i) to (v).

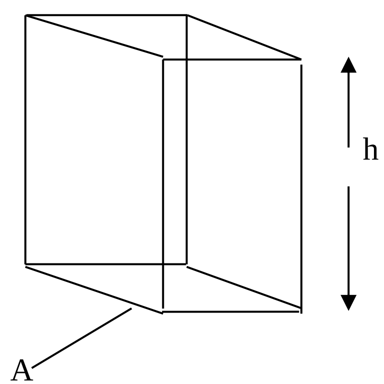
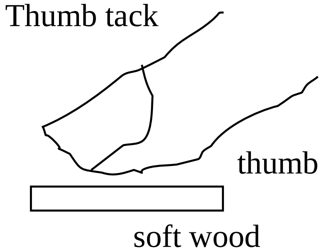
SCOPE OF WORK
GRADE: 10
UNIT: FORCES

TOPIC: MOMENTS **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Investigate factors which affect the moment (turning effect) of forces. • Describe and identify force couples.	**Moment** The moment, M, of a force, F, about an axis is the product of the force and the perpendicular distance, d, from the axis to the line of action of the force. Thus, **M = F d**. A moment produces a turning effect (rotation) about an axis. The rotation could be clockwise or anti-clockwise. Moment is sometimes called *torque*.	**1 Calculating moments** Students calculate moments in the two types of situations shown below:  Note: In the second case, students use the perpendicular distance from the axis to the line of action of the force. **2 Investigating factors affecting moment** 1. Place a metre rule on a pivot (e.g. the side of a pencil) so that the ruler balances (approximately). Note the balance point and use this pivot at this point throughout the experiment. 2. Place a 100-g mass on the ruler at a distance of 20.0 cm from the pivot. The ruler becomes overbalanced. 3. Attempt balancing the ruler using - a smaller mass (e.g. 50 g) - a larger mass (e.g. 200 g) Ask students how enough moment is obtained to balance the ruler using (1) a smaller mass and (2) a larger mass (with the 100-g mass at a given position) In other words: what are the factors affecting moment?	*Physics for CSEC*, by Farley and Trotz, ch. 6 Metre rule Pencil as pivot (or hang by a string) Masses (50 g, 100 g 200 g) Worksheets	**Calculating moments** Rubric for assessing **Conducting an investigation** - correct placement of masses - identifying factors affecting moment Numerical Problem Solving

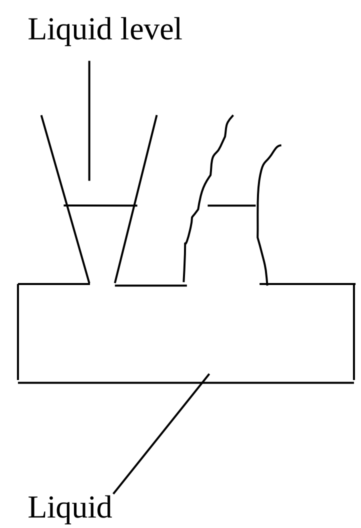
SCOPE OF WORK
GRADE: 10
UNIT: FORCES

TOPIC: PRESSURE **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Recognise the relationships existing between pressure, force and area • Manipulate the equation Pressure = $\frac{force}{area}$ to solve problems • Solve problems using p = hρg	**Pressure** is defined as the perpendicular force per unit area on a surface. In equation form. **P = F / A** **………….** (1) **Hydrostatics** is the study of forces on and in fluids at rest **Pressure in fluids**  Consider a column of fluid of height, h, cross-section area, A, mass, m, and density, ρ. Since ρ = mass / volume = m / Ah Then, m = ρAh But weight of fluid, W = mg = ρAhg Therefore, pressure on the base, P = ρAhg / A, or **P = hρg** **……….** (2)	**Demonstrating pressure** Press hard with your thumb on a piece of soft wood. Let students observe. Then press with the same force on a thumb tack with the point placed on the wood. Discuss observations in terms of P = F / A. **Numerical problem solving** Students solve simple numerical problems involving P = F / A. **Numerical problem solving** Students solve simple numerical problems involving p = hρg.	Many of the concepts and activities in this topic are treated quite clearly in *Conceptual Physics* by A. Farley and C. Trotz. Piece of soft board Thumb tack 	**Student observations** Students describe the effect of the thumb alone, and then the thumb with the thumb tack, on the wood. Students deduce that pressure causes the difference since force was the same in both cases. **Student solutions** Students solve problems using a logical format e.g. To find, Given, Solution, Ans. **Student solutions** Students solve problems using a logical format e.g. To find, Given, Solution, Ans.

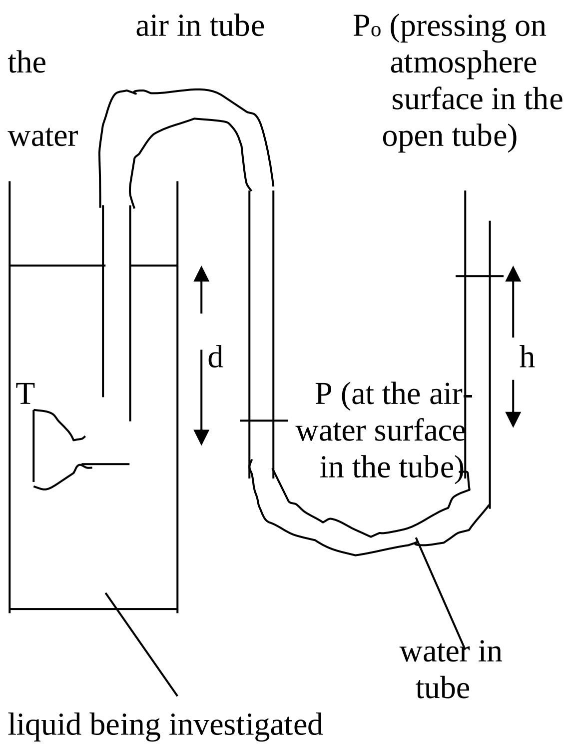
SCOPE OF WORK
GRADE: 10
UNIT: FORCES

TOPIC: PRESSURE IN FLUIDS **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Investigate factors that affect pressure in fluids - depth, density • Design/conduct experiments to investigate/demonstrate that pressure acts equally in all directions at the same depth • Design/conduct experiments to investigate/demonstrate that liquid pressure is independent of shape, width or area of container base (liquid finds its own level) • Perform calculations to determine force and pressure in hydraulic systems	**Factors affecting pressure in fluids** Pressure in fluids can be investigated using a <u>manometer</u>. The manometer consists of a thistle funnel, T, with a sheet of rubber stretched over its mouth and secured with a rubber band. The stem of the thistle funnel is connected to a flexible tubing which, in turn, is connected to a U-tube containing water. (See diagram below.) The pressure of the liquid at the surface of the rubber sheet over the mouth of the thistle funnel (i.e. the pressure at a depth, d, in the liquid) is equal to the pressure of the air trapped in the manometer.	**Investigating factors affecting pressure in fluids** - Students investigate the variation of pressure, P, with depth, d, using the water manometer. (Note: the U-tube must be adjusted so that the level at P is the same as the level at T.) - Using other fluids of known density (e.g. oil or salt water) in the fluid container, students investigate the variation of fluid pressure, P, with density of the fluid. (In both of the above examples, discuss control of variables. For example, in the first investigation, the kind of liquid and temperature are kept constant; in the second example, the depth and temperature are kept constant.)	Manometer Large container (e.g. large measuring cylinder) Metre rule Oil Salt Mass balance Measuring cylinder  	Practical Assessment: selection and use of materials; identifying and holding variables constant; measuring, recording and processing data; formulating conclusions and communicating information

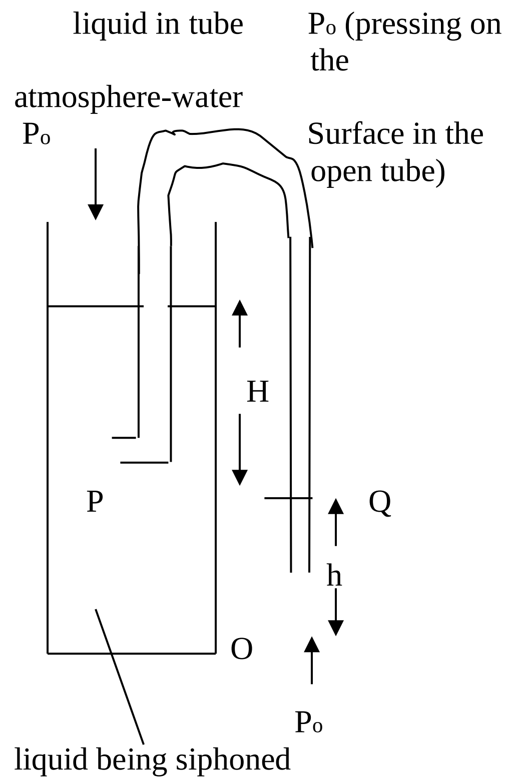
SCOPE OF WORK
GRADE: 10
UNIT: FORCES

TOPIC: PRESSURE IN FLUIDS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	This pressure, P, is given by $P = h\rho g + P_o$ where ρ is the density of the water in the manometer U-tube.  	**Investigating direction of pressure within a fluid** By keeping the depth constant, and swiveling T in various directions, students investigate if the fluid pressure varies with direction within the fluid. A thistle funnel with a straight glass tube, or with a U-tube, can also be used to point in the downward or upward direction at the depth, d. **Investigation of liquid level** The teacher sets up the apparatus shown on right in which the liquid in all the tubes is exposed to atmospheric pressure. The fact that all surfaces exposed to the atmosphere are at the same height shows that the pressure at their bases depend only on vertical height and not on shape or size of tube or area of base.	Thistle funnel U tube Straight glass tube	Practical Assessment: selection and use of materials; identifying and holding variables constant; measuring, recording and processing data; formulating conclusions and communicating information

SCOPE OF WORK
GRADE: 10
UNIT: FORCES

TOPIC: PRESSURE IN FLUIDS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	<u>Applications</u> - Dams are built thicker and stronger at their bases because the pressure of the water increases with depth. - Siphons work as follows: The pressure, P, inside the liquid = $P_o + h\rho g$ The pressure at Q is therefore $P_o + h\rho g$ Therefore the pressure at the open end, O, due to the liquid = $P_o + H\rho g + h\rho g$. The atmospheric pressure outside the open end is P_o and is therefore less than the pressure of the liquid at O. Hence the liquid will run out, as long as O is below the horizontal level with P. (See diagram in column 3)	**Demonstrating siphon action** The teacher can set up the siphon apparatus below: 	Siphon arrangement made by teacher or students - large measuring cylinder - rubber tubing (the straight pieces of glass tubing are optional (**CAUTION!** Students must NOT use their mouths to get their siphons going. They must simply fill the rubber tube with water, close one end, and then dip the open end under the water in the container. Then they open the closed end. Explain why it is not safe ever to use one's mouth to make a siphon.)	**Siphon made by students**

SCOPE OF WORK
GRADE: 10
UNIT: FORCES

TOPIC: FORCES/ HYDROSTATICS- SCIENTISTS AND CAREERS **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe the importance of one aspect of the work of Blaise Pascal • Select scientists of interest including at least one Bahamian/ Caribbean scientist and describe their work in the field of forces/ hydrostatics CAREERS • Describe careers which rely on the study of forces/ hydrostatics • Describe the use of forces/ hydrostatics in various careers (including emerging careers)		**Student research** who Blasie Pascal was and a little about his work. **Student research** Students find out in which careers or occupations a knowledge of Pascal's Principle are useful.	Internet Textbooks	**Student presentation/ report to class** **Student presentation/ report to class**

SCOPE OF WORK
GRADE: 10
UNIT: FORCES

TOPIC: PASCAL'S PRINCIPLE & ITS APPLICATIONS **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• State Pascal's principle and describe its application to hydraulic systems e.g. braking systems, hydraulic press. • Perform calculations to determine force and pressure in hydraulic systems	**Pascal's Principle** Pascal's Principle states that pressure is transmitted equally in all directions in a fluid. Therefore, for a liquid in a narrow tube of cross-section area, A_1 , connected to a wide tube of cross-section area, A_2 , it follows that $F_1 / A_1 = F_2 / A_2$ Therefore, $F_2 = (F_1 / A_1) \times A_2$ It follows that a large force, F_2 , can be obtained from a smaller force, F_1 , if the smaller force is applied on fluid in a narrow tube that is connected to a wider tube. This principle is applied in hydraulic braking systems in vehicles and hydraulic lifts at vehicle service station and tyre repair workshops.	**Numerical problem-solving** Students are given practice in solving problems involving $F_1 / A_1 = F_2 / A_2$. **Demonstration of hydraulic system** Some labs might have a hydraulic demonstration system. A small weight placed on the narrow cylinder side overcomes a large weight placed on the wide cylinder side.	Laboratory hydraulic demonstration system (Teacher may improvise by linking cylinders of different diameters with a rubber tubing).	**Student solutions to numerical problems** (Done in the usual format: To find, Given, Solution and Ans.)

SCOPE OF WORK
GRADE: 10
UNIT: WORK, ENERGY AND POWER

TOPIC: WORK AND ENERGY **DURATION: 2 WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
WORK AND ENERGY • Apply the relationship work = force x displacement to calculate energy transferred	Work and energy If something can do work, we say it possesses energy. Thus, we define energy as the ability to do work. We define work as the product of force, F, and displacement, d, in the direction of the force. Thus. Work = F x d (Nm) ………..(1) Lord Kelvin found that whenever work was done, an energy conversion took place. In fact, the more work done, the more energy is obtained. Thus there is an equivalence between work and energy. 1 Nm of work done is equivalent to 1 joule (J) of energy converted. Work can be regarded as a process in which one form of energy is converted to another.	1 Measuring work done - Students connect a spring balance (calibrated in N) and measure the work done against friction in pulling horizontally on a block placed on the lab desk. (Work = F x d) - Students connect a spring balance (calibrated in N) and measure the work done against gravity in raising a block through a vertical distance, h. (Work = F x h) 2 Calculating work done Students are given practice in using the equation, Work = F x d.	Spring balance Metre rule Wooden block	Lab worksheet report Student calculations

SCOPE OF WORK
GRADE: 10
UNIT: WORK, ENERGY AND POWER

TOPIC: WORK AND ENERGY

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Solve problems using the relationship $P.E._g = mgh$	**Potential energy** We define **potential energy** as stored energy. - An object at a height above the ground can do work. It possess gravitational potential energy. - A stretched spring (or rubber band) can do work. It possesses elastic potential energy. - A battery can do work when connected to an electric motor. We say the battery possesses chemical potential energy. We derive the equation for gravitational potential energy, PE, as follows: Consider a mass, m, being raised a height, h. The force, F, required to raise the mass (at constant speed) must be equal to the weight, mg, of the mass. The potential energy, PE, gained by the mass is equal to the work done in lifting the mass. Therefore, PE = F x d, that is, **PE = mgh** ……………..(2)	**3 Demonstrations of pote**ntial energy (stored energy) - Place a 30-cm ruler partly protruding over the edge of a lab table surface. Hold a board eraser at a safe height over the protrusion. The fact that when the eraser is released it moves the ruler shows that the eraser had (gravitational) potential energy. - Show that a stretched rubber band can do work in moving a small folded paper (do this with attention to safety). **4 Calculations involving gravitational potential energy** - Students are given practice in using the equation PE = mgh	30-cm ruler Board eraser Rubber band Small, folded paper	**Lab worksheet report** **Student calculations**

SCOPE OF WORK
GRADE: 10
UNIT: WORK, ENERGY AND POWER

TOPIC: WORK AND ENERGY

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Solve problems using the relationship K.E. = ½ mv^2	**Kinetic energy** Consider a mass whose initial velocity, v_o, is changed to a final velocity, v, by the action of a force, F. The force causes the mass to undergo an acceleration, a. through a distance, d. We get the following: Work = Fd But, by Newton's Second Law, F = ma Therefore work = mad But $a = \frac{v^2 - v_0^2}{2d}$ (since $v^2 = v_0^2 + 2ad$) Therefore work done = $m\left(\frac{v^2 - v_0^2}{2d}\right) \times d$ That is, **Work (Fd) = ½ mv^2 - ½ mv_0^2** ..(3) The quantity, ½ mv^2 (or ½ mv_0^2) is <u>energy</u>, since, when work is done, an energy conversion takes place. The quantity, ½ mv^2 (or ½ mv_0^2) is called <u>kinetic energy</u> (KE), since it is energy due to motion. We therefore get, for a mass, m, moving with speed, v, the kinetic energy of the mass is given by: **KE = ½ mv^2** ………..(4)	**5 Demonstration of kinetic energy** A force is exerted on a dynamics cart for a short distance. Work is done and the cart gains kinetic energy. The kinetic energy of the moving cart can do work in moving a chalkboard eraser some distance along the desk surface. **6 Calculations involving kinetic energy and/or work-energy theorem, e.g.** - KE of a moving car. (Discuss what happens to the initial KE In a crash where the car comes to a stop,) - KE of a moving car. The car skids to a stop. (Calculate the force of friction, F. Show students how to use equation (3).)	Dynamics trolley Board eraser	**Lab worksheet report** **Student calculations**
• Explain that moving bodies have kinetic energy which is converted into other forms when stopped	Equation (3) shows that, **Work done, Fd = final KE – initial KE** Or work done = change in kinetic energy (ΔKE) This last statement is called the **Work-Energy Theorem.**	Energy Conversion - Give examples of conversion of energy from one form to another - Discuss the law of conservation of energy (1st law of thermodynamics). - Students connect a fan and lamp to an energy source and discuss the energy conversion.	Fan Lamp	**Quiz/Worksheet**: State the law of conservation of energy. Give 2 examples. - Illustrate the energy conversion using an energy flow diagram.

SCOPE OF WORK
GRADE: 10
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: SCIENTISTS AND CAREERS **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe the importance of one aspect of the work of Robert Brown and Archimedes • Select scientists of interest including at least one Bahamian/ Caribbean scientist and describe their work in the field of the structure and behaviour of matter and thermal effects **CAREERS** • Describe careers which rely on the study of the structure and behaviour of matter and thermal effects • Describe the application of the structure and behaviour of matter and thermal effects in various careers (including emerging careers)		**Student research** who Robert Brown and Archimedes were and a little about their work. **Student research** Students find out which careers or occupations a knowledge of the structure and behaviour of matter and thermal effects.	Internet Textbooks	**Student presentation/ report to class** **Student presentation/ report to class**

SCOPE OF WORK
GRADE: 10
MATTER AND THERMAL EFFECTS

TOPIC: KINETIC THEORY OF MATTER **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• State the postulates of the kinetic theory.	**Assumptions of the Kinetic Theory of Matter** • Matter is made up of tiny particles. • The particles are always in motion • Particles exert strong forces (of attraction or repulsion) on each other when their separation distance is very small. • Collisions between particles are perfectly elastic i.e. energy is not lost overall by the particles during collisions. **Particles of matter** An atom is the smallest particle of an element that retains the chemical characteristics of the element. (An element is a substance that cannot be broken down into any simpler substance by chemical means. Oxygen and hydrogen are elements. Water is not an element since it can be broken down into simpler substances, namely, hydrogen and oxygen.)	Simulation: https://phet.colorado.edu/sims/html/states-of-matter-basics/latest/states-of-matter-basics_en.html Discussion	Internet	Observations stated by students

SCOPE OF WORK
GRADE: 10
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: KINETIC THEORY OF MATTER

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	A molecule is the smallest particle of a substance that can exist by itself. A molecule can consist of one atom (e.g. the helium molecule), more than one atom of the same kind (e.g. the oxygen molecule has two atoms of oxygen), or atoms of different kinds (e.g. the water molecule has two atoms of hydrogen and one atom of oxygen). An ion is an atom that is charged, either by gain or loss of electrons. *Only certain kinds of substances are made up of molecules*. Gases are one example. Organic compounds, e.g. wax, are also made up of molecules. (Solid conductors consist of a vibrating lattice of positive ions among which electrons move freely. Compounds like salt (sodium chloride) consist of ions of sodium bound tightly with ions of chlorine to form giant structures.)	Simulation: https://phet.colorado.edu/sims/html/states-of-matter-basics/latest/states-of-matter-basics_en.html Discussion	Internet	Observations stated by students

SCOPE OF WORK
GRADE: 10
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: KINETIC THEORY OF MATTER: BROWNIAN MOTION, DIFFUSION **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Describe and demonstrate phenomena which provide evidence for the kinetic theory of matter (Brownian motion, diffusion)	**Evidence for the Kinetic Theory** Evidence that particles of matter are actually moving can be seen from the following: Brownian motion in liquids Robert Brown, looking at tiny pollen grains through a microscope, noticed that the pollen showed continuous, irregular vibrations. He suggested that the vibrations were due to the motion of water molecules that were bombarding the pollen grains. Hence the name *Brownian motion*.	**Brownian motion of pollen in water** Set up a microscope slide with water on it and sprinkle a few pollen grains (or very fine powder) on the water. Have students state their observations. Students can also be encouraged to check the internet for video clips and simulations of this kind of experiment.	Microscope with bright illumination Slide Pollen grains (or fine powder grains)	Student Presentation/ report of findings Observations stated by students Drawings sketched by students
	Brownian motion in gases Particles of smoke in a transparent container illuminated with very bright light themselves look like tiny specks of light when viewed under a microscope. These specks of light are observed to move about randomly in jerky fashion. This is explained by assuming that molecules of the air in the container are colliding with the smoke particles.	**Brownian motion in gases** Set up a smoke-cell apparatus (e.g. Figure 11.6, *Physics for CSEC*, by A. Farley and C. Trotz). Let students describe their observations.	Brownian motion smoke-cell apparatus	Practical Assessment: selection and use of materials; identifying and holding variables constant; measuring, recording and processing data; formulating conclusions and communicating information
	Diffusion in liquids When a crystal of potassium permanganate is dropped gently in a beaker of water, the purple colour gradually spreads throughout the water.	**Diffusion in liquids** Have students gently drop a crystal of potassium permanganate in a beaker of water. Let students sketch their observations at the start, 1 hour later, several hours later and 24 hours later.	Potassium permanganate crystals Beaker	Practical Assessment: selection and use of materials; identifying and holding variables constant; measuring, recording and processing data; formulating conclusions and communicating information

SCOPE OF WORK
GRADE: 10
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: KINETIC THEORY OF MATTER: BROWNIAN MOTION, DIFFUSION

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	Diffusion in gases See Activity 5 in the column on the right.	**Diffusion in gases** Open a bottle of highly scented perfume in the middle of the classroom at the start of the class. After 15 minute intervals, students are to show hands if they had got the scent. Discuss with students how a record could be made to show where the scent spread.	Highly scented perfume	Practical Assessment: selection and use of materials; identifying and holding variables constant; measuring, recording and processing data; formulating conclusions and communicating information

SCOPE OF WORK
GRADE: 10
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: STATES OF MATTER **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
STATES OF MATTER • Account for the properties of solids, liquids & gases in terms of motion, energy & arrangement of particles, and forces between particles. • Name the states of matter as solids, liquids, gases, and demonstrate an awareness that there are other states e.g. plasma and Bose-Einstein Condensate.	**States of matter** Solid Solids have fixed shapes. This is because particles that make up a solid are, on the average, very close to each other and therefore the forces between them are very large. As the particles vibrate, when they move closer to each other, repulsion forces are very large. When they move away from each other (from the close mean separation distance), forces of attraction are also very large. That is why solids are "incompressible" and are also not easy to pull apart. Liquid Liquids take the shape of their containers. But the particles that make up a liquid generally stay together. This is because the vibrating particles, on the average, are still close to each other, but not as close as in solids. As they move toward each other, they experience large forces of repulsion. Hence, like solids, liquids are fairly "incompressible". However, as particles move away from each other, the forces of attraction between the particles are not so great because the	**Demonstrations involving states of matter** Solid Let students try to compress and also to try to pull apart a nail or metal cylinder. Students can also try tearing apart a rubber band by pulling on it. (The first "elastic" stretching is due to molecules arranged in coils like a spring. When the band is straightened out, the molecules are now straight and the strong forces between molecules become evident.) Liquid - Fill a syringe with water. Close the bottom end of the syringe. Let students try to compress the water in the syringe. The water does not reduce in volume. - Place the same amount of water in containers of different shapes to show that liquids take the shapes of their containers. Gas - Pull the plunger of a gas syringe upward to let air inside the barrel. Seal the bottom with your finger and have students try to compress the air. The air will show some reduction in volume.	Small metal object e.g. nail Rubber band Gas syringes Assorted lab apparatus (beakers, measuring cylinders, conical flasks)	Observations stated by students Record of data submitted by students

SCOPE OF WORK
GRADE: 10
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: STATES OF MATTER

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	average separation distance is larger. Particles can therefore move away from each other fairly easily, resulting in a liquid taking the shape of its container. Particles in a liquid therefore show both translation and vibration motions. However, the forces of attraction, though not as great as in solids, are large enough to keep most of the particles together. (A few particles at the surface of the liquid do, however, gain enough energy to escape from the liquid.) Gas Gases have no fixed shape. They fill any container in which they are put. This is because, on the average, particles of a gas are very far apart and so, hardly exert any force on each other. Gases are therefore compressible and easy to expand as well.	(You can discuss why there is still a pressure exerted by the gas that tends to oppose compression – the pressure is due to molecular bombardment of the particles with the walls of the container and not due to individual molecules of gas repelling each other.) Place a drop of bromine liquid in a gas jar and cover the jar. After a while, the bromine colour fills the jar.	Liquid bromine Gas jar	Observations stated by students Record of data submitted by students
		Reading/internet research on other states of matter Students find out about other states of matter, e.g., plasma and Bose-Einstein condensate.		Reports presented by students to class

SCOPE OF WORK
GRADE: 10
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: CHANGE OF STATE **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Relate temperature to molecular speeds	**Temperature and molecular speeds** By a theoretical analysis of molecular motion, it has been shown that temperature of a gas varies directly with the mean square speed per molecule in the gas. At *absolute zero* of temperature, all motion of molecules cease. **Pressure and molecular speeds** When molecules of a gas bombard the walls of its container, their rebound causes a change in their momentum. This change in momentum results in a force being exerted on the walls of the container. It follows that at absolute zero of temperature, since all molecular motion ceases, the pressure exerted by the gas on the walls of its container is theoretically zero as well. **Changes of state** Solid-liquid change The change from solid to liquid can be brought about by imparting energy to the solid by heating. During this change of state, the temperature of the substance does not change. The mean vibrational energy per particle does not change. The energy taken in causes work to be done, resulting in an increase of the average	Simulation: https://phet.colorado.edu/sims/html/states-of-matter-basics/latest/states-of-matter-basics_en.html Discussion	Internet	Observations stated by students

SCOPE OF WORK
GRADE: 10
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: CHANGE OF STATE

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
CHANGE OF STATE • Perform experiment and plot heating/cooling curve and identify phase change (for wax, naphthalene-only in fume chamber!) from constant temperature.	separation distance between particles. The change from solid to liquid at constant temperature is called melting and the temperature at which it occurs is called the melting point of the solid. The reverse process at constant temperature is called freezing (or fusion or solidification). The temperature at which freezing occurs is called the freezing point of the liquid. During freezing, heat is given up by the liquid to the surroundings.	**Heating/cooling curves** The teacher can perform demonstration of heating (or cooling as appropriate) the following in a small beaker in which a thermometer is inserted. The teacher gives temperature readings at regular time intervals. Students use the data to plot temperature vs. time graphs. - crushed ice starting below 0 $_o$C - solid naphthalene Students identify melting points and boiling points from their graphs. **(CAUTION!** Since naphthalene vapour is toxic and flammable, this experiment should be carried out in a fume chamber and done by a qualified person)	Beaker Thermometer Ice below 0 $_o$C Naphthalene Heat source (See *Physics for CSEC* by A. Farley and C. Trotz, pages 167-168.)	Student Lab Report/ Practical Assessment: selection and use of materials; identifying and holding variables constant; measuring, recording and processing data; formulating conclusions and communicating information Student drawings
	Liquid-gas change The change of state from liquid to gas can also be brought about by heating. During the change of state, the temperature of the substance remains constant and the average separation distance between the particles increases tremendously. The mean separation is so large that particles hardly exert forces of attraction or repulsion on each other and so they move about practically freely at high speeds. The change from liquid to gas at constant temperature is called boiling.	Observation of boiling and condensation Students observe bubbles of steam rising during boiling. Condensation should be observed on the cooler parts of the beaker.	Heat source Beaker Water Evaporating dish	Observations stated by students

SCOPE OF WORK
GRADE: 10
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: CHANGE OF STATE

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	The temperature at which boiling occurs is called the boiling point of the liquid at the pressure at which the boiling occurs. Boiling takes place throughout a liquid and bubbles of gas formed rise to the top of the liquid and burst, releasing the gas. The change from gas to liquid at constant temperature is called condensation. During condensation, heat is given up to the surroundings by the condensing gas as it turns to liquid.			
• Determine the effect of dissolved solids (impurities) and pressure changes (e.g. altitude, pressure cookers) on the boiling point of liquids.	Factors affecting boiling point and freezing point • Dissolved solids Dissolved solids cause boiling point temperatures to be elevated and freezing point temperatures to be lowered. When ice at temperatures below zero is mixed with salt, the ice melts (and freezes) at a lower temperature. The solution formed is not only colder than pure, melting ice, but can also make good contact, say, with the metal container in an ice-cream can, resulting in quicker formation of ice cream.	Effect of dissolved salt on boiling and melting points of water Students design an investigation (involving control of variables) to show the effect of dissolved salt on boiling point of water. After discussion of students' ideas, the teacher can carry out the experiment, paying due attention to safety. Students can also design investigations on the effect of dissolved salt on melting or freezing point of water.	Beaker of water Thermometers Salt Small beakers Thermometers Salt Refrigerator Ice cube	Designs suggested by students Student lab reports/ Practical Assessment: selection and use of materials; identifying and holding variables constant; measuring, recording and processing data; formulating conclusions and communicating information

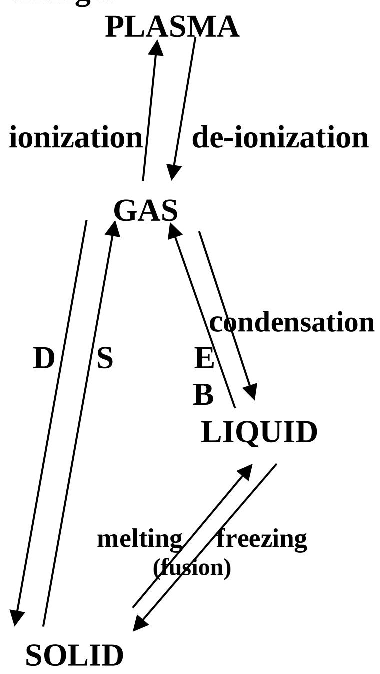
SCOPE OF WORK
GRADE: 10
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: CHANGE OF STATE

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	Pressure A high pressure above a liquid surface causes boiling point to be higher. (This is because more energy has to be imparted to the molecules of liquid to create enough pressure in the bubbles of gas formed to overcome the external pressure and burst.) A pressure cooker makes use of this fact. Its tight cover prevents steam from escaping and hence a buildup of pressure due to the hot steam occurs above the surface of the contents of the pot. The liquid therefore boils at a higher temperature, resulting in food cooking more quickly. A low pressure, e.g. up in a mountain, causes liquids to boil at lower temperatures. That is why boiling an egg up a mountain takes so long and may require using a pressure cooker.	Pressure cooker demonstration Show students a pressure cooker and its rubber seal. Show the pressure weights and the safety valve. Point out that a pressure-cooker should never be opened when contents are boiling as the pressure under the cover can cause steam to escape under high pressure, leading to severe steam burns. Show how the pressure-cooker is first left to cool naturally, and then tap water is run over the pot for further cooling. Read the manufacturer's instructions to the students.	Pressure cooker	Observations stated by students

SCOPE OF WORK
GRADE: 10
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: PHASE CHANGE **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Define and demonstrate phase changes. (sublimation, re-sublimation-deposition, melting, freezing condensation and vaporization.)	**Changes of phase** Above a certain temperature, called the critical temperature, substances cannot become liquid, no matter how much pressure is exerted. Below this temperature, a substance can show various transitions between solid, liquid and gas. We refer to these transitions as changes in phase. The following are some phase changes: **Vaporization** is the change of solid, or liquid, to the vapour phase. **Evaporation** is the change of liquid to vapour at the surface of a liquid. Molecules near the surface of the liquid may transfer some of their kinetic energy by collisions to molecules at the surface. The latter may acquire enough energy to overcome the forces of attraction of the rest of the molecules in the liquid and escape from the liquid surface. Since the liquid loses energy to the molecules of gas that escape, the average kinetic energy of the rest of the molecules of the liquid decreases. Hence, the temperature of the liquid drops, since temperature is directly related to the mean square speed of molecules, which, in turn, is proportional to the average kinetic energy per molecule	**Demonstrations** of the following: - Sublimation and deposition using iodine or naphthalene (naphthalene becomes vapour at room temperature, that is why it smells so strongly) - Boiling and condensation of water that is heated and vapour is cooled - Evaporation of water in a shallow petri dish	**Diagram showing phase changes**  **D – deposition** **S – sublimation** **E – evaporation** **B – boiling** (Note that vaporization can be produced by sublimation, evaporation or boiling)	Student discussions and observations

SCOPE OF WORK
GRADE: 10
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: PHASE CHANGE

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	($KE = \frac{1}{2} mv^2$) Unlike boiling, evaporation occurs at any temperature. **Boiling** is the change from liquid to vapour at a particular temperature and pressure. During boiling, the temperature of the substance does not change. **Condensation** is the reverse of boiling. It is the change from the vapour phase to the liquid phase. **Sublimation** is the change from solid directly into vapour without passing through a liquid phase. Solid carbon dioxide sublimes at atmospheric pressure. At standard pressure, ice goes through the liquid phase before becoming vapour. However, at very low pressures, ice also sublimes. **Deposition** is the change from the vapour phase directly to the solid phase. Like sublimation and boiling, deposition depends on the prevailing pressure. **Melting** is the change from the solid to the liquid phase. The reverse, freezing is the change from the liquid to the solid phase. Ionization produced by high temperatures, results in substances being converted into plasmas. The reverse, deionization is the conversion of plasmas to liquids.		Test tube Bunsen burner Naphthalene Petri dish	

SCOPE OF WORK
GRADE: 10
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: PHASE CHANGE

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Demonstrate and account for the cooling effect of evaporation. • Explain how phase changes are useful in the operation of refrigerators and air conditioners	**Usefulness of liquid-vapour phase change** A large quantity of energy is needed to convert a liquid into vapour. Certain substances easily undergo this change by taking energy from the container in contact with them. The container becomes cooled as a result. (Such substances are said to be ***volatile*** and are used refrigerants.) Refrigerants are used in refrigerators and air-conditioners. The refrigerant is circulated in metal pipes and allowed to expand through fine holes to become vapour. In the vaporization process, the refrigerant takes heat from the metal pipes, which in turn take heat by conduction from the food or air in contact with the metal pipes. The vapour then passes through a condenser which is usually painted black to assist in radiating heat from the vapour, causing the vapour to condense back to liquid.	**Diagrams and/or inspection of:** Refrigerator Air-conditioner	**Diagrams and/or inspection of:** Refrigerator Air-conditioner	Designs suggested by students lab

SCOPE OF WORK
GRADE: 10
UNIT: STRUCTURE AND BEHAVIOUR OF MATTER

TOPIC: PHASE CHANGE

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Examine the use of environmentally safe refrigerants, proposing of legislation, strategies for preventing/dealing with pollution by refrigerants.	Certain refrigerants, called *chlorofluorocarbons* (CFCs), are very damaging to the ozone layer that protects the Earth from very damaging ultraviolet rays. By international agreement (The Montreal Protocol), these types of refrigerants are now banned.	**Student research** Students do research on the following: - The Montreal Protocol - The Kigali Amendment to the Montreal Protocol - Environmentally safe refrigerants - Products other than refrigerants that contain CFCs and other volatile substances in their homes that are damaging to the ozone layer **Class discussion** Strategies for dealing with pollution by refrigerants and other volatile substances.	Internet	**Collaborative Student Presentations and reports in one of several modes –** Information and Communication Technology (Power Point, flyers, brochures, blogs), Oral (speech, song, rap, news bulletin, public service announcement), Visual (cartoons, tri-fold, posters, video) Presentations

SCOPE OF WORK
GRADE: 10
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: ARCHIMEDES PRINCIPLE AND DENSITY **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Design and perform experiment to demonstrate/verify Archimedes principle • Use Archimedes Principle to explain floating and sinking • Perform experiments to investigate the ease of flotation in fluids of different densities. • Discuss everyday applications of Archimedes principle- such as Andros water barge, cruise ships, shipping between waters of different densities.	**Archimedes' Principle** *The upthrust on an object placed in a fluid is equal to the weight of fluid displaced by the object*: i.e. Upthrust = weight of fluid displaced For an object to float, the upthrust on the object must be equal the weight of the object: i.e. Upthrust = weight of object Thus, *a floating object displaces its own weight of fluid in which it floats.* This last statement is sometimes called the *Principle of flotation.* **Archimedes' Principle and flotation** If an object displaces a volume, V, of fluid of density, ρ, the mass, m, of the fluid displaced is given by $m = \rho V$. The weight of the fluid displaced is therefore given by $W = \rho V g$. Since upthrust is equal to weight of fluid displaced, then upthrust is greatest when density of fluid is greatest and volume of liquid displaced is greatest. That is why ships and barges are made with large volumes (to displace large volumes of water so as to obtain large upthrust) but	**Verifying Archimedes' Principle** Students design and carry out an experiment to verify Archimedes' Principle. You can show them the following equipment they can use: spring balance, thread, stone, overflow can, suitable beaker and top-pan (or beam) balance. They may request other equipment if they wish. **Investigating floatation in fluids** A narrow test tube, loaded with some sand for stability, is placed in liquids of various densities (e.g. fresh water, oil, salt water, ice water, warm water). Students observe and record the depths the test tube sinks in the liquids of various densities and make a conclusion. Students can even calibrate their test tubes using the known densities and given a liquid of unknown density (e.g. milk or a sugar solution made up by the teacher) to infer its density from the depth the test tube sinks. In effect, they would have made a hydrometer.	Spring balance Thread Stone Overflow can Suitable beaker Top-pan (or beam) balance Narrow test tube Liquids of various densities Metre rule (or graph paper placed in the inside wall of the test tube)	Design submitted by each group Lab report submitted by each student /group Practical Assessment: selection and use of materials; identifying and holding variables constant; measuring, recording and processing data; formulating conclusions and communicating information Hydrometer made and calibrated by students

SCOPE OF WORK
GRADE: 10
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: ARCHIMEDES PRINCIPLE AND DENSITY

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	hollow so that their weights are smaller than the upthrust on them. Density is mass per unit volume of a given substance. The SI unit of density is kgm^{-3} (kg/m^3), however, it is sometimes more convenient to use gcm^{-3} (g/cm^3) for small values. **Density =** $\frac{mass}{volume}$ Density of water = 1 g/cm^3 or 1000 kg/m^3 An object will float in a fluid if its density is less than the density of the liquid, i.e. the volume of fluid displaced has a greater mass than the object itself. Density is useful for comparing materials and deciding which material is best for a given job. • Volume and density are inversely related, the higher the volume occupied by a given mass, the lower the density. • Mass and density are directly related, the higher the mass in a given volume, the higher the density. • When a substance is heated, its mass remains the same, its volume increases (since it expands) and density decreases • When a substance is cooled, its mass remains the same, its volume decreases (since it contracts) and density increases	**A discussion** could follow as to ease of floatation of ships in the following waters: Cold and fresh; Cold and salty Warm and fresh; Warm and salty Students can then do research as to what are the Plimsoll Lines in international shipping. **Practical Activities** Designing a density tower using four to five liquids of varying densities Observing the behaviour of an orange with and without its peel in pure water Observing the behaviour of an egg in pure water and salt water. Repeat with a can of soda. Finding density of a liquid e.g. water or oil Place measuring cylinder on balance. Add liquid. Reading on measuring cylinder = V, change in mass on balance = m. Use formula. density = mass/volume Finding density of solid e.g. aluminum block, small stone, rubber stopper Finding mass: Use balance Finding the volume: To find out volume of a regular object, use mathematical formula. To find out volume of an irregular object by displacement –use a displacement can or put object into a measuring cylinder with water and the rise of water is the volume of the object. Density = mass/ volume		Student reports to class on findings about Plimsoll Lines Lab report submitted by each student /group Practical Assessment: selection and use of materials; identifying and holding variables constant; measuring, recording and processing data; formulating conclusions and communicating information

SCOPE OF WORK
GRADE: 10
UNIT: WAVES

TOPIC: MECHANICAL WAVES **DURATION: 1 ½ WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Demonstrate that mechanical waves transfer energy along matter. • Recognize that a medium is needed for mechanical wave propagation. • Make simple models of transverse and longitudinal waves • Define the terms: frequency, wavelength, speed, and period as they apply to waves. • Label and use simple displacement-time and displacement-position graphs to find and show amplitude, frequency and wavelength of waves. • List behaviours shown by waves: rectilinear propagation, reflection, refraction, diffraction. • State and apply the wave equations: $v = f\lambda$ and $v = x/t$ • Recognize that longitudinal and transverse waves show similar behaviours and obey the same laws.	• Energy is transferred in the form of waves. • Classified as **Mechanical waves:** need media for transmission. **Electromagnetic waves**. Waves: no medium needed, travel through a vacuum. **Longitudinal waves:** cause the particles over which they pass to vibrate parallel to the direction in which the waves are moving. **Transverse waves:** cause the particles over which they pass to vibrate perpendicular to the direction in which the waves are moving. • Mechanical waves are either transverse or longitudinal. • Water waves are mechanical and transverse Sound waves are mechanical and longitudinal. • Frequency is the number of waves/vibrations/oscillations, cycles that pass a given point in 1 second.(cycles per second or Hertz) • Wave: each crest and its adjacent trough make up a wave.	• Use slinky to show transverse and longitudinal waves. (Mark a position on the slinky with a coloured cloth.) • Make “ballpark” waves with students as particles, to demonstrate transverse and longitudinal waves. • Use ripple tank experiments, demonstrations. (Use large aluminium baking pans). • (Students construct simple ripple tank given diagram). in ripple tank: • identify parts of water wave • Create circular and plane wave fronts in ripple tank. • Observe and construct ray diagrams for reflection of plane wave incident upon plane surface along the normal and at an angle.	ripple tank or materials which can be used to construct ripple tank. Slinky http://www.acoustics.salford.ac.uk/feschools/waves/super.htm#phase appropriate animations.	Written quizzes, unit tests, home work, project assignments (eg constructing ripple tank and demonstrating aspects of unit.) Group presentations to class. Observation skills assessed. Processing skills assessed.

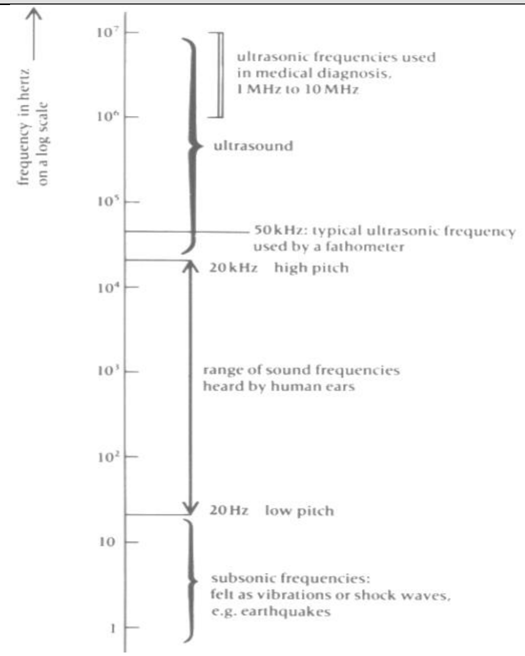
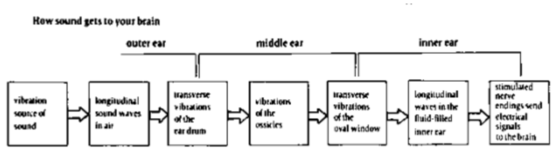
SCOPE OF WORK
GRADE: 10
UNIT: WAVES

TOPIC: MECHANICAL WAVES

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	• Wave front: an imaginary line which joins a set of particles which are in phase in a wave motion. • Wavelength: the distance between two successive crests or two successive troughs. (The distance between successive identical parts of the wave…the distance between two successive particles which are at exactly the same point in their paths and are moving in the same direction –exactly in phase.) • Amplitude: the maximum displacement of a particle from its rest position. (measure of the energy of the wave) • Speed: $v = x/t$, $v = f\lambda$, where v is the speed of the wave, f is the frequency and λ is the wavelength of the wave. Perform calculations. Note S.I. units for quantities. • Period: the time it takes for 1 wave, oscillation to be completed. • The period of a wave and its frequency are the inverse of each other.	• Observe and draw general diagrams to show reflection of plane waves from concave and convex surfaces. • Observe and draw general diagrams to show the reflection of circular wave from a plane surface. • Demonstrate refraction of waves in ripple tank. Set up thick glass plate or tiles in bottom of ripple tank to produce boundary between deep and shallow water. Observe plane wave as it crosses the plane boundary along the normal. Observe and sketch refraction of plane wave as it crosses the plane boundary at an angle of incidence other than 90_0. • Set up gaps in the ripple tank and observe and sketch interference. • Observe and sketch diagrams to show diffraction of water waves in ripple tank by setting up gaps of various sizes and creating plane wave fronts to pass through the gaps. • Perform calculations using the wave equation.	http://www.physicsclassroom.com/Class/waves/u10l1a.cfm some animations, many questions to check understanding, answers provided. CXC Physics Alec Farley & Clarence Troz Macmillan Publishers Limited 2007. A World of Physics Avison Encyclopedia Britannica GCSE Physics waves	Observations & diagrams assessed quiz

SCOPE OF WORK
GRADE: 10
UNIT: WAVES

TOPIC: SOUND WAVES **DURATION: 1 ½ WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Explain that sound waves are produced when objects vibrate, e.g. vibrating tuning forks, speakers, strings etc. • Recognize that sound waves require a medium for propagation. (bell-jar expt.) • Construct a simple model to show the transmission of sound. • Describe characteristics of sound (pitch, loudness, quality) in relation to frequency and amplitude. • Describe the qualitative effects (relationship between) of thickness, tension and length on (and) the frequency/pitch of a vibrating string or skin. • Classify sound into major frequency bands: infrasound, audible sound and ultrasound • Describe cathode ray oscilloscope traces and their relationships to frequency (pitch), amplitude (loudness) and wave shape (quality) of sound waves.	 The audio frequency range for humans is 20 Hz to 20 kHz.  Physics for CXC John H. Avison 1998 pg 240 Sound waves exhibit the same properties as mechanical waves: reflection, refraction, diffraction.	• Examine waves produced by tuning fork, vibrating speakers, strings of a guitar, insect rubbing wings together • Bell jar experiment: if bell jar with pump not available-challenge students to construct an apparatus in which this experiment can be done. Brainstorm other ways to demonstrate that sound need a medium to travel. • Make a model to demonstrate transmission of sound using cups, string. • Pluck guitar strings and listen to how pitch varies with length, thickness and tension of string. Write expressions for the relationships • Convert diagrams showing longitudinal waves movement into standard wave diagram (e.g. areas of maximum contraction represents a crest and areas of maximum rarefaction represent a trough) • Use Snapple bottles with varying amounts of water to make simple tunes. • Research the audio frequencies range for other animals (e.g. whales, bats, dogs etc)	tuning forks, bell jar apparatus, CRO, speakers **Textbooks** **Internet**	Quizzes, unit tests, practical demonstrations, cooperative group activities, presentations, construction of musical instruments, project presentations, video presentations, research presentation, debates. Quiz Model to show transmission of sound assessed for creativity and functionality. (sound must be transmitted from place to place). Musical instruments assessed for functionality. Research assessed.

SCOPE OF WORK
GRADE: 10
UNIT: WAVES

TOPIC: SOUND WAVES

<table>
<tr><th>LEARNER OUTCOMES</th><th>CONTENT</th><th>ACTIVITIES</th><th>RESOURCES</th><th>METHOD OF ASSESSMENT</th></tr>
<tr>
<td>• Make musical instruments</td>
<td>All musical instruments, have a vibrating system which produces all musical sounds e.g. the strings on the guitar, or the air column in the clarinet, and the head of the drum are examples of vibrating systems.

Wind instruments depend on the vibration of a column of air to produce sound. The column of air vibrates when wind is blown into or across an instrument. Changes in pitch or frequency may be achieved by altering length, diameter and tension of the vibrating material.

Most string instruments have a sounding board which increases the intensity of a sound. The vibration made on the sounding board is called forced vibration because the natural frequency of the board usually does not match the frequency of the vibrating string. As the two frequencies match when the string is plucked, resonance amplifies the sound.

Doppler effect: when waves are created in a medium by a moving source, the frequency observed at a point towards which the source is moving becomes greater. When the source moves away from that point, the frequency (pitch) becomes less.</td>
<td>Stretch a rubber band between one's finger and thumb. Pluck the rubber band and describe the loudness of the sound. Place the same rubber band around a pie plate and pluck the rubber band. They will find that the sound of rubber band is much louder.

Students can construct other simple musical instruments using the principles learned. e.g. Making a Snapple Bottle xylophone.

Obtain 6 bottles of Snapple Juice
Tear off the labels from the bottles. Pour out juice from each bottle (into the cups provided) so that the heights stated below remain in the bottles. (and take a drink on us! Cheers!). Label the bottles from 1 to 6 as shown below.
<table>
<tr><td>Height of juice in bottle</td><td>5 1/2 "</td><td>4 "</td><td>3 1/4 "</td><td>3 "</td><td>2 1/4 "</td><td>2 "</td></tr>
<tr><td>Label on bottle</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
</table>
Try to tap out the tunes below by hitting the bottles with the stick provided.
<table>
<tr><td>Mary Had a Little Lamb
3212333 222 355
3212333 322321</td><td>Jingle Bells
333 333 35123
444 4433 3355421</td></tr>
<tr><td>Twinkle, Twinkle Little Star
11 55 66 5 44 33 22 1
55 44 33 2 55 44 33 2
11 55 66 5 44 33 22 1</td><td>This Old Man
535 535 6543234
345 1 111 12345
5224321</td></tr>
</table>
Tapping the bottles with the stick causes the glass of the bottle to vibrate and produce sound. The juice dampens these vibrations. So, the less juice in the bottle, the faster the bottle vibrates and the higher the pitch.
Hey, if it doesn't work after a good try, just drink the juice and feel the rhythm!

http://www.musicwithmelissa.com/index_files/Page892.html</td>
<td>• Students can construct other simple musical instruments using the principles learned.</td>
<td>Quiz, homework assignments assessed</td>
</tr>
</table>

SCOPE OF WORK
GRADE: 10
UNIT: WAVES

TOPIC: LIGHT AS A WAVE (SPECTRUM) **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
To identify the colours of the spectrum produced when white light passes through a prism.	White light is a mixture of several colours (red, orange, yellow, green, blue, indigo, violet), which may be separated by refraction. The band of colours formed is called a spectrum and the process is called dispersion. Refraction of light through a prism, or diamond and rainbows are examples of dispersion,	• Practical Activity – Forming a spectrum with a prism Using a raybox, shine a ray of white light through a glass prism and onto a white screen • Repeat using a convex lens to focus the rays to form a pure spectrum (GCSE Physics; page 27) (Physics for You, page 206)	Raybox Prisms Convex Lenses Screens	Practical demonstrations, cooperative group activities, presentations,
To describe how a spectrum can be recombined to produce white light	White light can be recombined to produce white light by: (i) arranging a second prism so that light is deviated in an opposite direction and (ii) spinning a disc at high speeds with the colours of the spectrum painted on its sectors	• Practical Activity – Recombining spectrum to produce White light • Using two prisms opposite arranged • Constructing a colour wheel and spinning it at high speeds using an electric motor	Raybox Prisms Colour wheel Electric motor	Practical demonstrations, cooperative group activities,
To describe the relationship between the colours of the spectrum and their wavelength.	The colours of the spectrum vary in their wavelength. In transparent materials, such as glass, the colours of the spectrum travel at different speeds based on their wavelength. The greater the wavelength, the slower the speed and the greater the angle of refraction. Violet has the shortest wavelength and is refracted through the greatest angle since its speed decreases the most. Red has the longest wavelength and is refracted least since its speed decreases the least.	Research Drawing and labeling colours of the spectrum and their relative wavelengths after refraction through a prism.	Raybox Prisms	Practical demonstrations, cooperative group activities,

SCOPE OF WORK
GRADE: 10
UNIT: WAVES

TOPIC: LIGHT AS A WAVE (SPECTRUM)

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
To describe the factors that affect colour of an object	The colour of an object depends on the colour of light falling on it and the colour it transmits or reflects. The primary colours of light are red, green and blue. Secondary colours of light are yellow, magenta and cyan. A filter only allows light to pass through of certain colours only e.g a green filter only transmits mostly green light and absorbs other colours. Opaque objects are seen as reflected light. In general, white reflects all light falling on it, coloured objects reflect the colour they contain and absorb other colours e.g. a red object appears red in white light because it reflect red only and absorbs the other colours of the spectrum. It also appears red in red light, but black (the absence of colour) in green light since no light is reflected. Duncan, Tom (2001) GCSE Physics. 4th Ed. Pgs.27 -29	Practical Activity • Mixing coloured lights … primary colours can be mixed by shining beams of red, green and blue light unto a white screen allowing them to partially overlap. • Using coloured filters to investigate the transmission of light through them	Ray box Light box & accessory kit Colour filters Screen	Practical demonstrations, cooperative group activities, presentations, quizzes,

SCOPE OF WORK
GRADE: 10
UNIT: WAVES

TOPIC: RECTI-LINEAR PROPAGATION OF LIGHT **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe the recti-linear propagation of light, justifying with examples in everyday life • Construct a pin-hole camera (model –viewing images, real- taking actual pictures)	**Recti-linear propagation** describes the tendency of Electromagnetic waves (light) to travel in straight lines. Light only deviates from a straight line when the medium it is travelling through changes density, i.e. when refraction occurs. Light does not deviate when travelling through a homogenous medium, which has the same refractive index throughout. Evidence of rectilinear propagation of light is provided by the observation of light travelling from a cinema projector on the screen; the fact that is not possible to see around corners; the formation of shadows cast by opaque objects; eclipses and through the construction of a pin-hole camera A pinhole camera consists of a closed box with a screen and a small pinhole at the other end. (Johnson, Keith (2006) **<u>New Physics for</u> <u>You</u>** Pg. 174) • The image formed in a pinhole camera is real and inverted. • The closer the pinhole camera is to the light source, the bigger the image. • A wider hole produces a brighter image which is blurred (not sharp). • Multiple holes produce multiple images.	Construction of a pinhole camera Viewing real inverted images using: • Single pin hole • Enlarged hole • Multiple holes Drawing diagrams illustrating formation of real inverted images in a pinhole camera	cardboard box, translucent paper, black construction paper, scissors, glue, Jackson B. & P. Whiteley (2007) **<u>Longman Physics for CSEC</u>** 3rd. Ed (pgs.153-155) Johnson Keith (2006) New Physics for You. Pg. 174.	Practical Assessment: selection and use of materials; making observations, formulating conclusions and communicating information Assessment of model of Pinhole camera for functionality and creativity

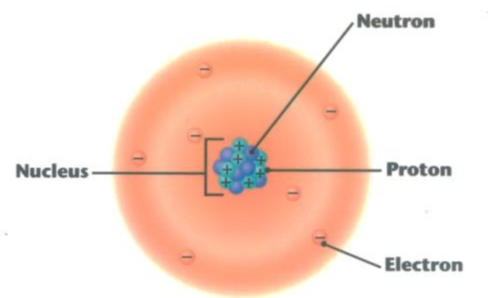
SCOPE OF WORK
GRADE: 10
UNIT: WAVES

TOPIC: RECTI-LINEAR PROPAGATION OF LIGHT

<table>
<tr><th>LEARNER OUTCOMES</th><th>CONTENT</th><th>ACTIVITIES</th><th>RESOURCES</th><th>METHOD OF ASSESSMENT</th></tr>
<tr>
<td>• Describe the image formed by optical devices (nature – real, virtual; orientation upright, inverted; size –magnified, diminished, same size; position in relation to optical device)</td>
<td>The image formed by an optical device may be real or virtual; upright/erect or vertically inverted; laterally inverted; magnified or diminished and its position may vary in relation to object position from device.</td>
<td>Practical activity involving viewing images formed by an assortment of optical devices with plane mirrors, curved mirrors, concave and convex lenses.</td>
<td>Candles, pins, ray boxes, plane mirrors, curved mirrors, light boxes and accessory kit</td>
<td>Assessment of practical skills:
• Observation
• Communication
• Measurement
• Collection, processing and interpretation of data</td>
</tr>
<tr>
<td>• Describe the image formed by optical devices (nature- real, virtual, orientation upright, inverted, vertically or laterally inverted, size- magnified or diminished, position- in relation to device).</td>
<td>
<table>
<tr><th>Image in Pinhole Camera</th><th>Image in Plane Mirror</th></tr>
<tr><td>Real</td><td>Virtual</td></tr>
<tr><td>Vertically inverted</td><td>Laterally inverted</td></tr>
<tr><td>Varies depending on object position ... the closer the object is to pinhole camera, the larger it is</td><td>Same size as object</td></tr>
<tr><td>-</td><td>Same position behind mirror as object is in front</td></tr>
</table>
</td>
<td>Practical demonstration using pinhole cameras and plane mirrors</td>
<td>Pinhole cameras, Plane mirrors Suitable objects (pins, light, candles, bulbs)
Longman Physics for CSEC 3rd. Ed (pgs. 158-160)</td>
<td>Assessment of Practical skills:
• Observation
• Classification</td>
</tr>
</table>

SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: THE ATOM & STATIC CHARGES **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Define the term atom • List the subatomic particles in an atom and describe their relative charges and masses • Construct models of simple atoms	The smallest object that retains properties of an element. Composed of electrons and a nucleus (containing protons and neutrons). 	Students can build models of an atom	Styrofoam Modeling clay	Student models assessed using rubric for accuracy and creativity
• Describe charging as a result of the movement of electrons. • Describe static electricity as stationary positive or negative charges	Particle / Relative Mass / Relative Charge Proton / 1 / +1 Neutron / 1 / 0 Electron / 0.0005 / -1 Static electricity is the accumulation of electrical charges on the surface of a material, usually an insulator or non-conductor of electricity. It is called "static" because there is no current flowing. It is usually caused when certain materials are rubbed against each other—like wool on plastic or the soles of your shoes on the carpet. It is also caused when materials are pressed against each other and pulled apart.	**Activity 1**: Rub a piece of ebonite (very hard, black rubber) across a piece of animal fur. Explain what happens. The fur does not hold on to its electrons as strongly as the ebonite. Some of the electrons will be ripped off of the fur and stay on the ebonite. The fur now has a slightly positive charge (it lost some electrons) and the ebonite is slightly negative (it gained some electrons).The net charge is still zero between the two… remember the conservation of charge. No charges have been created or destroyed, just moved around.	An ebonite rod, a piece of animal fur, a glass rod and a piece of silk	Practical Assessment: selection and use of materials; measuring, making observations; formulating conclusions and communicating information

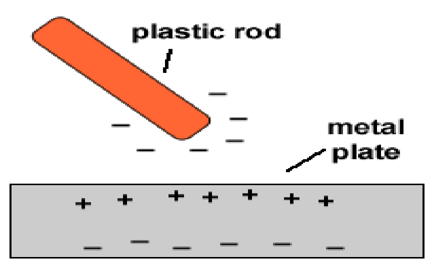
SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTROSTATICS - LAW OF CHARGES & INVERSE SQUARE LAW **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	Both +ve and –ve electrostatic charges are produced by the movement of electrons. The +ve charge is caused by electrons moving away from the object whilst the –ve charge is caused by electrons moving onto the object. For example if a polyethene rod is rubbed with a cloth it becomes negatively charged because electrons move from the cloth to the polyethene rod. If an acetate rod is rubbed with a cloth, it becomes positively charged because electrons move from the acetate rod to the cloth.	**Activity 2:** Rub a glass rod with a piece of silk. Explain what happens. While, this is similar to activity 1, in this case the silk holds onto the electrons more strongly than the glass. Electrons are ripped off of the glass and go on to the silk. The glass is now positive and the silk is negative.	A glass rod and a piece of silk	Practical Assessment: selection and use of materials; measuring, making observations; formulating conclusions and communicating information
• State and demonstrate the law of charges • Describe the force between charged bodies and the qualitative relationship of size of charge and distance between charge bodies (inverse square law: product of charged of bodies /distance squared)	Like charges repel one another and unlike charges attract one another.  **Opposite charges attract. Like charges repel** There is a force between the charges and the bigger the charges the greater the force and the shorter the distance between the charges the bigger the force. This is called Coulomb's Law of charges which states: The force between two charged objects is directly proportional to the product of their charges and inversely proportional to the square of the distance between them.	Students can suspend charged polyethene and acetate rods to investigate the law of charges. Students can charge a polyethene and an acetate rod (which are charged negative and positive respectively) then suspend them on a string. Coulomb's Law can then be investigated qualitatively. Viewing of Coulomb's Law Interactive Simulations: https://www.physicsclassroom.com/Physics-Interactives/Static-Electricity/Coulomb-s-Law/Coulomb-s-Law-Interactive	A polyethene rod, an acetate rod and strings. Internet	Practical Assessment: selection and use of materials; measuring, making observations; formulating conclusions and communicating information

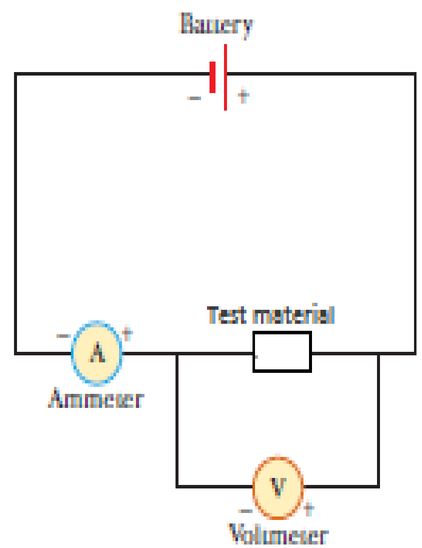
SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTROSTATICS - LAW OF CHARGES & INVERSE SQUARE LAW

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	The magnitude of the electrostatic force (F) on a point charge (q_1) due to the presence of a second point charge (q_2), is given by $$F = k_e \frac{q_1 q_2}{r^2}$$ where r is the distance between the two point charges and k_e a proportionality constant. A positive force implies a repulsive interaction, while a negative force implies an attractive interaction	https://phet.colorado.edu/sims/html/coulombs-law/latest/coulombs-law_en.html		
• explain how a charged object can attract objects having net zero charge.	A charged object attracts a neutral object by electrostatic induction. This is the redistribution of electric charge on one material under the influence of an electric charge on a nearby object. When a negatively charged object is brought near a neutral object, it induces a positive charge on the near side of the object and a negative charge on the far side. This causes the negatively charged object to attract the neutral one.  	Students can charge a polyethene and an acetate rod (which are charged negatively and positive respective) and then investigate their attraction to neutral tiny strips of paper, inflated balloons and a stream of water Engaging in interactive simulation: https://www.cengage.com/physics/phet/simulations/simsf2c4.html?sim=Balloons_and_Static_Electricity https://www.s-cool.co.uk/gcse/physics/static-and-current-electricity/revise-it/static-electricity	A polyethene rod, an acetate rod, a duster rod, tiny bits of paper, balloons and stream of water	Practical Assessment: selection and use of materials; measuring, making observations; formulating conclusions and communicating information

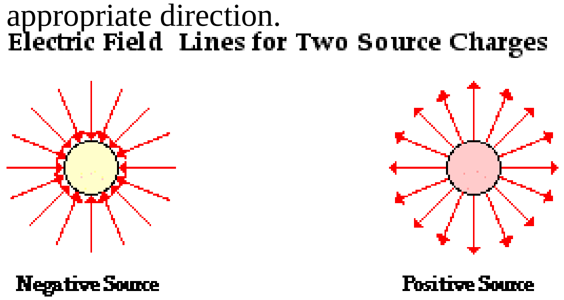
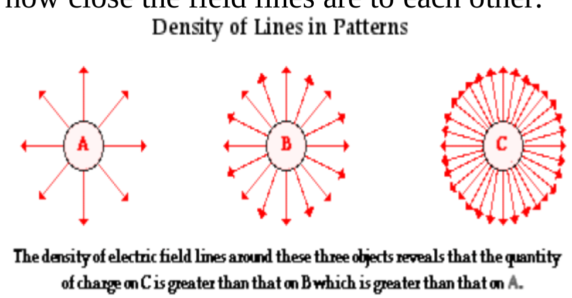
SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: INSULATORS AND CONDUCTORS **DURATION: ½ WEEK**

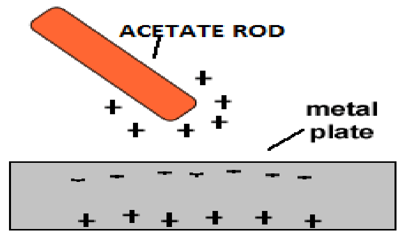
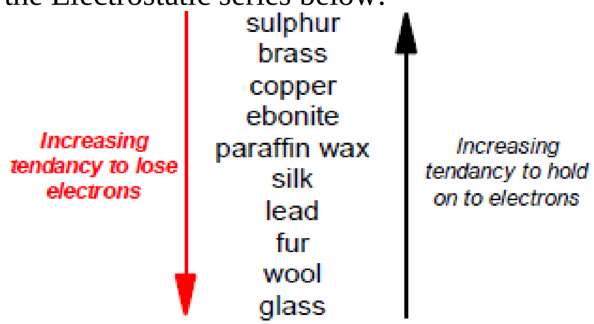
LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Distinguish between insulators and conductors in terms of movement of electrons	• Insulators are materials do not allow the movement of electrons readily through the material e.g. rubber, glass. It is easy to place an electrostatic charge on an insulator because the charge does not move easily. • Conductors are materials that allow the movement readily through the material e.g copper, silver. In order to charge a conductor, that conductor should be isolated by an insulator.	Students can test various materials to see whether they are insulators or conductors by using the circuit diagram below:  ✓ If the ammeter registers a reading then the material is a conductor. ✓ If the ammeter does not registers a reading then the material is an insulator.	Battery / power supply, connecting wire, ammeter, voltmeter and several insulators and conductors.	Practical Assessment: selection and use of materials; measuring, recording and processing data; formulating conclusions; communicating information and making predictions

SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTROSTATICS - ELECTRIC FIELDS **DURATION: ½ WEEK**

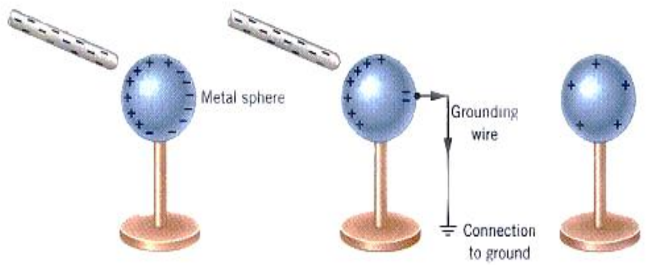
LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Explain the factors determining field strength (quantity of charge, distance of separation from source charge). • Illustrate electric lines of around point charges and charged plates .	An electric field surrounds an electric charge, and exerts force on other charges in the field, attracting or repelling them. Electric field lines of force may be used to visually represent the vector nature of an electric field. The lines are directed away from positively charged source charges and toward negatively charged source charges. Each line must include an arrowhead that points in the appropriate direction.  The strength of an electric field is indicated by how close the field lines are to each other. 	Interactive Simulations: https://phet.colorado.edu/en/simulation/charges-and-fields https://phet.colorado.edu/en/simulation/legacy/electric-hockey Think –Pair- Share: In pairs, students draw magnetic field patterns between similar and opposite point charges and plates	Internet Computer	Communicating information gleaned from interactive simulations Presenting and explaining electric field lines drawn during think-pair-share activity

SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM
TOPIC: ELECTROSTATICS - CHARGING AND DISCHARGING MATERIALS **DURATION: 1 ½ WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	When a positively charged object is brought near a neutral object, it induces a negative charge on the near side of the object and a positive charge on the far side. This causes the positively charged object to attract the neutral one. 			.
• Describe and demonstrate charging by friction e.g. balloons, ebonite rod, polythene	It is possible to charge an object positively or negatively. One way to do this is by rubbing two different materials together, a process known as charging by friction. Since the two objects are made of different materials, their atoms will hold onto their electrons with different strengths. The strengths with which materials hold onto electrons is shown by the Electrostatic series below:  http://www.studyphysics.ca/2007/30/06_forces_fields/08_charging.pdf	Students can practice charging by friction using polythene rods, acetate rods, duster cloth, balloons strings, bits of paper, electroscope	A polyethene rod, an acetate rod, a duster cloth, balloon, string and an electroscope	Practical Assessment: selection and use of materials; measuring, making observations; formulating conclusions and communicating information

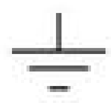
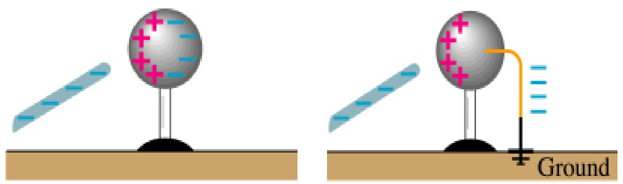
SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTROSTATICS - CHARGING AND DISCHARGING MATERIALS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe the charging of objects and electroscopes by electrostatic induction and by contact.	 • The negatively charged rod is brought near the sphere. It pushes electrons to the back side of the sphere. • The ground wire is then connected to the sphere (or you can touch the sphere) resulting in the electrons moving to ground. • The ground wire is disconnected to prevent the return of the electrons from ground, and then the rod is removed. • The sphere is now positively charged • Induction can similarly be used to charge an object negatively by using a positively charged rod. • **Charging by contact:** Rub an insulator to charge it up. Then stroke it across the top plate of the electroscope. This will transfer charge from the insulator to the electroscope. The charge left on the electroscope will not always leave it fully deflected.	Students can practice charging an object positively or negatively by induction or by contact using an electroscope (or a metal sphere connected to an insulator). Interactive simulation: https://www.physicsclassroom.com/mmedia/estatics/isop.cfm	An electroscope, a polyethene rod, an acetate rod and a duster cloth.	Practical Assessment: selection and use of materials; making observations; formulating conclusions and communicating information

SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

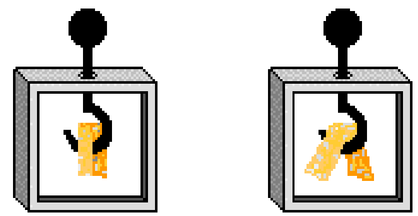
TOPIC: ELECTROSTATICS - CHARGING AND DISCHARGING MATERIALS

<table>
<tr><th>LEARNER OUTCOMES</th><th>CONTENT</th><th>ACTIVITIES</th><th>RESOURCES</th><th>METHOD OF ASSESSMENT</th></tr>
<tr>
<td>Describe the discharging of positive and negative charges by earthing (grounding)</td>
<td>Symbol for earth:

The build-up of static charge on an object can be eliminated by grounding (or earthing). This is accomplished by connecting the object via a conductor to the ground. The diagram illustrates how a negative charge can be grounded:

If a negatively charged object is grounded, electrons flow from that object to earth.
If a positively charged object is grounded, electrons flow from earth to that object</td>
<td>Students can practice grounding when discharging an electroscope

Interactive simulation:
https://www.physicsclassroom.com/class/estatics/Lesson-2/Grounding-the-Removal-of-a-Charge</td>
<td>An electroscope, a polyethene rod, an acetate rod and a duster cloth.</td>
<td>Practical Assessment: selection and use of materials; making observations; formulating conclusions and communicating information</td>
</tr>
</table>

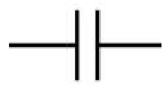
SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTROSTATICS - DETECTING THE PRESENCE OF CHARGE **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe the use the electroscope to detect the presence of a charge and the sign of charge on objects	• An electroscope can be used to detect the presence of a charge, by induction and by contact. • If a positive or negative charge is brought near an uncharged electroscope the leaf will deflect by induction. • Similarly, if a charged object is brought near an electroscope of the same charge, the deflection of the leaf will increase. • This increase in deflection is the only sure way of testing a charge because both an uncharged object and one of the same charge will cause a decrease in deflection.  Relaxed Leaves Neutral Deflected Leaves Charged	Demonstration of the use of the electroscope in collaborative groups Engaging in interactive simulation: https://www.physicsclassroom.com/mmedia/estatics/esn.cfm	Electroscope Charged rods (polythene, Perspex)	Practical Assessment: selection and use of materials; making observations; formulating conclusions; communicating information and making predictions Communicating information: students oral report on simulation

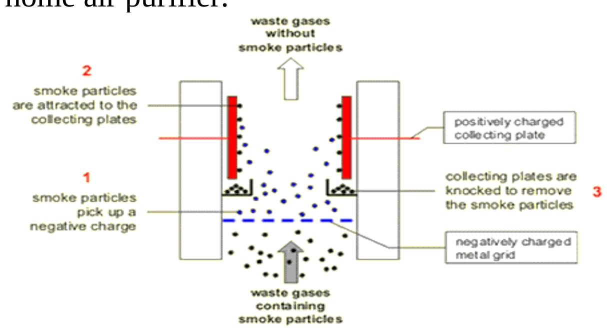
SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTROSTATICS - CAPACITANCE **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe the capacitor as a device used to store charges (energy). • Describe the construction of a simple capacitor.	A capacitor is a device that stores electrical energy. Inside the capacitor, the terminals connect to two metal **plates** separated by **a non-conducting substance,** or **dielectric**. Symbol:  A simple capacitor can be built from two pieces of aluminum foil and a piece of paper. It won't be a particularly good capacitor in terms of its storage capacity, but it will work.	Students can build a simple capacitor using the materials listed on the left. ✓ Cut two 1" square pieces of aluminum foil. ✓ Cut about five 1" square pieces of paper. ✓ Place the sheets of paper between the two sheets of aluminum foil. ✓ In the centre of the two sheets of aluminum foil, via the wires, connect to the battery. (For safety, do not exceed 3V as indicated on the weblink below) http://sciencewithkids.com/Experiments/Energy-Electricity-Experiments/how-to-make-a-capacitor.html	Sheets of aluminum foil, paper, connecting wire and a battery (3V)	Student model of capacitor assessed using rubric for accuracy, creativity and functionality
• Relate capacitance to the quantity of charge (energy) stored and Identify the Farad as the unit for capacitance (qualitative only)	A capacitor's storage potential, or **capacitance**, is measured in units called **farads**. A 1-farad capacitor can store one coulomb of charge at 1 volt. An ideal capacitor is characterized by a constant capacitance *C*, defined as the ratio of charge $\pm Q$ on each conductor to the voltage *V* between them: $$C = \frac{Q}{V}$$	Numerical problem solving of the following types using C=Q/V: Engaging in interactive simulation: https://phet.colorado.edu/en/simulation/capacitor-lab-basics https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/capacitor	Worksheets Internet	Solutions to problems presented Students oral report on simulation

SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

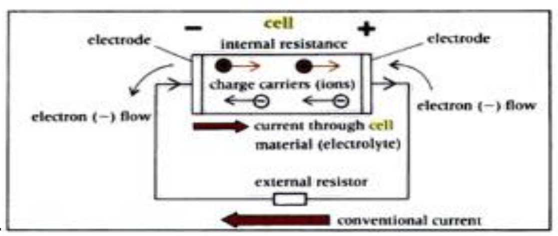
TOPIC: APPLICATIONS, HAZARDS AND SAFE USE OF STATIC ELECTRICITY **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe applications; hazards, and their associated safety procedures of electrostatics, e.g. capacitors, spark plugs, lightning and lightning conductors, gas lighters, photocopying devices, painting of automobiles, electrostatic precipitation.	***Practical Uses of Static Charges*** The ability of opposite charges to attract each other (or for a charged object to attract an uncharged object) in static electricity is what's used when designing applications for it. Here are a few examples: ✓ **Dust removal:** There are some appliances that can eliminate dust from the air, like air purifiers. They use static electricity to alter the charges in the dust particles so that they stick to a plate or filter of the purifier that has an opposite charge as that of the dust (opposite charges attract each other). This effect is also used in industrial smokestacks to reduce the pollution that they generate, although they work in a very large scale, the effect is basically the same as the home air purifier.  From BBC - Electrostatic Precipitators	**Student research** Students do research on the following: - The applications of static electricity in everyday life - The hazards of static electricity - Safety procedures commonly observed when dealing with static charges Debates/ Think-Pair-Share/ Cooperative Learning: Applications, hazards and safety of electrostatics Viewing of YouTube Videos Engaging in Interactive online simulations: http://phet.colorado.edu/en/simulation/travoltage https://phet.colorado.edu/en/simulation/legacy/travoltage https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/van-de-graaff-generator	Internet Many of the concepts and activities in this topic are treated quite clearly in *Complete Physics for IGCSE* by S. Pople.	**Collaborative Student Presentations and reports in one of several modes –** Information and Communication Technology (Power Point, flyers, brochures, blogs), Oral (speech, song, rap, news bulletin, public service announcement), Visual (cartoons, tri-fold, posters, video) Presentations

	✓ **Photocopying:** The photocopier or Xerox machine uses static electricity to copy print to a page. This is done through the science of xerography. One version of this device electrically charges ink so that it will stick to the paper in the designated areas. Another version of a photocopier uses charges to stick the ink to a drum, which then transfers it to the paper. ✓ **Car painting:** To make sure a car's paint is uniform and that it will resist the high speeds and weather to protect the car's metal interior, it is applied with a static charge. The metal body of the car is submerged in a substance that charges it positively, and the paint is charged negatively with the paint sprayer. This process ensures a uniform layer of paint. **Hazards of Static Electricity** The main hazards of static electricity are: ✓ the creation of sparks in an explosive or flammable atmosphere. These sparks can set off an explosion or fire. The danger is greatest when flammable liquids are being poured or transferred. ✓ the risk of electric shock. If the static charge build up is high, it can be discharge (dissipate) via a spark. This can be dangerous or lethal. Most static electricity control measures provide ways for the static charges to discharge (dissipate) harmlessly before sparks occur. Some ways to prevent static charges from accumulating on materials are: grounding; humidification; static collectors and additives.			

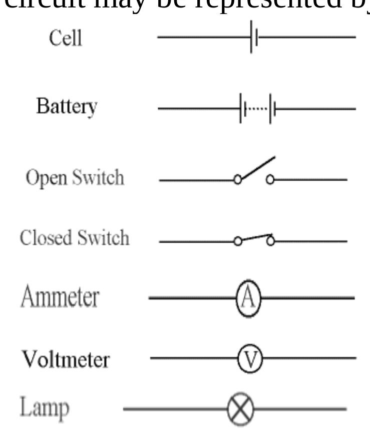
SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: CURRENT ELECTRICITY - THE SIMPLE VOLTAIC (GALVANIC) ELECTRICAL CELL **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• discuss the function, parts of operation of a simple cell	The simple voltaic (or galvanic) electrical cell, is an electro-chemical device which converts chemical energy into electrical energy. It consists of two electrodes (terminals) made of different materials and an electrolyte. When a cell is a part of a complete circuit, positive ions and electrons are generated at the negative electrode. The positive ions flow into *into* the electrolyte, while the electrons take the easiest path to the positive electrode by flowing around the outside circuit. At the positive electrode, incoming electrons recombine with ions taken *out* of the electrolyte, so completing the circuit. Conventional current leaves the electrode labelled +, flows through the external circuit, and returns to the other terminal labelled  - pg 264 Physics for CXC Avison The exact reactions depend on the materials from which the electrodes and electrolyte are made. As a cell generates power, the chemicals inside it are gradually converted into different chemicals and its voltage slowly falls. The typical output of a simple cell varies from 0 to 6V.	<u>Laboratory Practical</u> Making a lemon battery Think-Pair-Share: Why are the electrodes made of different materials? Research: Conduct research on the different type of batteries and their associated scientists. Create a time-line of findings https://www.explainthatstuff.com/batteries.html **Interactive Simulations:** https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/simple-electrical-cell https://phet.colorado.edu/en/simulation/legacy/battery-voltage	Galvanized nail (zinc) Ungalvanised nail Lemon Multimeter(ammeter/voltmeter) LED lamp Connecting wires Textbook Internet	Practical Assessment: selection and use of materials; making observations, formulating conclusions and communicating information Probing questions Student presentations of research findings and think-pair-share brainstorming activity

SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: CURRENT & CIRCUIT SYMBOLS **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Current electricity • Define current as the rate of electron flow (charge) measured in coulombs per second and use $I = \frac{Q}{t}$ to solve Problems	Current is defined as the rate of flow of electrons (the quantity of charge) around an electric circuit. $I = \frac{Q}{t}$ It is measured in Amperes or Coulombs per second.	Laboratory Practical Students construct circuit and measure the amount of current using an ammeter. Worksheet: Students complete worksheet: calculations involving Q = It **Interactive Simulation:** https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc-virtual-lab	Textbook Worksheets Internet LCD projector Laptop Student electricity apparatus sets (circuit boards, power supply, connecting wire, bulb, switch, ammeter) Worksheet: Calculations involving Q = It	Practical Assessment: selection and use of materials; measuring, recording and processing data; formulating conclusions and communicating information Solutions to Worksheet
• Use circuit symbols and describe circuit components, symbols, and functions (including switches, fuses, resistors, variable resistors, filament lamps)	A circuit refers to the arrangement of electrical components. Each component in a circuit may be represented by symbols e.g. 	Matching Game: Students participate in a game of matching, in order to correctly link the symbol to the component using concrete objects or pictures	Worksheet Matching Circuit Symbols Construction paper Markers Concrete objects PowerPoint	Written Assessment Oral questions

SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: POTENTIAL DIFFERENCE & RESISTANCE **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Define potential difference as the work done or energy transferred per unit charge passed between any two points ($V = \frac{W}{Q}$)	The potential difference measures the amount of work done or the energy converted per unit charge passed between two points. $V = \frac{W}{Q}$ Voltage, also called potential difference, or p.d. is measured using a voltmeter. The unit of potential difference is the volt (V).	Laboratory Practical Students construct circuit and measure the amount of voltage across components using the voltmeter. **Interactive Simulation:** https://phet.colorado.edu/en/simulation/legacy/battery-voltage	Student electricity apparatus sets (circuit boards, connecting wire, bulb, switch, ammeter)	Practical Assessment: selection and use of materials; measuring, recording and processing data; formulating conclusions and communicating information
• Define resistance as the opposition to the flow of electrons through a conductor. • State and investigate factors which affect resistance of a conductor. (cross-sectional area, length, type of material, temperature)	Resistance is the opposition to the flow of electrons through a conductor. Resistance is dependent on several factors such as: thickness (cross-sectional area), length, the nature (material) of the conductor and temperature.	**Laboratory Practical** Students investigate the effect of (i) Length (ii) Thickness (iii) Type/ nature of conducting material on resistance Note: All other variables are held constant, except variable being investigated. **Interactive Simulations:** https://phet.colorado.edu/en/simulation/resistance-in-a-wire https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/rheostat	Wires of different thickness Wires of different types Wires of different lengths Power pack Ammeter Voltmeter 1 meter ruler 110cm of wire Crocodile clips	Practical Assessment: selection and use of materials; identifying and holding variables constant; measuring, recording and processing data; formulating conclusions and communicating information

SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: OHM'S LAW **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Use instruments to accurately measure current and voltage. • Describe why (a) an ammeter should have a very low resistance and positioned in series (b) a voltmeter should have a very high resistance and positioned in parallel circuitry.	Current is measured by an ammeter. Ammeters have low resistance so that they could measure circuit current without affecting its value. Voltmeters measure voltage across two points. It has very high resistance ad is always connected in parallel with the component so that minimum current flows through it.	Practical Assessment Students construct circuit and measure the current at different points and the voltage across components using the voltmeter. **Interactive Simulation:** https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc-virtual-lab	Student electricity apparatus sets (circuit boards, connecting wire, bulb, switch, ammeter, power pack. battery)	Practical Assessment: selection and use of materials; measuring, recording and processing data; formulating conclusions and communicating information.
• State Ohm's law ($R = \frac{v}{I}$) and apply it to solve problems (including graphical problems).	Resistance (R) is measured in Ohms (Ω) and may be calculated by the equation $R = \frac{V}{I}$ (Ohm's Law) where V= voltage and I = current. Ohm's law states the current is proportional to potential difference applied, provided that the temperature of the conductor remains constant.	**Laboratory Practical** Students design and construct a test circuit with a voltmeter connected parallel, an ammeter in series and a rheostat to determine resistance of a given circuit component Worksheet: Students apply Ohm's Law to solve calculations **Interactive Simulations:** https://phet.colorado.edu/en/simulation/ohms-law https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/rheostat	Student electricity apparatus sets (circuit boards, connecting wire, bulb, switch, ammeter)	Practical Assessment: selection and use of materials; identifying and holding variables constant; measuring, recording and processing data; formulating conclusions and communicating information Written assessment (quiz, worksheet)

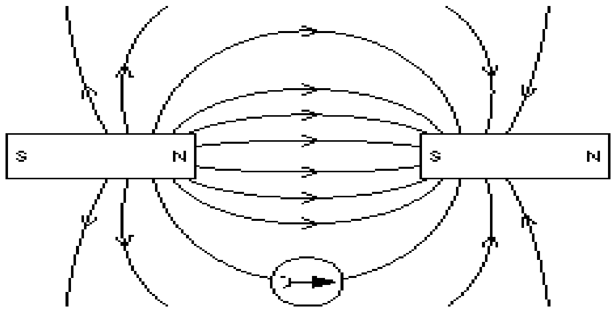
SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: MAGNETISM – MAGNETIC FIELDS AND THEORY **DURATION: 1½ WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Identify the poles of a magnetic dipole by suspending it freely in the earth's magnetic field	All magnets have two poles: a **'north-seeking'** or **'N'** pole, and a **'south-seeking'** or **'S'** pole. When a magnet is allowed to move freely by being suspended, it always comes to rest roughly in a north–south direction. The north-seeking (N) pole points towards the northern end of the Earth while the south-seeking (S) pole points to the southern end of the Earth.	Practical Activity Suspend bar magnet using a wooden clamp stand or wooden table and allow t to come to rest. https://phet.colorado.edu/en/simulation/legacy/magnet-and-compass	Bar magnet Thread Wooden Clamp stand	Practical Assessment: selection and use of materials; making observations, formulating conclusions and communicating information
• Classify materials as magnetic and non- magnetic.	Magnets only attract strongly certain materials (ferromagnetics) such as iron, steel, nickel and cobalt, and their alloys	Use magnets to test and classify materials as magnetic or non-magnetic.	Magnets, Assorted materials (iron, brass, copper, lead, steel, gold, silver, nickel, nickel, aluminium, cobalt)	Practical Assessment: selection and use of materials; making observations, recording data; formulating conclusions and communicating information
• Describe the domain theory	Magnets are made up of groups of atoms called **domains**, which behave like magnets within magnets. A magnetic domain is a region in a ferromagnetic material where each atom acts as a small magnet called a dipole. They are grouped together in domains. Domains in an un-magnetised ferromagnetic material are arranged in random directions (haphazardly). When the ferromagnetic material is exposed to a magnetic field, the domains line up in the magnetic field. All the north poles point in the same direction.	**Interactive Simulation** https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/magnetic-domains Making Models simulating domain theory Drawing magnetic domains in un-magnetized and magnetized ferro-magnetic materials.	Internet Paper, markers, pencils	Probing Questions Model assessed for accuracy and creativity.

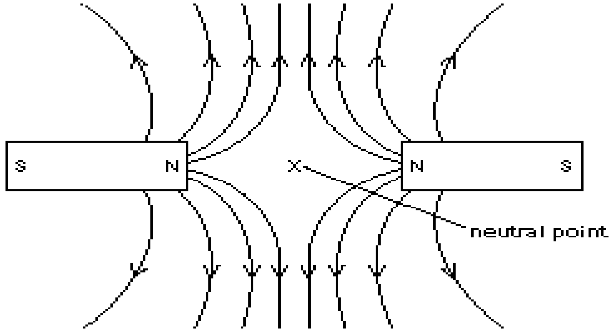
SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: MAGNETISM – MAGNETIC FIELDS AND THEORY

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Explain the factors determining field strength (closeness of poles, alignment of domains).	Magnetic field refers to the space around a magnet, which produces a magnetic force. (i.e. the area where magnetism acts). The strength of a magnet is determined by how well the domains are lined up. When all the domains are lined up, is termed a saturated magnet and therefore cannot get any stronger. The closer the poles the stronger the magnetic field strength.	Interactive Simulations: http://www.s-cool.co.uk/gcse/physics/magnetism-and-electromagnetism/magnetism.html https://phet.colorado.edu/en/simulation/legacy/magnets-and-electromagnets Practical demonstrations	Internet Projector Computer	Oral reports by students along with in-class demonstration
• Illustrate magnetic lines of force for a bar magnet and between poles of two bar magnets.	Iron fillings may be used to determine the shape of the magnetic field. The magnetic field is represented by field lines or lines of force. When two bar magnets with unlike poles face each other, attraction occurs. North and south poles attract. The field lines go from the N pole of one magnet to the S pole of the other. 	Plotting magnetic fields around magnets (bar, disc, horseshoe) to determine shape and strength of magnetic field Identify the north pole and south poles of magnets. Alternatively bring poles together to observe when attraction or repulsion occurs. Plot field lines between opposite poles. Use plotting compass to determine direction of field lines. Draw magnetic field patterns between magnets with opposite poles facing each other.	Magnets (bar, disc, horseshoe) Iron fillings Paper Bar magnets Plotting compasses Iron fillings paper	Practical Assessment: selection and use of materials; making observations; processing data; formulating conclusions and communicating information Oral report by students along with in-class demonstration Written Assessment • Quiz Worksheet

SCOPE OF WORK
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

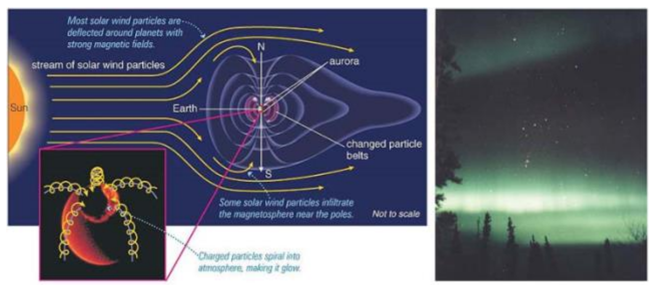
TOPIC: MAGNETISM – MAGNETIC FIELDS AND THEORY

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	When similar poles of two magnets face each, (N pole to N pole) or (S pole to S pole), repulsion occurs. The single point in the centre in between the two similar poles is a neutral point. At this point, the field due to one magnet cancels out that due to the other and there are no lines of force.  	Plot field lines between similar poles. Use plotting compass to determine direction of field lines Draw magnetic field patterns between magnets with similar and opposite poles facing each other. **Interactive simulation:** https://phet.colorado.edu/en/simulation/legacy/magnets-and-electromagnets	Bar magnets Plotting compasses Iron fillings paper	Practical Assessment: selection and use of materials; making observations; processing data; formulating conclusions and communicating information Oral report by students along with in-class demonstration Written Assessment • Quiz • Worksheet

SCOPE OF WORK

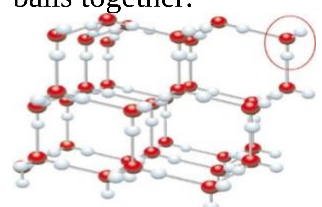
GRADE: 10
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: MAGNETISM –APPLICATIONS OF EARTH'S MAGNETIC FIELD **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Describe the importance of the earth's magnetic field to life on earth (bird navigation, deflection of charged particles from the sun)	The Earth's strong magnetic field creates a magnetosphere that acts like a protective bubble surrounding our planet (see part a in figure below). The magnetosphere deflects most of the charged particles from the Sun around our planet. Charged particles trapped in the magnetosphere also create the beautiful spectacle of light, known as auroras (see part b in figure below).  **a** This diagram shows how Earth's magnetosphere deflects solar wind particles. Some particles accumulate in charged particle belts encircling our planet. The inset is a photo of a ring of auroras around the North Pole; the bright crescent at its left is part of the day side of Earth. **b** This photograph shows the aurora near Yellowknife, Northwest Territories, Canada. In a video, you would see these lights dancing about in the sky. Source: *Cosmic Perspective* by Bennett, Donahue The magnetosphere still allows a few solar wind particles to get through, especially near the magnetic poles. Once inside the magnetosphere, these particles move along magnetic field lines, collecting in charged particle belts that encircle our planet. (These belts are often called the Van Allen belts after their discoverer.) The high energies of the particles in charged particle belts can be hazardous to spacecraft and astronauts passing through them	Conducting research on the importance of the earth's magnetic field (magnetosphere) Viewing videos/simulations of the earth's magnetic field.	Source: *Cosmic Perspective* by Bennett, Donahue	Research Project Oral reports by students

SCOPE OF WORK
GRADE: 10
UNIT: THE ATOM & NUCLEAR PHYSICS

TOPIC: THE ATOM **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
1 THE ATOMIC THEORY • State the Atomic Theory	**The Atomic Theory:** According to the Atomic Theory - Matter is made up of tiny particles. - The particles cannot be destroyed by chemical means. - Atoms of the same element are alike; atoms of different elements are different. **Definition of an element** An element is a substance that is made up of one kind of matter only (e.g. aluminium and sulphur are elements because the former consists of aluminium only and the latter sulphur only; water is not an element since it consists of two different kinds of substances, hydrogen and oxygen). **Definition of atom** An atom is the smallest particle of an element that retains the chemical properties of the element.	**1. Making and displaying models** (What the Atomic Theory puts forward is a particle model of matter. There are other models (e.g. wave-probability model). Using polystyrene balls you (or students) can make and display models of - elements (similar balls stuck together) - substances that are not elements but combinations of elements e.g. ice (the building block water molecule model should also be pointed out) **2 Looking at "photographs" of atoms** (note that these are not photographs taken with light, so they do not represent what atoms look like; the "pictures", taken with special devices only provide evidence to support the particle model of matter).	Models depicting matter being made up of atoms These could be made ahead of time or during class time, using polystyrene balls of at least two different sizes and some method of attaching polystyrene balls together.  Model of ice (made up of H_2O molecules) http://www.oup.co.uk/oxed/children/oise/pictures/atoms/ice/' "Photographs" of atoms "Picture" of atoms (e.g.) http://www.physik.uni-augsburg.de/exp6/imagegallery/afmimages/atoms.jpg *Physics for CSEC*, by Farley and Trotz, ch. 35	Statement of Atomic Theory Definition of element Definition of atom Identifying atoms in pictures and models Making of atomic models of matter

SCOPE OF WORK
GRADE: 10
UNIT: THE ATOM & NUCLEAR PHYSICS

TOPIC: THE ATOM

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
2 STRUCTURE OF THE ATOM • Describe the importance of alpha particle scattering experiments with regard to the structure of the atom	**The Geiger-Marsden Experiment (Geiger and Marsden were Rutherford's research assistants)** In this experiment, positively charged alpha (α) particles (helium nuclei) were aimed at very thin sheets of gold foil. - The fact that most of the particles went straight through the foil suggested that most of the atom was an empty space. - Since and only a few alpha particles were scattered, this suggested that: an atom has a very heavy, but very tiny, positively charged part (which is now called the nucleus). The experiment confirmed that the atom contained a positively charged, but heavy and tiny nucleus. The experiment showed that an existing "plum pudding" model of the atom, where positive charge in the atom was assumed spread out as a cloud within the atom, could not be correct.	**1 Simulation of αlpha particle scattering** Show students how to operate the simulation. There are two models being simulated – paths taken by alpha particles according to a nuclear (Rutherford) model, and also according to a "plum pudding" model - Most of the alpha particles show straight, or nearly straight, paths. - Very few are deflected backwards, confirming the Rutherford model. - All the alpha particles go straight through in the plum pudding model. This shows that there are no heavy, positive scattering centres.	**Alpha-particle scattering simulation** Click on the link below. **http://phet.colorado.edu/simulations/** Then type 'Rutherford scattering' in the search bar and click on the simulations link that shows up. Run both simulations for the Rutherford atom and the plum-pudding atom models. *Physics for CSEC*, by Farley and Trotz, ch. 35	Inferring location of nuclei from paths taken by alpha particles Predicting paths of alpha particles, given location of heavy nuclei Drawing and labeling the Geiger-Marsden apparatus

SCOPE OF WORK
GRADE: 10
UNIT: THE ATOM & NUCLEAR PHYSICS

TOPIC: THE ATOM

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe the structure of an atom (review: nucleus, proton, neutron, electron, orbits) • Describe the properties of sub-atomic particles	**Structure of the atom** In 1932, James Chadwick discovered the neutron in the nucleus. The neutron had almost the same mass as a proton, but had no charge. It is believed that neutrons help to keep the protons together in the nucleus (protons are positively charged and would have repelled each other, causing the nucleus to break up). The atom was now believed to be made up of a tiny, but heavy, nucleus, consisting of positively charged protons and zero charged neutrons; negatively charged electrons orbited the nucleus. Since atoms are neutral, the number of positive charges (protons) are equal to the number of negative charges (electrons). **Properties of sub-atomic particles** Charge Electron (-e) Proton (+e) Neutron (0) where $e = 1.6 \times 10^{-19}$ C Particles — Mass/kg — Mass units/u Electrons — 9.11×10^{-31} — 0 Protons — 1.67×10^{-27} — 1 Neutrons — 1.67×10^{-27} — 1	**2 Making / displaying polystyrene models of the atom** **3 Discussing diagrams of the simple atom from textbook** **4 Drawing diagrams of simple atoms** (showing: nucleus, protons, neutrons, orbits and electrons) **5 Discussion** Point out that - the proton and the neutron each has a mass that is about 2000 times that the mass of an electron - the mass unit, u, is 1/12 the mass of a carbon-12 atom and that 1 u = 1.66×10^{-27} kg. However, the values of these masses in kg do not need to be memorized.	Models depicting structure of the atom These could be made ahead of time or during class time, using polystyrene balls and wire ‘orbits’ containing ‘electrons’. *Physics for CSEC*, by Farley and Trotz, ch. 35 and ch. 36, p 505 Properties of sub-atomic particles See, for example, *Physics for CSEC*, by Farley and Trotz, ch. 36, p 503-504	Drawing an atom and labeling the parts Stating properties of sub-atomic particles on terms of e and u.

SCOPE OF WORK
GRADE: 10
UNIT: THE ATOM & NUCLEAR PHYSICS

TOPIC: THE ATOM

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
3. DESCRIBING THE NUCLEUS • Define the terms: atomic number (Z), mass number (A), neutron number (X)	**Numbers describing the nucleus** Atomic number (Z); the number of protons in the nucleus (this will also be the same as the number of electrons orbiting a neutral atom, and it is this number of electrons that determines the chemical character of each element). Mass number (A): the total number of particles (protons + neutrons) in the nucleus. The mass number gives an idea of the total mass of an atom, since the electrons have negligible mass. Neutron number (X): the number of neutrons within a nucleus. A simple reasoning shows that **A = Z + X**	1 **Building/displaying models of simple nuclei** (e.g He, C, N) 2 **Writing nuclear symbols** (using atomic number and mass number information from Periodic Table).	Models of nuclei These could be made ahead of time or during class time, using polystyrene balls and some method of gluing them together. Periodic Table *Physics for CSEC*, by Farley and Trotz, ch. 36, p 509	Defining atomic number, mass number and neutron number Using the equation A = Z + X Writing nuclear symbols (using atomic number and mass number information from Periodic Table).
	Nuclear symbols Nuclear symbols are written by placing the mass number as a superscript and the atomic number as a subscript on the left of the chemical symbol of the element. Thus, the carbon-12 nucleus is written as $^{12}_{6}C$, since the carbon-12 nucleus has 6 protons and 6 neutrons.	3 **Using the equation** **A = Z + X**		
• Define isotopes, noting that isotopes of the same element have identical chemical properties, and give examples of isotopes including radioisotopes	**Isotope** Isotopes of an element have atoms that have the same number of protons but different numbers of neutrons. Thus isotopes of an element have the same atomic number (hence the same chemical properties) but different mass numbers. Some isotopes are radioactive.	4 **Building/drawing models of isotopes** (e.g. C-12 and C-14)		Defining isotope Identifying isotopes (from Periodic Table)

SCOPE OF WORK
GRADE: 10
UNIT: THE ATOM & NUCLEAR PHYSICS

TOPIC: _RADIOACTIVITY **DURATION: 1½ WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
4 RADIOACTIVITY • Design and perform investigations on naturally occurring radioactivity in the environment	**Discovery of naturally occurring radioactivity** Natural radioactivity was discovered quite by chance in 1896 by the French scientist, Henri Becquerel. Shortly after, Ernest Rutherford, experimenting in Canada, and Marie and Pierre Curie, experimenting in France, investigated	**Investigations** In all investigations, we must pay attention to controlling variables. We suggest using only materials common to our environment as other radioactive materials are too dangerous for high school demonstrations or experiments.	Geiger-Muller tube attached to ratemeter or counter and metre rule Foodstuffs to be investigated - e.g. tea bags	Laboratory investigation designs and reports
• Account for the presence of background radiation. (cosmic rays, earth-minerals, foods, etc)	**Sources of naturally occurring radioactivity**: These include - cosmic rays (charged particles e.g. protons that reach the Earth from space; one source of cosmic rays is the Sun) - minerals that make up the Earth (especially, but not restricted to, those with large mass numbers e.g uranium-235) - foods, objects and living organisms (since these are made from minerals that come from the Earth)	**1 Measuring background radiation -** using a Geiger-Muller tube connected to a counter or ratemeter, you can measure the background radiation in places such as the lab or outdoors. **2 Other investigations** It is said that the food we eat does emit radiation. One such investigation is described in *Physics for CSEC*, by Farley and Trotz, p 575.	*Physics for CSEC*, by Farley and Trotz, ch. 37	
• Describe the detection of radioactive emissions using GM tube, ratemeter/counter and cloud chamber	**Detection of radioactivity** First detected (by Becquerel) by fogging that the emissions produced on photographic film. Later, other detectors were developed such as: the Geiger-Muller tube that could assist in determining the number of emissions detected and cloud chambers that could show the tracks of these emissions (through no fields or through electric or magnetic fields).	**3 Discussion** - how the GM tube works - how cloud chambers work	Geiger-Muller tube attached to ratemeter or counter Pictures of cloud chambers	Drawing labeled diagrams of GM tube and cloud chambers Outlining the functioning of the GM tube and ratemeter, and cloud chambers

SCOPE OF WORK
GRADE: 10
UNIT: THE ATOM & NUCLEAR PHYSICS

TOPIC: _RADIOACTIVITY

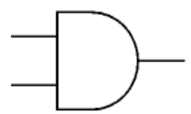
LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe and compare alpha, beta, gamma radiation in terms **of** their nature, penetration ability, ionization effects, deflection by electric & magnetic fields, speeds • Describe safety precautions to protect from harmful radiation	**Nature of radioactive emissions** Rutherford's investigations identified three types of emissions radiated from the nucleus: - alpha particles (helium nuclei) - beta particles (high speed electrons coming from the nucleus) - gamma rays (high energy electromagnetic waves emitted by the nucleus). **Harm caused by radioactivity** Radioactivity is extremely dangerous. What makes it so dangerous is that its effects are not usually felt at the time of contact but manifests later. - on entering living matter, alpha particles ionize matter, disrupting cell functioning; when they come to a stop, they also give up their energy and cause cells to overheat. Since alpha particles have short range, most of the damage is to the outer layer of the skin. - beta particles penetrate deeper into living tissue and also disrupt ionic reactions within cells - gamma rays are not only the most penetrating of the three, but also damage chromosomes, affecting cell functions, including reproduction Symptoms of radiation sickness include: loss of body hair, nausea, a feeling of exhaustion, drop in white blood-cell count and sterility after overexposure **Protection from harmful radioactivity** Clearly, only trained persons should be handling radioactive materials. Materials should be handled with tools - never with bare hands, lead aprons should be worn, sources should never be pointed toward users or other living organisms, monitoring devices and alarms should be present, there should be no eating or drinking, and radioactive materials must be locked away in lead containers when not in use.	**4 Discussion** Using the textbook, lead discussions on comparing the three types of radiations in terms of - nature - penetrating ability (ranges in different materials) - ionization effects - deflection by electric fields - deflection by magnetic fields **5 Discussion** Harm caused by radioactivity **6 Discussion** Protective measures when handling radioactive materials	Pictures from internet or books (showing harm caused to humans and other life forms by radioactivity) Pictures from internet or books (showing protective procedures and/or wear during handling of radioactive materials)	Inferring the signs of charges given the paths they take as they enter - electric fields - magnetic fields Predicting the paths of charges given the direction of fields they enter - electric fields - magnetic fields Describing harm caused by radiation Describing protective actions and wear when handling radioactive materials.

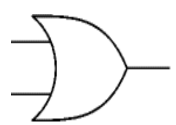
SCOPE OF WORK
GRADE: 10
UNIT: ELECTRONICS

TOPIC: SIMPLE ELECTRONIC CIRCUITS & LOGIC GATES **DURATION: ½ WEEK**

<table>
<tr><th>LEARNER OUTCOMES</th><th>CONTENT</th><th>ACTIVITIES</th><th>RESOURCES</th><th>METHOD OF ASSESSMENT</th></tr>
<tr>
<td>• Draw circuit symbols AND and OR gates.

• Construct a mechanical switching model of AND and OR gates and corresponding truth tables (using 2 inputs only).</td>
<td>Logic gates are elementary building blocks of digital circuits. They are the complex circuitry of number of transistors and resistors. Most logic gates have two inputs and one output. At any given moment, every terminal is in one of the two binary conditions low means 0(zero) or high 1(one), represented by different voltage levels.

• AND Gate
The output Q is true if input A AND input B are both true: Q = A AND B. An AND gate can have two or more inputs, its output is true if all inputs are true.

<table>
<tr><th>Input A</th><th>Input B</th><th>Input C</th></tr>
<tr><td>0</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>1</td><td>1</td></tr>
</table>
Symbol Truth Table

• OR Gate
The output Q is true if input A OR input B is true (or both of them are true): Q = A OR B. An OR gate can have two or more inputs, its output is true if at least one input is true.

<table>
<tr><th>Input A</th><th>Input B</th><th>Input C</th></tr>
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<tr><td>0</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>1</td></tr>
</table>
Symbol Truth Table
In most logic gates, the low state is approximately zero volts (0 V), while the high state is approximately five volts positive (+5 V).</td>
<td>Student activities can include designing and testing these monitoring systems

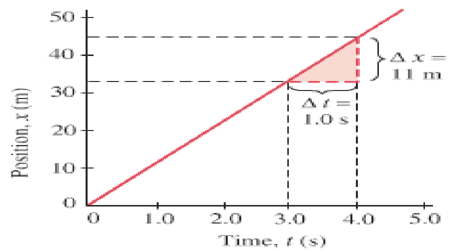
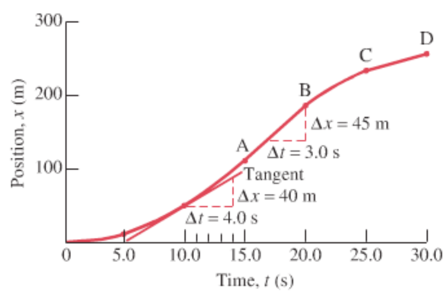
Students can design simple electronic circuits using readily available materials.</td>
<td>Snap Circuits®

Internet access</td>
<td>• Students can draw circuit diagrams for types of electronic circuits and then construct them.

• Worksheets exercises can be found on: http://www.scribd.com/doc/5370651/9-4-Logic-Gates-doc</td>
</tr>
</table>

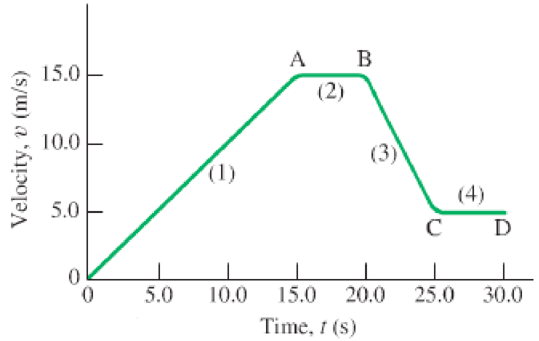
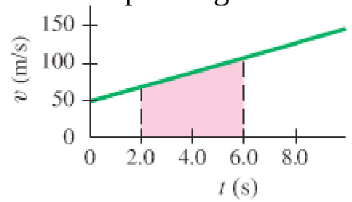
SCOPE OF WORK
GRADE: 11
UNIT: KINEMATICS IN ONE DIMENSION (STRAIGHT LINE MOTION)

TOPIC: LINEAR MOTION GRAPHS **DURATION: 1 ½ WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
GRAPHS OF MOTION • draw, interpret & use motion graphs (displacement-time and velocity-time) qualitatively and quantitatively to determine displacement, time, speed, acceleration etc	**Graphs of motion** **Position vs. time graphs** - The slope of a position vs. time graph gives the *velocity* of an object. If the graph is a sloping straight line, the velocity is constant.  The object is moving with a constant velocity of 11 m/s. - If the graph of a position vs. time is curved, the slope, and hence the velocity, is changing. The slope of the tangent line represents the velocity at a given time, i.e. the *instantaneous* velocity. 	**Simulations and corresponding graphs** (See information in the Resources column.) **In-class walking demonstrations followed by class discussions** A student can walk slowly next to a wall in the classroom. The wall is marked in 1m intervals. As the student passes each metre, students record the time. Then a graph of the walk is plotted. The following walks might be done: - slowly at constant speed from one wall to the next - slowly at constant speed, stopping for about 2 seconds, then resuming at the same speed to the other wall - slowly at constant speed from one wall, then turning back and walking to the starting point at the same speed. (The above activity might even be adapted to outdoors.)	**Colorado PhET simulations** file:///C:/Program%20Files /PhET/ simulations/sims0048.html ?sim=The_Moving_Man The *Moving Man* simulation found at the above link allows you to set initial velocity, initial position and acceleration. Three graphs are displayed as the simulation runs: - displacement vs. time - velocity vs. time - acceleration vs. time **Textbooks e.g.** *Physics for CSEC*, by Farley and Trotz, Chapter 7.	**Drawing/sketching of graphs** - from a motion (e.g. a walk) - from data given **Interpreting of graphs of motion** Obtaining the following from suitable graphs - a verbal description of the motion - displacement at a given time - displacement during a given time interval - instantaneous velocity - constant velocity - constant acceleration

SCOPE OF WORK
GRADE: 11
UNIT: KINEMATICS IN ONE DIMENSION (STRAIGHT LINE MOTION)

TOPIC: LINEAR MOTION GRAPHS **DURATION: 1 ½ WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	Velocity vs. time graphs - The slope of a velocity vs. time graph gives the acceleration of an object. If the graph is a sloping straight line, the *acceleration* is constant.  (1) constant positive acceleration (2) constant velocity (3) constant negative acceleration (4) constant velocity - The area under a velocity vs. time graph gives the *displacement* that took place during the corresponding time interval.  $\Delta x = 360$ m			

SCOPE OF WORK
GRADE: 11
UNIT: KINEMATICS IN ONE DIMENSION (STRAIGHT LINE MOTION)

TOPIC: ACCELERATION **DURATION: 1½ WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
EQUATIONS OF MOTION AT CONSTANT ACCELERATION • derive & manipulate equations of motion: $a = \frac{v2-v1}{t}$ $v_2 = v_1 + at$ ………………… (i) $x_2 = x_1 + v_1 t + \frac{1}{2}at^2$ ..………..(ii) $v_2^2 = v_1^2 + 2a(x_2 - x_1)$ ..……(iii) $v_{av} = x/t$ ……………..........(iv) $v_{av} = \frac{v_2 + v_1}{t}$ ………………..(v) to solve motion problems	**Equations of motion at constant acceleration** The equations (i) to (v) shown in the left column are equations of motion at constant acceleration. Students can be expected to derive equation (i) from the definition of acceleration. Teachers should go through the derivations of (ii) and (iii) (found in most textbooks) but not necessarily emphasize student derivations	**Solving Problems using Equations of Motion:** Review examples on pages 23 -25 *PHYSICS by GIANCOLI 6th edition* These can be taken from textbooks. However, the teacher must be careful to use examples that, initially at least, do not overwhelm the students.	**Textbook practice examples** *GCSE Physics* by Tom Duncan, pages 125 *PHYSICS by GIANCOLI 6th edition pages 23-25*	**Deriving** Students deriving at least equation (i) **Numerical problem-solving** Students use a methodical approach in solving problems involving equations (i) to (v).

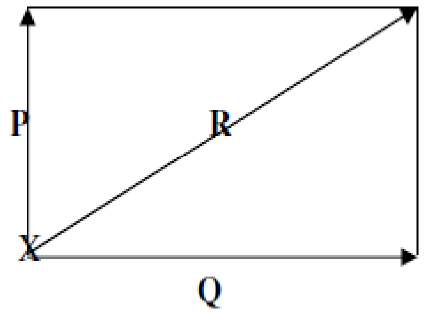
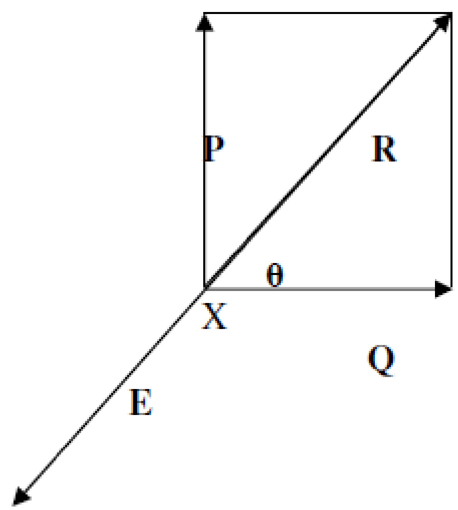
SCOPE OF WORK
GRADE: 11
UNIT: KINEMATICS IN ONE DIMENSION (STRAIGHT LINE MOTION)

TOPIC: ACCELERATION

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
DETERMINING ACCELERATION EXPERIMENTALLY • determine experimentally acceleration due to gravity using the free fall method	**Free fall** At the same location on Earth and in the absence of air resistance, all objects fall under the same constant acceleration. We call this acceleration, **acceleration due to gravity, g.** It has a value of -9.8 m/s2. So, the equations of motion can be applied to free falling objects, replacing a with g. For an object dropped from rest the equation $x_2 = x_1 + v_1 t + \frac{1}{2}at^2$ becomes $x_2 = \frac{1}{2}gt^2$ (x_1 is considered zero). Hence the distance travelled by the object is directly proportional to t^2. An object can be dropped from several different heights, each of which is timed. A graph of d vs. t^2 is then plotted, its slope is $\frac{1}{2}g$. **Free-fall methods for determining acceleration due to gravity, *g*** Free-fall methods typically involve very short time intervals and special equipment. Methods that can be tried include: - Simulations - Special free-fall timing equipment - Ticker-tape equipment - Cell phone, digital camera or camcorder	**1 Simulations** A fun simulation is the Colorado PhET *Vacuum Drop*, where objects are dropped from a given height near the surface of a planet and the time taken to reach the surface is read. The values for *g* near the surface of each planet can be calculated using equation (ii). **2 Special free-fall timing equipment** These include photogates and ball-and-pad equipment connected to a millisecond timer. These can be used in a teacher demonstration and the students calculate *g* using equation (ii). They can test if the mass of the falling object makes a difference to the value for *g*.	**Free-fall simulations** http://phet.colorado.edu/teacher_ideas/view-contribution.php?contribution_id=88 Run the *Vacuum Drop* simulations. **Special free-fall timing equipment**	**Calculating *g* from experimental data**

SCOPE OF WORK
GRADE: 11
UNIT: FORCES

TOPIC: FORCES AS VECTORS **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Determine the resultant of perpendicular forces.	 (Point out to students that a rectangle is a parallelogram.) 	(**Caution: this must be done so that in no way the paper can move in the direction of any student when the paper is released by the teacher.)** Students can be asked to predict the direction of the paper before the teacher lets go of it. Students are told that the paper moves in the direction of the resultant force. **Finding the resultant of two forces acting at a right angle to each other (two methods)** • By scale drawing • By Pythagoras' Theorem to find the magnitude of **R** and using the tan to find the direction (the angle between **R** and **Q**).	Rubber band Small, folded paper *Physics for CSEC*, by Farley and Trotz, ch. 5	**Determining resultant of two forces at right angles to each other** • By scale drawing • By Pythagoras' Theorem **Lab report**

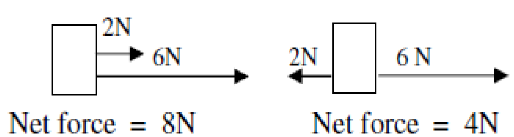
SCOPE OF WORK
GRADE: 11
UNIT: FORCES

TOPIC: HOOKES LAW **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• State Hooke's law • Draw and interpret load extension graphs.	(Robert) Hookes Law states: "If a force does not extend a spring beyond its elastic limit, the extension of a spring is directly proportional to the stretching force." $F_s=k\Delta l$ $\Delta l=l_s-l_o$ where: Fs = the stretching force k = the spring constant (specific for every spring); given by the slope of a load-extension graph Δl = the change in length of the spring ls = (extension) the added length of the spring due to the stretching force lo = the length of the unloaded spring (no mass attached) The graph of extension against load(force) for a spring is a **linear** graph below its elastic limit. The spring constant is given by the gradient (rise/run) of the graph. The curved portion of the graph below shows that the spring that has been stretched beyond its elastic limit.	Draw load extension graphs, Numerical problem solving: Calculating extension and spring constanr Hooke's Law experiment 1. Measure the length of an unloaded spring 2. Load spring and measure new length 3. Calculate extension. 4. Repeat for different loads.	Rulers Spring Clamp and stand Graph paper	Observations Lab report Quiz

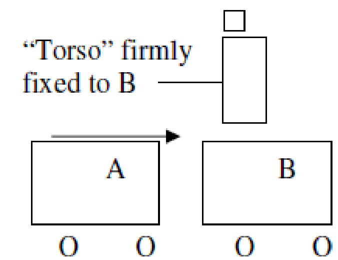
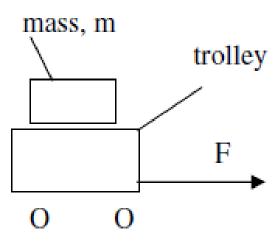
SCOPE OF WORK
GRADE: 11
UNIT: FORCES

TOPIC: NEWTONS LAWS **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
HISTORY • Describe the importance of one aspect of the work of each of the following scientists in the area of linear motion: **Isaac Newton**, **Galileo**. **NEWTON'S FIRST LAW** • State Newton's First law of motion. • Define inertia. • Illustrate on diagrams, all forces acting on an object. • Identify and model examples where Newton's first law is demonstrated. (use of seat belts, &head rests in vehicles.)	**Newton's First Law of Motion** Every object remains in its state of rest or of uniform motion in a straight line, unless a net force acts on it. **Inertia** Inertia is the tendency of an object to remain at rest, if originally at rest, or to continue its state of uniform motion in a straight line. Mass is a measure of an object's inertia. The more mass an object has, the greater its inertia. **Net force** When forces are parallel to each other, the net force is the sum. When they are anti-parallel, the net force is the difference. 	**1 Student reading/internet research** Find out two experiments Galileo did that showed that Aristotle's ideas of motion were wrong. **2 Student reading/internet research** Find out three things for which Issac Newton was famous. **3 Demonstrations of inertia** (a) Place a coin on a cardboard over an open plastic cup. Quickly pull the cardboard off the cup. The coin falls into the cup because its inertia - its tendency to remain at its original position when the cardboard was quickly pulled away. If the cardboard is pulled slowly, the coin does not fall into the cup. This is because the force has enough time to change the coin's position of rest. (b) Place a suitable object (e.g. a board eraser) on a trolley. Set the trolley moving on a horizontal surface with the object on it. When the trolley bumps into a fixed object (e.g. a heavy book), the board eraser falls forward. You can discuss this observation in terms of inertia and also with the need for a seatbelt.		**Student presentations to class on** - Galileo - Newton **Calculation of net force** - parallel forces - anti-parallel forces **Hypothesizing** - reason for board eraser "flying forward" after trolley has come to a stop

SCOPE OF WORK
GRADE: 11
UNIT: FORCES

TOPIC: NEWTONS LAWS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
NEWTON'S SECOND LAW (in terms of acceleration) • State Newton's second law of motion in terms of acceleration. • Investigate the relationship between mass, applied force and acceleration • Manipulate and use the relationship Force =mass x acceleration to solve problems	**Equilibrium** When the net force on an object is zero, the object either stays at rest or moves in a straight line with constant speed. We say that such an object is in equilibrium. The diagrams show two cases of equilibrium and the forces involved. **Newton's Second Law of Motion (in terms of acceleration)** The acceleration of an object is directly proportional to the net force acting on it and inversely proportional to its mass. In equation form, a = F/m or **F = ma .... (1)** **Definition of the newton** The newton of force is defined using equation (1) above. 1 newton is the force that gives a mass of 1 kg an acceleration of 1 m/s².	(c) Using blocks of wood or metal, make a "torso" with a "head" and a "neck". Fix the body on a trolley so that the body cannot move in the trolley. Let a trolley A collide with B, which is at rest but is free to move. The "head" jerks back because it wants to remain where it was originally, i.e. because of the head's inertia. The jerking causes whiplash, a crushing of tender bones and nerves in the neck. Discuss the role of head rest in cars. **4 Demonstration of Newton's Second Law** The apparatus on the right can be used to demonstrate Newton's Second Law qualitatively. - A constant force F is applied to a trolley of mass m by means of a spring balance. The acceleration is observed. The trolley is loaded so as to double the mass and the same force F is applied. The acceleration becomes reduced. - Using a constant mass the force F is doubled and the acceleration observed. The acceleration increases.	"Head" attached with tape at the back to the "torso". The tape represents the flexible "neck".  	**Hypothesizing** - reason for "head" jerking backwards when trolley B hits stationary trolley A." **Student observations** - a larger mass gives rise to a smaller acceleration for the same force. - a larger force gives rise to a larger acceleration for the same mass

SCOPE OF WORK
GRADE: 11
UNIT: FORCES

TOPIC: NEWTONS LAWS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
NEWTON'S THIRD LAW • State Newton's third law of motion • Identify and model examples where Newton's Third Law is demonstrated. (launching rockets etc.)	**Newton's Third Law of Motion** If an object A exerts a force on an object B, the object B exerts an equal and opposite force on the object A. <u>Discuss the following, asking students if they illustrate Newton's Third Law of Motion:</u> Two people pulling a rope or string at opposite ends (Yes.) Jet aircraft: the force of the engines on the air they expel is equal and opposite to the force of the air on the engines. The engines are connected to the aircraft and this force of the air therefore causes the aircraft to move forward. (Yes.) Launching a rocket (Yes.) Athletes are able to do high jump because the force they press on the ground is equal and opposite to the force the ground pushes on them. (Yes.)	**5 Numerical problem solving** Students are given practice in solving numerical problems involving F = ma. They must be encouraged to follow the steps: To find/Given/Solution. **6 Demonstrations: Jet aircraft principle** Blow up a balloon and then release it with its neck open. The stretched balloon forces air backwards and the air forces the balloon forward. Launch a water-rocket (a toy) (outdoors in a safe place, of course) **7 Student demonstration** Two students, each with a spring balance, pull on the ends of a string and measure the forces. The forces are equal in magnitude, even if a tiny student does the demonstration with a large student.	Balloon Toy water-rocket Two spring balances	**Numerical problem solving** Students solve numerical problems involving F = ma. **Students make balloon rockets**

SCOPE OF WORK
GRADE: 11
UNIT: FORCES

TOPIC: NEWTONS LAWS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
CAREERS • describe careers which rely on the study of physics • describe the use of physics in various careers (including emerging careers)	A book remains stationary on a table because the normal contact force is equal and opposite to the weight of the book. (No! Although the forces are equal and opposite, this is NOT a case of the force of A on B being equal and opposite to the force of B on A. Weight is provided by the pull of the Earth, not the pull of the table. Actually, these equal and opposite forces can be explained by Newton's Second Law. Since the book is in equilibrium, the net force on the book is zero, and therefore the two forces must be equal and opposite.) **Important note:** *This last example shows that we must avoid teaching Newton's Law as "action and reaction are equal and opposite", as this tends to result in misconceptions in students' minds. The Law should be taught in terms of <u>two</u> objects exerting forces on each other.*	**8 Reading/Internet research** Students find out and list careers in which Newton's Laws of Motion are applied.		Lists of careers presented to the class by students.

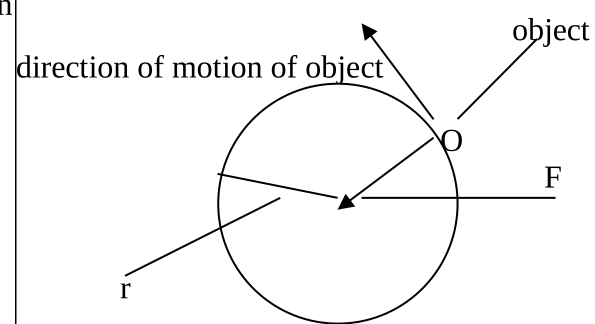
SCOPE OF WORK
GRADE: 11
UNIT: FORCES

TOPIC: MOMENTUM **DURATION: 1 WEEK**

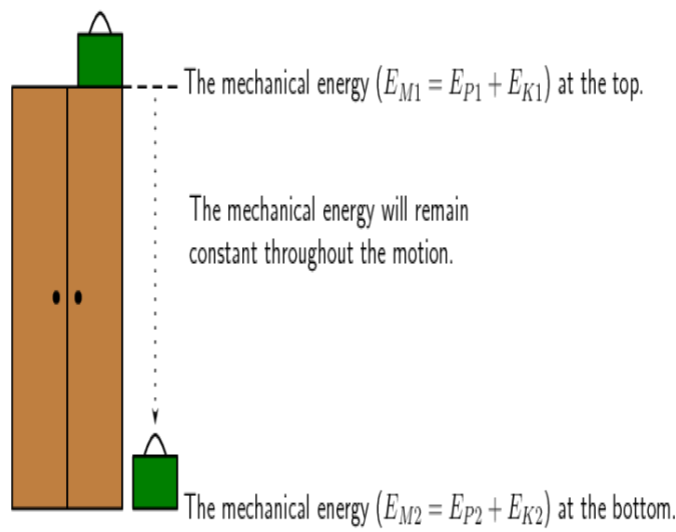
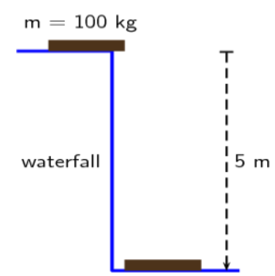
LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
MOMENTUM • Define momentum as a product of mass and velocity and use this formula to solve problems **NEWTON'S SECOND LAW (in terms of momentum)** • State Newton's second law in terms of rate of change of momentum. ($F = (mv – mv_o)/t$: substituting for a) • Apply Newton's second Law of motion to the transfer of momentum e.g. popping a string, catching a ball, hammering a nail and packaging of eggs	**Momentum** ***Momentum is the mass times the velocity of an object.*** Momentum, p, is given by the equation $$p = mv \quad \ldots\ldots\ldots (1)$$ The S.I. unit for momentum is kilogram meters per second or kg.m/s. Note that since velocity has direction, then momentum also the same direction as velocity. Momentum is therefore a ***vector*** quantity. **Newton's Second Law in Terms of Momentum** ***The net force applied to an object is directly proportional to its rate of change of momentum, and the change of momentum takes place in the direction of the net force***, In equation form $$F \propto \frac{\text{change in momentum}}{\text{time taken to make the change}}$$	 **1 Discussion of cases relating to equation (2)** Large force required (Momentum change in a short time) - hammering a nail - hitting a baseball Small force required (Momentum change in a long time) - catching a ball - packaging of fragile objects - "breaking" a fall on landing from a high jump.		**Solving numerical problems involving** • Momentum • Momentum change and force for short and longer times **Statement of laws and definitions** • Newton's Second Law in terms of momentum • Momentum **Identifying Applications of Above laws and definitions**

SCOPE OF WORK
GRADE: 11
UNIT: FORCES

TOPIC: CENTRIPETAL FORCES **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
CIRCULAR MOTION Recognize that a centripetal force is needed for circular motion. Recognize the relationships between centripetal force, mass, distance and speed. (f=(mv2)/r) Identify examples of centripetal force. (gravity in planetary and satellite motion, friction in moving around curves- roundabouts, tension in string whirling objects around,)	**Uniform Circular Motion** For an object to move uniformly in a circle, two things are necessary: - the object move with constant speed - that must be constant force F acting at right angles to the direction the object is moving at every instant of time. Since the force F acts at right angles to the velocity, F points towards the centre of the circle. F is called a **centripetal force**.  Example of centripetal forces See Discussion 5 Calculating centripetal force The centripetal force, F, on an object if mass m, moving in a circle of radius, r is given by $\mathbf{F = mv^2 / r}$	Applications of the results can be discussed in terms of sports. **1 Discussion** Ask students to identify the centripetal forces in each of the following situations: - The Earth moving in circular orbit around the Sun - A satellite moving in circular orbit around the Earth - A car moving in a circle on a horizontal roundabout A ball being whirled in a circle horizontally on a string. **2 Numerical problem solving** Make up problems based on the equation $F = mv^2 /r$ and have students practice solving them. Encourage them to use the format:	Internet Text book	Worksheet

TOPIC: CONVERSION OF MECHANICAL ENERGY **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
WORK AND ENERGY • discuss the conservation of mechanical energy	The principle of the **conservation of mechanical energy** states that the total **mechanical energy** in a system (i.e., the sum of the potential plus kinetic energies) remains constant as long as the only forces acting are conservative forces. 	**Discussion**: Conservation of mechanical energy, giving examples in everyday life **Simple demonstrations:** Conversion of energy https://www.siyavula.com/read/science/grade-10/mechanical-energy/22-mechanical-energy-05 **Problem-solving** During a flood a tree trunk of mass 100 kg falls down a waterfall. The waterfall is 55 mm high.  If air resistance is ignored, calculate: • the potential energy of the tree trunk at the top of the waterfall. • the kinetic energy of the tree trunk at the bottom of the waterfall. • the magnitude of the velocity of the tree trunk at the bottom of the waterfall	A length of plastic pipe with diameter approximately 20 mm, a marble, some masking tape and a measuring tape.	Communicating information Practical Assessment: selection and use of materials; making observations; processing data; formulating conclusions and communicating information Solutions to worksheets

SCOPE OF WORK

GRADE: 11
UNIT: WORK, ENERGY AND POWER

TOPIC: RENEWABLE ENERGY **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
ENERGY: THE WAY FORWARD • Critically appraise current events reports involving use of energy- renewable & non-renewable	**Current energy usage in the world** Most of the energy used in the world today comes from fossil fuels, of which oil usage is greatest. Approximate percentages are given below: Oil (35%), Coal (26%), Gas (19%), Biomass (11%), Nuclear (6%), Hydroelectric (2%), Solar/Wind/Geothermal (1%).	Students can make a pie chart to show current energy usage in the world. **Current energy usage in the world** Most of the energy used in the world today comes from fossil fuels, of which oil usage is greatest. Approximate percentages are given below: Oil (35%), Coal (26%), Gas (19%), Biomass (11%), Nuclear (6%), Hydroelectric (2%), Solar/Wind/Geothermal (1%). **Class discussion (or debate)** Students do research and then participate in discussion/debate on "Advantages and disadvantages of using fossil fuels**".** **Demonstration** Burn some kerosene oil and show that soot, carbon dioxide and acidic gases are given off (**Note: on account of safety issues it is NOT recommended that students do these types of investigations.)** **Simulation** Show the effect of a very dilute solution of sulphuric acid or nitric acid on limestone or metals (these acids are formed from oxides released in the air when engines use fossil fuel in combustion.	Internet Research Internet photos and video clips showing: Advantages and disadvantages of fossil fuels; Effects of climate change' Effects of acid rain Effects of oil spills Kerosene "lamp" Test tube Lime water (calcium hydroxide)	

GRADE: 11
UNIT: WORK, ENERGY AND POWER

TOPIC: RENEWABLE ENERGY

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Discuss the importance of energy conservation • Discuss energy conservation tips/strategies	**Fossil fuel energy** Fossil fuels take millions of years to form. Plants trapped energy by photosynthesis and became buried by layers of earth where they slowly changed form into fossil fuels. **Some advantages of using fossil fuel energy** - relatively cheap - easily transported - plenty of energy per unit mass of fuel - many devices have been invented that can make use of fossil fuels **Some disadvantages of using fossil fuel energy** - not renewable in our lifetime; known oil resources are expected to last to only about the middle of this century - very polluting to the air, water and land: oil spills are toxic in water and also smother aquatic life; the air becomes acidic and toxic - much carbon dioxide is produced when combustion takes place and this is believed to contribute to global warming - only a few countries are the major suppliers and they can manipulate world prices	**Student research** - Find out how the internal combustion engine works. - Internal combustion engine principles are based on work done by Boyle and Charles on pressure, volume and temperature of gases. Find out about Joules, Boyle and Charles and about one aspect of each of their work. **Student research** Find out the meaning of OPEC and list the countries that form OPEC and their geographic location. **Making working models** to demonstrate the use of alternative sources of energy Making of simple models of the following using small low-voltage d.c motors (to which a turbine is attached) - hydroelectricity - wind-generated electricity Students make models of trapping solar thermal energy to warm up water. **Student research** Students find out a little about Faraday (he showed how to obtain electricity from magnetism), and Einstein	Low-voltage d.c. motor Solar cell Voltmeter (or light-emitting diode) Internet Research/ video clips	Communicating information Practical Assessment: selection and use of materials; making observations; processing data; formulating conclusions and communicating information Solutions to worksheets

GRADE: 11
UNIT: WORK, ENERGY AND POWER

TOPIC: RENEWABLE ENERGY

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	The need for developing and using alternative sources of energy - The effects of fossil fuel use are very damaging to the planet - Fossil fuels will soon run out - As the world becomes more developed and also as the world population keeps growing, there is an increasing demand for energy The following are some sources being pursued: Hydroelectric: Potential energy of water stored in reservoirs at a height is transformed into kinetic energy at the base of the reservoir as the water falls. The running water causes turbines connected to generators to spin. The generators convert the kinetic energy into electrical energy. Wind: Wind causes turbines connected to generators to spin. The generators convert the kinetic energy into electrical energy. Solar voltaic: Solar cells convert light into electricity Solar thermal: Blackened metal objects containing water heat up the water when exposed to sunlight. Also, water gets heated up inside a closed glass container by the “greenhouse effect” Nuclear Energy is obtained from nuclei of atoms when fission or fusion takes place. The energy comes from mass that is converted according to the Einstein equation = mc^2. Bio-fuels: Energy is obtained by combustion of ethanol or wood. Biogas fuel is also produced by decaying organic materials.	**Discussions** - Current events concerning energy use - importance of energy conservation - energy conservation tips and strategies that students can employ **Student research:** - Investigate the effects of using fossil fuels on global warming and on the ability of presently harmless micro-organisms to become pathogenic) - Career involving alternative sources of energy and what area of physics is involved - Pros and cons of using various alternative sources of energy. - UN 2030 Sustainable Development Goals and the role of Small Island Developing States such as The Bahamas in working to achieve same	Internet Textbooks	Communicating information Solutions to worksheets

GRADE: 11
UNIT: WORK, ENERGY AND POWER

TOPIC: RENEWABLE ENERGY

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Select scientists of interest including at least one Bahamian/ Caribbean scientist and describe their contribution(s) to the field of physics	**Energy: The way forward** - More use of alternative sources (e.g. drying clothes in the sunshine) - Improvement of present efficiencies of appliances - More use of energy efficient appliances - Energy conservation practices: - Less use of motor cars; car- pooling; - Turn off appliances when not in use; - Make sure windows and doors are closed and cracks are sealed when using air-conditioning; - Use light colours on roofs and buildings; - Design buildings to make use of natural ventilation and cooling.	- Bahamian/Caribbean scientist doing work on development of alternative sources of energy or energy conservation.		

SCOPE OF WORK
GRADE: 11
UNIT: HEAT ENERGY

TOPIC: EFFECTS OF HEAT ON EXPANSION & APPLICATIONS / ANOMALOUS EXPANSION OF WATER **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Relate temperature changes to thermal expansion/contraction of various materials • Describe the anomalous expansion of water between 0^{o}C and 4^{o}C. • Interpret volume/temperature, density/temperature graphs for water. • Use the anomalous expansion of water to account for phenomena such as the freezing over of lakes, bursting of containers as their contents freeze e.g.water pipes	• Usually as temperature increases the particles average energy and thus they vibrate more, pushing against each other resulting in expansion. • Water contracts when cooled steadily up to 4^{0}C for the same mass of water the volume therefore gets smaller giving rise to a larger density. Water is densest at 4^{0}C. As cooling continues below 4^{0}C, water behaves anomalously because it starts to expand. As it expands water becomes less dense. As cooling continues water will freeze at 0^{0}C (at sea level, at atmospheric pressure)	In collaborative groups, students demonstrate the following effects of heat: • expansion of solids (the ball & ring and bar & gauge experiments) • expansion of liquids when heated • expansion of gases when heated.	Bunsen burner, water, ice, potassium permanganate, wire gauze, convection box, light bulb, discarded clothes iron, glass sheet, alcohol, Ball and ring apparatus, bar and gauge apparatus	Practical Assessment: selection and use of materials; making observations; processing data; formulating conclusions and communicating information
• Recognize and demonstrate that different materials expand by different amounts for the same change in temperatures (linear expansivity)	• The linear expansivity of a substance is the fraction of its original length by which a rod of the substance expands per Kelvin rise in temperature. (Abbott pg. 162)	Using the bi-metallic strip Students examine thermostats in electrical irons. Students use bimetallic strips obtained from discarded appliances to demonstrate operation or to operate other circuits	Bi-metallic strip	Practical Assessment: marking observations, processing data, formulating conclusions - (relationship between temperature and length), communicating information
• Discuss applications of linear expansion (building of bridges, concrete pavements, steel bridges, aluminium power lines, Removing tight-fitting caps from bottles)	Expansion & contraction applications • Avison J. (2000) Physics for CXC. pg. 165 • Pople S. (2015) Complete Physics for IGCSE. pgs. 108 – 109	• Examine the functioning of a thermostat in an electrical iron. • Construct/design thermostats using bi-metallic strip and thermometers	Bi-metallic strips	Use of rubric to assess projects for functionality, resourcefulness, innovation and creativity.

SCOPE OF WORK
GRADE: 11
UNIT: HEAT ENERGY

TOPIC: HEAT TRANSFER **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe heat as the transfer of thermal energy from one object to another due to a temperature difference between them. • Define internal energy of a substance and describe the factors (mass, temperature, nature and state of substance) that affect the total internal energy of an object	• Heat is defined as the energy that flows from hotter objects to colder objects. Heat passes form one object to another in the form of infrared rays. When heat is absorbed by a body it increases the kinetic and/or potential energy of its molecules. Temperature describes how hot or cold a body is with respect to a given standard. Temperature is a measure of the average kinetic energy of the particles of the body. • Thermal energy, internal energy: the total (kinetic and potential) energy of all the particles of a substance. The greater the number of particles (& therefore mass) and temperature of the substance, the greater will be its internal energy (thermal energy) Two bodies can be the same temperature and have different internal energy because they have different masses.	Correct use of thermometers • Heating of water • Cooling of water Students research and demonstrate the following (as review where necessary): solids conduct heat at different rates • water is a poor conductor of heat • convection in liquids • convection in gases • dark surfaces absorb more radiation the shiny surfaces • the greenhouse effect • land and sea breezes	Thermometers Bunsen burners Electrical heaters	Practical Assessment: selection and use of materials; making observations; processing data; formulating conclusions and communicating information

SCOPE OF WORK
GRADE: 11
UNIT: HEAT ENERGY

TOPIC: SPECIFIC HEAT CAPACITY/ LATENT HEAT **DURATION: 3 WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Define and demonstrate an understanding specific heat capacity	• The specific heat capacity of a substance is the quantity of heat energy required to change (increase or decrease) the temperature of 1Kg of the substance by 1 Kelvin ($_0$C).	Compare the temperature changes when heating oil and water. (Use a water bath) Interactive simulation: https://phet.colorado.edu/sims/html/energy-forms-and-changes/latest/energy-forms-and-changes_en.html Experiment to estimate specific heat capacity of substances by method of mixtures and by direct heating methods.	Assorted lab materials and apparatus – thermometers, metal samples e.g. Al or Zn, calorimeters, heaters, Bunsen burners, tripod, gauge, retort stands and clamps, water bath, beakers, tongs, triple beam balance/ top pan balance, water, oil (paraffin) Farley A. & C. Trotz (2009) CXC Physics. Pgs. 191-193 Pople S. (2015) Complete Physics for IGCSE. pgs 120 -123	Observe temperature changes for same amount of heat. Graph represents the data. Practical Assessment: selection and use of materials; making measurements and observations; processing data; identifying sources of error, formulating conclusions and communicating information
• Define and demonstrate an understanding of specific latent heat.	• Specific latent heat of a substance is the quantity of heat required/removed to change the state of 1Kg of the substance without a change in temperature.	Experiment to estimate latent heat of ice by method of mixtures.		
• Distinguish between latent heat of fusion and latent heat of vaporization	• Specific latent heat of fusion is the quantity of heat required/removed when 1Kg of the substance melts/freezes without a change in temperature. • Latent heat of vapourization is the quantity of heat required/ removed when 1kg of the substance evaporates/ condenses without a change of temperature.			
• Use the equations $Q = mc\Delta T$ and $Q = ml$ to perform calculations involving heat energy, specific heat capacity, specific latent heat.	• To find the quantity of heat energy needed to change (increase or decrease) the temperature of a certain mass of substance find the product of the mass, the specific heat capacity and the temperature change of the substance.	Perform calculations.	Worksheets	**Student solutions** Students solve problems involving heat energy, specific heat capacity, specific latent heat, state change and temperature change, power, time taken, using a logical format

SCOPE OF WORK
GRADE: 11
UNIT: HEAT ENERGY

TOPIC: SPECIFIC HEAT CAPACITY/ LATENT HEAT

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	• To find the quantity of heat energy needed to change the state of a certain mass of a substance at a specific temperature, find the the mass and the specific latent heat of the substance. (The equations can be rearranged to determine any unknown variable). **Specific heat capacity of a solid by method of mixtures.** assumption: total heat lost/given out by one substance is equal to the heat gained by the other substance/s			
• Determine the specific heat capacity of a solid or liquid using direct heating method and method of mixtures • Perform experiments to determine the specific latent heat of fusion or vaporization of a substance.	• **Specific heat capacity of liquid by direct heating method**: assumption: • total heat lost/given out by one substance is equal to the heat gained by the other substance/s.	Plan and conduct experiment to estimate the specific heat capacity using electrical method.	Assorted lab materials and apparatus – thermometers, metal samples e.g. Al or Zn, calorimeters, immersion water heaters, electrical kettles retort stands and clamps, water bath, beakers, tongs, triple beam balance/ top pan balance, a.c./d.c power supply Farley A. & C. Trotz (2009) CXC Physics. Pgs. 191-193 Pople S. (2015) Complete Physics for IGCSE. pgs 120 -123	Accurately applies the equation. Practical skills assessed: processing data (graph), observation, measurement, recording, calculating, concluding, identifying sources of errors, identifying anomalous results. Lab report assessed. Students complete worksheets with problems involving heat energy, specific heat capacity, specific latent heat, state change and temperature change, power, time taken

SCOPE OF WORK
GRADE: 11
UNIT: HEAT ENERGY

TOPIC: SPECIFIC HEAT CAPACITY/ LATENT HEAT

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe applications of specific heat capacity and specific latent heat (e.g. use of water as a coolant)	• Water has a large specific heat capacity. 1 kg of water has to absorb 4000J of energy to change its temperature by 1K. Water is therefore useful as a coolant, to extinguish most fires, substances like metals with lower heat capacities may be used to make pots, since it requires a small amount of heat to cause a large temperature rise, so heat is not wasted on the pot itself – • The refrigerator and air conditioner utilize the principle of the cooling effect of evaporation: volatile liquids absorb heat to change state from liquid to gas, giving rise to a lower temperature of the surroundings. Also, the gas readily loses heat to change back to liquid. Therefore refrigerators and air conditioners act as heat pumps. Sweating cools the body in the same manner. As sweat evaporates from the skin, it requires energy, this energy is absorbed form the skin, thus lowering the temperature of the skin.	Research and present applications of latent heat and specific heat capacity Students research and demonstrate the following: 1. Applications of the use of water in a car's radiator as a coolant due to its high specific heat capacity 2. The cooling effect of evaporation relating this to the operation of the refrigerator/air conditioner	Research materials - Suitable texts - internet Farley A. & C. Trotz (2009) CXC Physics. Pgs. 200 Pople S. (2015) Complete Physics for IGCSE. pgs. 119, 121	Presentations assessed: accurate presentation of concepts, (content), demonstrations, answering questions, creativity in presenting, resourcefulness

SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: MECHANICAL WAVE BEHAVIOURS **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• List behaviours shown by waves: rectilinear propagation, reflection, refraction, diffraction, interference. • Recognize that longitudinal and transverse waves show similar behaviours and obey the same laws.	• Reflection of waves governed by the laws of reflection: the incident, normal and reflected waves are in the same plane and the angle of incidence and reflection are equal. • Construction of ray diagrams would show reflection of plane waves from plane surface. • Reflection of plane waves from concave and convex surfaces (sketches only), plane wave incident upon a concave surface is reflected as a circular wave front converging at the principal focus of the surface. • Plane wave incident upon a convex surface is reflected from the surface as if there is a circular disturbance spreading out from the virtual principal focus of the surface. • Refraction of waves follows the laws of refraction: (1) the incident and refracted rays are on opposite sides of the normal at the point of incidence and all 3 are in the same plane, (2) Snell's law: the ratio of sine the angle of incidence to sine the angle of refraction is a constant for a given pair of media. • Also refractive index of the second medium = sin i / sin r, speed of wave in the first medium/speed of wave in the second medium, or wavelength of wave in the first medium / wavelength of wave in the second medium. Note that refraction causes the speed and wavelengths to change but the frequency remains the same. Do not include refraction of waves across curved boundaries	• Observe and construct ray diagrams for reflection of plane wave incident upon plane surface along the normal and at an angle. • Observe and draw general diagrams to show reflection of plane waves from concave and convex surfaces • Observe and draw general diagrams to show the reflection of circular wave from a plane surface. • Demonstrate refraction of waves in ripple tank. Set up thick glass plate or tiles in bottom of ripple tank to produce boundary between deep and shallow water. • Observe plane wave as it crosses the plane boundary along the normal. Observe and sketch refraction of plane wave as it crosses the plane boundary at an angle of incidence other than 90^{0}. • Set up gaps in the ripple tank and observe and sketch interference. Observe and sketch diagrams to show diffraction of water waves in ripple tank by setting up gaps of various sizes and creating plane wave fronts to pass through the gaps.	Plane mirrors. curved mirrors (concave and convex) ripple tank or materials which can be used to construct ripple tank. thick glass plate or tiles http://www.physicsclassroom.com/Class/waves/u10l1a.cfm some animations, many questions to check understanding, answers provided. CXC Physics Alec Farley & Clarence Troz Macmillan Publishers Limited 2007. A World of Physics Avison	Written quizzes, unit tests, home work, project assignments (eg constructing ripple tank and demonstrating aspects of unit.) Group presentations to class. Observation skills assessed. Processing skills assessed

SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: REFLECTION OF LIGHT FROM PLANE MIRRORS **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Investigate relationship between angles of reflection and angles of incidence for light reflected by a plane surface.	**LAWS OF REFLECTION FROM A PLANE MIRROR** (1) The angle of incidence (i) is equal to the angle of reflection r.	Practical Activity involving investigating reflection in plane mirrors.	Plane mirrors Raybox, pins Paper, plasticine, protractor Tom Duncan (2001) GCSE Physics 4th Ed. Jackson B. & P. Whiteley (2007) **Longman Physics for CSEC** 3rd. Ed (pgs. 153-155) Johnson, K. (2006) **New Physics for You** 6th Ed. Pg. 174 http://www.physicsclassroom.com/Class/refln/u13l1c.cfm	Lab Report Assessment of skills: • Observation • Measurement • Collection, processing and interpretation of data • Recognizing relationships • Predictions
• Demonstrate that incident, reflected & normal rays form in the same plane.	(2) The incident ray, the reflected ray and the normal all lie in the same plane.	Practical Activity involving investigating reflection in plane mirrors	Plane mirrors, plastic bottle, tape, scissors (or retort stand and clamps) Jackson B. & P. Whiteley (2007) **Longman Physics for CSEC** 3rd. Ed (pg. 157) Johnson, K. (2006) **New Physics for You** 6th Ed. Pg. 177	Assessment of model of simple periscope for functionality and creativity

SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: REFLECTION OF LIGHT FROM PLANE MIRRORS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Construct simple periscope, kaleidoscope using plane mirrors.	A simple periscope may be constructed with a tube containing two plane mirrors that are face each other and are parallel. Light is turned through a 90^o angle at each reflection enabling the viewer to see over an obstacle or crowd. Kaleidoscopes employ the use of plane mirrors to give multiple images of objects placed between them e.g. two mirrors at right angles to each other give three images of an object placed between them. A greater number of images are formed when the angle between the mirrors decrease.	Construction of simple periscope using two plane mirrors Construction of a kaleidoscope using two or more mirrors	Picture or painting, multiple plane mirrors Tom Duncan (2001) GCSE Physics 4th Ed.	Assessment of model of simple periscope for functionality and creativity

SCOPE OF WORK
GRADE: 11
UNIT: OPTICS

TOPIC: REFLECTION FROM CURVED MIRRORS **DURATION: 2 WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Define optical terms associated with spherical mirrors- (principal focus, principal axis, center of curvature, pole, focal length, radius of curvature.) • Relate images formed by concave & convex mirrors to their common uses.	• The pole, **P** of a mirror is the centre of its reflecting surface. • Centre of curvature, **C** is the centre of the sphere of which the mirror is a part. (located in front of a concave mirror and behind a convex mirror). • The principal axis is the line joining the pole P or centre of the mirror to the centre of curvature C. • Radius of curvature, **r** is the radius of the sphere of which the mirror is apart. It is the distance between the centre of curvature, **C** and the pole, **P**. • Focal length, ***f*** is half the radius of curvature. The focal length f is the distance FP. FP =CP/2 or f = r/2. Focal length = ½ the radius of curvature. • The principal focus, **F** refers to the point at which rays converge in a concave mirror, or the point from which they appear to diverge in a convex mirror. A concave mirror has a real principal focus, while the convex mirror has a virtual principal focus	Simulations http://www.physicsclassroom.com/mmedia/#optics Discussion Labelling of optical terms on illustrations of spherical mirrors Investigating images formed in convex and concave mirrors	table spoons, ray-box, concave and convex mirrors http://www.physicsclassroom.com/mmedia/#optics GCSE Physics The World of Physics Johnson, K. (2006) **New Physics for You** 6th Ed. Pg. 181 ray-box, concave and convex mirrors,	Written Assessment • Quiz • Worksheet Oral questions Practical Assessment of skills • Observation • Measurement • Collection, processing and interpretation of data • Recognizing relationships • Predictions

SCOPE OF WORK
GRADE: 11
UNIT: OPTICS

TOPIC: REFLECTION FROM CURVED MIRRORS APPLICATIONS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Investigate the use of concave mirrors in solar cookers. (eg. rotary cooking)	Convex mirrors diverge, while concave mirrors converge parallel rays of light. Convex mirrors produce virtual, upright, diminished images and reflect a large part of the surroundings (i.e. they give a wide field view). They are therefore used as driving mirrors on cars and for surveillance e.g. in aisles of stores. Duncan T. (2001) **<u>GCSE Physics</u>** 4th Ed. Concave mirrors produce virtual, magnified and upright images of close up objects. They are therefore used as shaving mirrors, in the field of dentistry and as reflectors (in torchlights or vehicle headlamps). As parabolic mirrors, they can be used to obtain a parallel beam of light. For distant objects, concave mirrors produce inverted real images. Johnson, K. (2006) **<u>New Physics for You</u>** 6th Ed. Pg. 183 Concave mirrors collect energy and converge it to a principal focus in front of mirror. An application of this is their use in solar cookers	Research Making and/or using solar reflectors to converge light energy and heat substances Drawing of images formed in concave and convex mirrors	solar reflectors, thermometers, water	Oral questions Assessment of model of simple periscope for functionality and creativity

SCOPE OF WORK
GRADE: 11
UNIT: OPTICS

TOPIC: REFLECTION FROM CURVED MIRRORS- RAY DIAGRAMS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Experimentally locate the principal focus of a concave mirror (rough method using screen)	Light may be converged towards a focus point in front of concave mirrors. The principal focus of a concave mirror may therefore be roughly determined using a screen as the point where the rays appear to converge.	Practical Activity – Determining the principal focus of a concave mirror	Concave mirror Screen Ray box	Practical Assessment Written Assessment • Quiz • Worksheet
• Construct ray diagrams (and scale drawings) to describe images formed by concave and convex mirrors.	The images formed by spherical mirrors can be found by drawing two of the following rays: (a) A ray drawn parallel to the principal axis, is reflected through the principal focus, F. (b) A ray drawn through the centre of curvature C which hits the mirror normally, is reflected back along its own path. (c) A ray drawn through the principal focus, F is reflected parallel to the principal axis. Duncan, T. (2001) GCSE Physics 4th Ed.	Construction of ray diagrams to illustrate the position and height of images formed in concave and convex mirrors	Ruler, pencil, graph paper Duncan, T. (2001) GCSE Physics 4th Ed.	Written Assessment • Quiz • Worksheet
• Apply the mirror formula using the real is positive sign convention, and the magnification formula to solve problems.	Calculations involving <u>Magnification (m)</u> and the <u>Focal length (f)</u> of a Mirror may be determined using the following formulae: Magnification (m) = $\frac{\text{height or size of image (hi)}}{\text{height of size of object (ho)}}$	Worksheet with Calculations on magnification and focal length	Worksheets	Written Assessment • Quiz • Worksheet

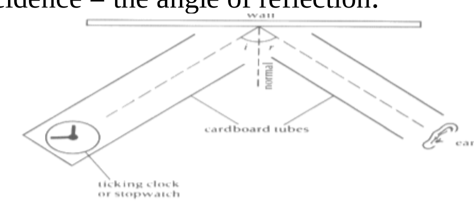
SCOPE OF WORK
GRADE: 11
UNIT: OPTICS

TOPIC: REFLECTION FROM CURVED MIRRORS RAY DIAGRAMS **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	Magnification (m) = $\frac{\text{distance of image from mirror (v)}}{\text{distance of object from mirror (u)}}$ $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ where f = focal length of mirror u = object distance v = image distance **Note:** (1) Distance to real images are positive. The focal length of a concave mirror is positive. Distance to virtual images are negative. The focal length of a convex mirror is negative.			

SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: SOUND WAVES, THEIR REFLECTION & APPLICATIONS **DURATION: 2 WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Determine the speed of sound from echo experiments.	• Sound waves travel at about 330 m/s in air All sounds in air at the same pressure and temperature travel at the same speed. Higher frequency sounds have shorter wavelengths and lower frequency sounds have longer wavelengths. • The speed of sound in a medium depends on the density and elasticity of the medium. Sound travels faster through denser more elastic materials. • If the speed of ultrasound in a medium is known, a pulse can be sent out and the time taken for that pulse to be received from a reflecting surface is noted. The distance to the reflecting surface can be determined using distance = speed x time. This echo method is used to estimate the depth of ocean floors by ships and the instrument is called a fathometer.	• Estimate the speed of sound in air using whatever is available. Discuss sources of errors, ways to improve etc. also degree of accuracy of measurement of time and distance. • Sound waves obey the laws of reflection: place a ticking clock or watch in the closed end of a long cardboard tube. Hold the open end of the tube at an angle (of incidence) to a hard wall. Place another cardboard tube (open at both ends) to the wall at about the same angle, in the same plane as the first. Try to hear the sound made by the clock or watch. By trial and error using different angles, students should find that the sound is heard best when the tubes are in the same plane and the angle of incidence = the angle of reflection.  Physics for CXC John H. Avison 1998 pg 4 Speed of sound by echoes. Speed= distance/time. Measure a distance of 50m-100m at right angles from a large wall. Make a sharp clapping sound by banging 2 blocks of wood together. Repeat the sound at regular intervals to coincide exactly with the echoes. Starting at zero as a stopwatch is started, count the number of claps and stop the stopwatch at 50 or 100 claps. Calculate the speed of sound in air using the equation speed=distance/time.	stop watches, hand towel rolls, meter stick	Planning and conducting investigation assessed.

SCOPE OF WORK
GRADE: 11
UNIT: Waves

TOPIC: SOUND WAVES, THEIR REFLECTION & APPLICATIONS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe echoes and their applications (e.g. in depth sounding using sonar and in ultrasound scans). • Critically evaluate the use of sonar in aquatic environments. • Describe acoustic resonance and its application in musical instruments.	• Ultra sound scans: ultra sound is used to obtain images of of internal parts of the body. Ultra sound pulses are sent into the body by a transmitter placed in contact with the skin. Reflections or echoes are received from ant surfaces within the body which have different density, structure, or elasticity. The time delay of the echoes gives the depth within the body of the reflecting surfaces, and the reflections in different directions can be used to construct an image of the internal body. CXC Physics Avison pg415 • Reverberation: when many echoes merge into one prolonged sound. • Acoustics: the sound reflecting and absorbing properties of a room. Acoustics are controlled by using different kinds of materials on the walls and in the room- some are sound absorbing and some reflecting- until the right balance is determined.	• Perform calculations involving depth sounding by echo. • Research the effect of sonar used in navy operations on marine mammals. (eg beaching of whales & dolphins) • Research the use of ultra sound in distance judging for blind persons. (how bats judge distance) • Make a speaking tube (internally reflected sound waves. Use a long piece of garden hose with funnels at the end place the ends far enough like in separate rooms and listen to sounds made even when the tube is curved (bent) • Research and debate the pros and cons of activities which result in noise pollution in aquatic environments (particularly in Bahamian waters) (PHSchool.com Web code cch-2173) http://www.phschool.com/webcodes10/index.cfm?wcprefix=cch&wcsuffix=2173&fuseaction=home.gotoWebCode&x=16&y=12	Worksheets Textbooks Internet	Quiz, homework assignments assessed Debates assessed for points made, clarity of presentation,

SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: REFRACTION OF LIGHT WAVES **DURATION: 2 WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
○ Observe, predict and account for the effect of light rays passing from one optical medium to another. (refraction)	Refraction is defined as the change in direction of a wave due to its change in velocity. (http://en.wikipedia.org/wiki/Refraction). Light travels through transparent materials e.g. air, glass, Perspex, and water. However it refracts, when the medium it is travelling in changes.	Practical demonstration: Pencil in water Coin in water Drawings illustrating refraction of Pencil in water Coin in water Discussion: Simulation: presentation from website: http://www.s-cool.co.uk/ http://www.physicsclassroom.com	GCSE PHYSICS: 4th Edition, CHAPTERS 5 & 6: PAGES 14 – 19 Computer Projector Internet Access	Practical Assessment of skills: • Observation • Making inferences and interpreting data • Predictions Written Assessment • Worksheet • Quiz
○ Relate the degree of deviation (change of speed) of light rays to the refractive index of the material it passes through.	The greater the refractive index of the medium, the greater the change in velocity and hence direction of the light wave. The lower the refractive index, the slower light travels and the smaller the deviation.	Ray box Light accessory kit (collection of prisms, rectangular glass boxes, semi-circular blocks)	electricity pencil, water, refraction tanks, beakers, coins, ray boxes, light accessory kit	Written Assessment • Drawing of refracted rays • Recognizing relationships
○ Verify Snell's law of refraction experimentally.	Snell's Law states that the sine of the angle of incidence divided by the sine of the angle of refraction is a constant. This is equal to the refractive index of a medium.	Discussion Laboratory Practical Measure at least five values of angles of incidence (i) and the associated angles of refraction (r)	rectangular glass block, raybox or pins, ruler, protractor, white sheet of paper and Styrofoam, graph paper, scientific calculator	Practical Assessment of skills: • Handling of Experimental data • present data in a tabular manner, find sine of the angle of incidence and angle of refraction, plot graph of sine i against sine r and find the gradient ($\frac{\Delta \sin i}{\Delta \sin r}$)

SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: REFRACTION OF LIGHT WAVES

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Define refractive index in terms real-apparent depth, wave speeds, angle of incidence & refraction. • Use the following relationships in calculations $n = \frac{real\ depth}{apparent\ depth}$ $n = \frac{speed\ in\ incident\ medium\ (c1)}{speed\ in\ refracted\ medium\ (c2)}$ $n = \frac{\sin i}{\sin r}$	The **refractive index** of a medium is a measure of how much the speed of light (or other waves such as sound waves) is reduced inside the medium. (http://en.wikipedia.org/wiki/Refractive_index) $_1n_2 = \frac{\sin i}{\sin r}$ $_1n_2 = \frac{\text{real depth}}{\text{apparent depth}}$ $_1n_2 = \frac{speed\ in\ incident\ medium\ (c1)}{speed\ in\ refracted\ medium\ (c2)}$ $_1n_2 = \frac{wavelength\ in\ incident\ medium\ \lambda 1}{wavelength\ in\ refracted\ medium\ \lambda 2}$	Discussion Critical Analysis and Problem Solving	Worksheets Text	Written Assessment • Worksheet • Quiz
• Experimentally determine the refractive index of a material (glass, water) by real & apparent depth method.	An object partially immersed in water (such as a stick or pencil) appears bent due to the refraction of light rays. The depth of object in a body of water appears closer to the surface than it really is. The apparent depth is less than the real depth due to refraction of light rays.	Discussion: Simulation: presentation from website: http://www.s-cool.co.uk/ http://www.physicsclassroom.com Practical Activity: Observing the apparent depth of a dot painted at the base of a 1000 ml measuring cylinder, with different heights of water	Measuring cylinder Indelible ink markers Water Metre Rule Graph Paper Calculator Internet	Practical Assessment • Handling of experimental data • Measure real depth and apparent depth of dot in water, present data in a tabular manner, plot graph of real depth against apparent depth and find the gradient ($\frac{\Delta\ real\ depth}{\Delta\ apparent\ depth}$)

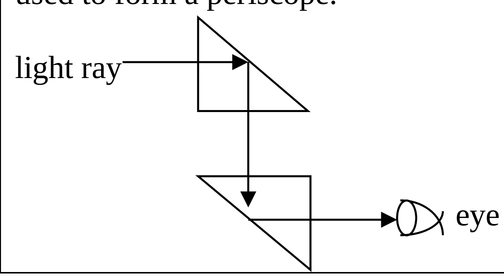
SCOPE OF WORK
GRADE: 11
UNIT: OPTICS

TOPIC: REFRACTION OF LIGHT WAVES

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• define critical angle	**The Critical Angle (c)** is defined as the threshold angle of incidence beyond which total internal reflection takes place.	Simulation from websites: http://www.s-cool.co.uk/ http://www.physicsclassroom.com Discussion Practical Activity Drawing diagrams to illustrate total internal reflection and the critical angle	Rectangular glass blocks, semi-circular glass blocks, prisms, fibre optic cables, lenses, coiled glass tubes, ray box, protractors Internet	Assessment of skills • Observation • Communication
• Measure critical angle for a material using a semi-circular block.	The critical angle for various transparent media (e.g. glass) may be measured as the angle of incidence producing an angle of refraction of 90^o.	Practical Activity Determining the critical angle of a semi-circular glass block	Semi-circular glass block, ray box, protractor , paper	Practical Assessment of skills; • Observation • Measurement • Recording Experimental data • Making inferences and drawing conclusions
• state the conditions for total internal reflection	Total internal reflection occurs when light travels from (1) a medium of higher refractive index to one of lower refractive index and (2) when the angle of incidence exceeds than the critical angle	Simulation from websites: http://www.s-cool.co.uk/ http://www.physicsclassroom.com Discussion Practical Activity	Rectangular glass blocks, semi-circular glass blocks, prisms, fibre optic cables, lenses, coiled glass tubes, ray box, protractors	Written Assessment • Worksheet • Quiz

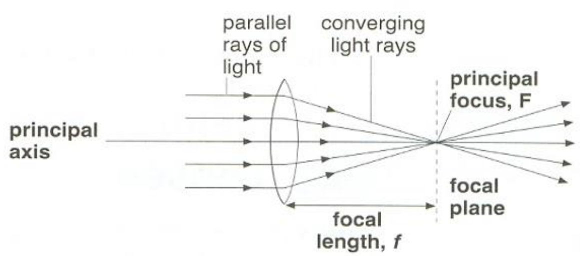
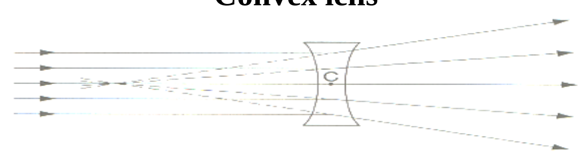
SCOPE OF WORK
GRADE: 11
UNIT: OPTICS

TOPIC: REFRACTION OF LIGHT WAVES

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Use the relationship sin c= 1/n to solve problems.	The refractive index (n) and the sine of the critical angle (c) are inversely related. $\mathbf{n = \frac{1}{\sin c}}$ $\mathbf{\sin c = \frac{1}{n}}$	Problem solving and Critical analysis	Worksheets Text	Written Assessment • Worksheet • Quiz
• discuss how total internal reflection is employed in fiber optical cables (and endoscopes)	Total Internal Reflection can be very useful. Its effect is evident in prisms, optical fibres, periscopes, bicycle, cable television, formation of mirages, diamonds. Optical fibres are used in endoscopes and for telecommunications. Since light enters one end of the fibre, at an angle greater than the critical angle, total internal reflection occurs. In endoscopes, other optical fibres in the bundle collect the reflected light using lenses and send it to a computer, where the information is displayed as a picture on a monitor.	Practical Demonstration Simulations: http://www.s-cool.co.uk/ http://www.physicsclassroom.com Discussions Illustrating applications of total internal reflection Research and presentations Field Trip to BTC/ Cable Bahamas Guest Speakers form BTC/ Cable Bahamas	Physics Text Guest Speaker Assortment of Fibre Optic Cables Coiled glass tubes Computer Projector	Oral Questions Written assessment Illustrations of applications of total internal reflection in endoscopes and fibre optic cables
• Draw diagram to show arrangement and path of light through 45^0 prisms as used in periscopes.	A right angle prism can be used to change the direction of a light ray. When light enters at 45^0 (an angle greater than the critical angle of glass), total internal reflection occurs at the back face of the prism. Two right angle prisms can therefore be used to form a periscope. 	Construction of model periscope using right-angled prisms Simulations: http://www.s-cool.co.uk/ http://www.physicsclassroom.com	Light source Prisms Clamp stands	Assessment of model of simple periscope for functionality and creativity

SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: LENSES & OPTICAL EQUIPMENT **DURATION: 3 WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
○ Define optical terms associated with lens- (principal focus, principal axis, optical center, focal length, power.)	**Principal Focus (F)** … is the point on the principal axis to which initially parallel rays converge, or from which they appear to diverge after refraction at the lens. **Focal length (f)** … is the distance from the center of the lens to the principal focus. **Principal Axis** …is the line joining the centers of curvature of the lens at its surfaces. **Focal Plane** is the plane, of which the principal axis is a part in which sharp images of the object are formed.  **Convex lens**  **Concave Lens** **Source (CXC Physics)** The power of a lens is defined as the reciprocal of its focal length (in metres). The unit of power is the Dioptre (D). Power (D) = $\frac{1}{f(m)}$	Practical demonstration Discussion Simulations: http://www.s-cool.co.uk/ http://www.physicsclassroom.com Drawing lenses and labelling associated optical terms - principal focus; principal axis; optical centre; focal length Worksheet Calculating power of a lens	Ray boxes Concave and Convex lenses Paper	Assessment of skills • Observation • Communication Written Assessment • Worksheet • Quiz

SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: LENSES & OPTICAL EQUIPMENT

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Experimentally determine the relationship between thickness and focal length of a convex lens.	The shorter the focal length (the fatter the lens), the greater its power. Thick lenses have a shorter focal length than thinner lenses.	Discussion Practical Activity Finding the focal length of thin and thick lenses	Ray boxes Assorted convex lenses of different thickness Rulers Paper	Assessment of skills • Correct use of materials and apparatus • Observation • Measurement • Recording Experimental data • Making inferences and drawing conclusions
• Construct ray diagrams (& scale drawings) to describe images formed by convex and concave lenses.	In order to locate the image formed by a converging lens, any two of three types of rays may be used to construct ray diagrams: • A ray of light parallel to the principal axis which is refracted through the principal Focus (F) • A ray of light through the optical center which is undeviated for thin lens • A ray of light through the principal Focus (F) which is refracted parallel to the principal axis. In order to locate the image formed by a concave (diverging) lens, any two of three types of rays may be used to construct ray diagrams:	Discussion Construction of Ray Diagrams to illustrate image formation in convex and concave lenses Practical activity Observe images formed when object is placed between F and 2F, 2 F and beyond F	Graph paper ruler pencil calculators Screen Lenses Metre Rule Raybox/ light source	Written Assessment • Worksheet • Quiz • Construction of Ray Diagrams

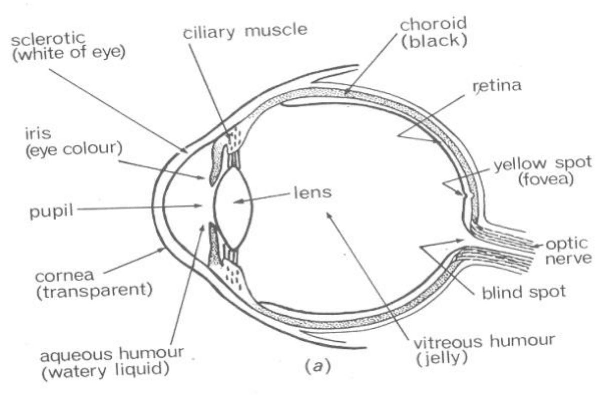
SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: LENSES & OPTICAL EQUIPMENT

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	• An incident ray parallel to the principal axis is refracted through the lens so that its extension passes through the focal point • A ray of light through the focal point will refract through the lens and travel parallel to the principal axis. • A ray of light through the center of the lens will continue undeviated (i.e. in the same direction as it entered the lens).			
• Apply the lens formula using the real is positive sign convention, the magnification formula and the power of a lens formula to solve problems.	The nature and position of an image may be found through calculations, by applying the Lens Formula, which is as follows: $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ where f = focal length v = image distance u = object distance Sign conventions when applying formulae: • Distances to real images are positive. The focal length of a convex lens is positive. • Distances to virtual images are negative. The focal length of a concave lens is negative	Problem Solving	Worksheets Calculators Text book	**Written Assessment** • **Worksheet** • **Quiz**

SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: LENSES & OPTICAL EQUIPMENT

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Construct models of the human eye and relate structures to the function.	Light undergoes successive refraction from cornea and is focused on retina after successive refractions. The retina is sensitive to light and sends messages to the brain by way of the optic nerves. Although the image on the retina is inverted, the brain interprets it correctly	Practical Activity: Construction of Models of Human Eye Discussion of Structure of Eye in relation to function	Suitable materials such as plasticine, Styrofoam, cardboard, markers, marbles	Assessment of model of simple periscope for functionality and creativity
• Examine/dissect a cow's/goat's eye and compare structure to human eye.		Practical Activity Dissection of cow's/ goat eye	Dissection kit Cow/ goat eye	Assessment of skills • Correct use of materials, apparatus and techniques • Observation • Recognising relationships

SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: LENSES & OPTICAL EQUIPMENT

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Perform experiments to demonstrate blind spot, binocular vision, inversion of image on retina,	The blind spot is the area on the retina without receptors that respond to light. Therefore an image that falls on this region will not be seen. http://faculty.washington.edu/chudler/chvision.html	Practical activity to demonstrate blind spot. Make a small dot on the left side of paper separated by about 12 – 15 cm from a small cross (+) on the right side. Close right eye. Hold the image 30 cm away. With left eye, look at the +. Slowly bring the image (or move head) closer while looking at the +. At a certain distance, the dot will disappear from sight...this occurs when the dot falls on the blind spot of the retina. Repeat with right eye. http://faculty.washington.edu/chudler/chvision.html	Paper Pencils Ruler	Assessment of skills • Observation • Making inferences and drawing conclusions
	Binocular vision is vision in which both eyes are used together. Advantages include a spare eye in case one is damaged, a wider field of view, the ability to detect faint objects is enhanced (binocular summation) and precise depth perception may be provided by the different positions of the two eyes on the head. http://en.wikipedia.org/wiki/Binocular_vision	Practical activity to demonstrate binocular vision. hold the ends a pencil one in each hand, facing each other, either vertically or horizontally at arms-length from the body. With one eye closed, try touching the ends of the pencils together. When repeated with two eyes: the task should be much easier because each eye looks at the image from a different angle. http://faculty.washington.edu/chudler/chvision.html	Paper Pencils	Assessment of skills • Observation • Making inferences and drawing conclusions
	The image formed in the eye is real and inverted.	Construction and use of a pin-hole camera to demonstrate formation of real inverted images.	cardboard box, translucent paper, black construction paper, scissors, glue,	Assessment of model of eye for functionality and creativity

SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: LENSES & OPTICAL EQUIPMENT

<table>
<tr><th>LEARNER OUTCOMES</th><th>CONTENT</th><th>ACTIVITIES</th><th>RESOURCES</th><th>METHOD OF ASSESSMENT</th></tr>
<tr><td>• Describe the focusing of the lens in the eye to see near & distant objects. (accommodation)</td><td>The ciliary muscles allow the lens to adjust their focal length to enable it to focus both far and near objects, by changing shape. This process is called accommodation.

<table><tr><th>Viewing Distant Objects</th><th>Viewing Near Objects</th></tr><tr><td>ciliary muscles relaxes</td><td>ciliary muscles relaxes</td></tr><tr><td>Lens flatten, becoming long and thin</td><td>Lens widen, becoming short and fat</td></tr><tr><td>Focal length increases</td><td>Focal length decreases</td></tr></table></td><td>Practical Demonstration
Use of a ray box and converging lens of different thickness to demonstrate focal length is smaller for fatter lens and greater for thinner lens.

Drawing diagrams to show the refraction of light rays through converging lens of varying thickness.</td><td>Ray box
Convex lens of different thickness</td><td>Assessment of skills
• Observation
• Communication
• Recognizing Relationships

Written Assessment
• Worksheet
• Quiz</td></tr>
<tr><td>• Draw diagrams to show eye defects associated with the lens and the use of additional lenses to correct these defects (long & short sightedness)</td><td>Defects in vision may be eliminated by using spectacles, whose lenses refract light before it enters the eye.
<u>Hypermetropia (long or farsightedness)</u> occurs when near objects cannot be focused because the diverging rays of light are focused behind the retina. Only far objects are clearly seen. This may be caused by a short eyeball or weak lens. It may occur in older people since the refractive power of the lens decreases with age.
Correction: use of a convex lens</td><td>Discussion

Simulations:
http://www.s-cool.co.uk/
http://www.physicsclassroom.com

Drawing diagrams of eye defects associated with the lens and the use of additional lenses to correct these defects</td><td>Internet

Physics text

Paper
pencil
ruler</td><td>Written/ Oral Questions

Written Assessment
• Worksheet
• Quiz
• Illustration of Eye Defects and their corrections</td></tr>
</table>

SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: LENSES & OPTICAL EQUIPMENT

<table>
<tr><th>LEARNER OUTCOMES</th><th>CONTENT</th><th>ACTIVITIES</th><th>RESOURCES</th><th>METHOD OF ASSESSMENT</th></tr>
<tr><td>• Make models of the eye to show defects and their corrections by use of additional lenses.</td><td><u>Myopia (short or near sightedness)</u> occurs when distant objects appear blurred because parallel light rays are refracted too much and become focused in front of the retina. Only near objects can be seen very clearly. It may be caused by a long eyeball, poor nutrition or genetic reasons.
Correction: use of a concave or diverging lens</td><td>Discussion
Practical activity: Construction of model of eye defects and their corrections</td><td>Suitable materials such as plasticine, Styrofoam, cardboard, lenses, marbles</td><td>Assessment of model for functionality and creativity</td></tr>
<tr><td>•
Compare & contrast the operation of the human eye, simple lens camera and the pin-hole camera</td><td><table>
<tr><th>Eye</th><th>Camera</th><th>Pinhole Camera</th></tr>
<tr><td>Convex lens form real inverted image on the retina</td><td>Convex lens form real inverted image on the film</td><td>No lens
Real inverted image formed on screen</td></tr>
<tr><td>Iris controls the amount of light entering the eye</td><td>The diaphragm controls the amount of light entering the camera</td><td>Light enters through pinhole</td></tr>
<tr><td>Black choroid layer absorbs stray light</td><td>Inside camera is black which absorbs stray light</td><td>Inside camera is airtight to prevent light escaping</td></tr>
</table></td><td>Research

Comparison of concrete models

Concept maps

Graphic organizers</td><td>Model of eye
Camera
Pinhole camera
Paper
Pencil</td><td>Written Assessment
• Worksheet
• Quiz</td></tr>
</table>

SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: LENSES & OPTICAL EQUIPMENT

<table>
<tr><th>LEARNER OUTCOMES</th><th>CONTENT</th><th>ACTIVITIES</th><th>RESOURCES</th><th>METHOD OF ASSESSMENT</th></tr>
<tr><td></td><td>
<table>
<tr><th>Eye</th><th>Camera</th><th>Pinhole Camera</th></tr>
<tr><td>Focusing is achieved by altering the shape (focal length) of the lens</td><td>Focusing is achieved by altering the distance between the lens and the film</td><td>Focusing is achieved by altering distance between pinhole camera and object</td></tr>
<tr><td>Image does not have a lasting record on the retina</td><td>Permanent record is possible when film is developed</td><td>Permanent record only possible if light sensitive photographic paper placed is developed after long exposure</td></tr>
<tr><td>Eyelids protect the cornea and lens from dust</td><td>Lens cap used to protect the lens</td><td>Not applicable</td></tr>
</table>
</td><td></td><td></td><td></td></tr>
</table>

SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: LENSES & OPTICAL EQUIPMENT

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Design & construct optical devices (single lens camera, projector, a compound microscope, a simple refracting telescope.	The camera consists of a light proof box containing: • An opening … which contains the convex lens. This gathers incoming light and focuses it on the film. • A light proof shutter … behind the lens, which when closed prevents light from reaching the film. • A diaphragm … located just behind the lens and is adjustable in size to control the amount of light passing through the shutter when it is opened. • A light sensitive film … which records the image and is later developed to give a permanent picture. (1) The Projector … uses several lenses and a concave mirror which produces on screen a real magnified and inverted image on the screen (for the image to be the right way up, the object (slide or film) must be upside down.	Research Use of Optical devices • Camera • Projector • Microscope • Simple refracting telescope Construction of simple optical instrument	Resource materials • Textbooks • Internet Cameras Projectors Microscopes Telescopes	Written Assessment • Worksheet • Quiz

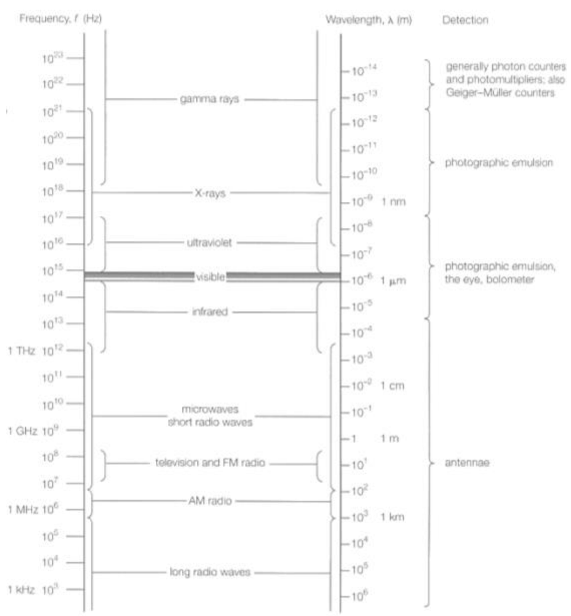
SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: LENSES & OPTICAL EQUIPMENT

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	(2) The Microscope: the objective lens, which is a powerful converging lens of short focal length, is used to produce a real inverted image and magnified image. The eyepiece lens is the lens that is nearest to the eye. It has a short focal length and is used to magnify the first image (acts as a magnifying glass). The combination of the two lenses produces a final image (I2), which is inverted compared to the object, virtual, and magnified. (3) The Telescope … uses two converging lens to produce an inverted virtual image. The objective lens is a wide aperture converging lens of long focal length. The aperture allows it to collect a lot of light from weak distant sources and forms a weak inverted diminished image (I1). The eyepiece lens is a short focal length convex lens, which is to magnify the first image. The final image is inverted.	Students and teachers can access the worldwide telescope® online on www.microsoft.com		

SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: ELECTROMAGNETIC SPECTRUM AND APPLICATIONS **DURATION: 1 ½ WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• State general properties of electromagnetic waves: possess electric and magnetic properties, transfer energy, travel at the speed of light, do not need material medium for propagation. • Infer that light is an electromagnetic wave (using knowledge that there is empty space between the Earth and the Sun). • Describe, using frequency or wavelength bands, the major constituents of the electromagnetic radiation spectrum.	• Properties of electromagnetic waves: -They travel through space at $3x10^8$ m/s (the speed of light) -They exhibit interference, diffraction and polarization. -They obey the wave equation $v = f\lambda$, where v=speed of light, f= frequency and λ=wavelength -They carry energy and can be absorbed by matter to cause heating and other effects. Pg 50 GCSE Physics T. Duncan 	• students research, collect photographs, construct charts, scrap books, etc. present on the uses and precautions of electromagnetic waves: gamma waves, x-rays, ultra violet, visible rays, infrared radiation, microwaves, • make models of the spectrum. • Debate the applications of electromagnetic waves eg in sterilization of foods, treatment of cancer, microwaves in communications (cell phones)	Internet Textbooks	Students research, presentations and models assessed for accuracy, creativity. Debates assessed for substantiated facts,

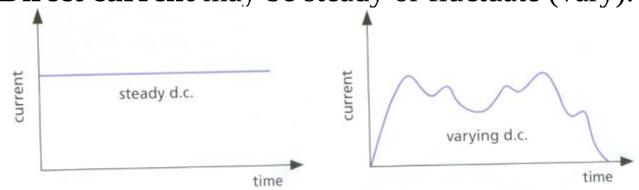
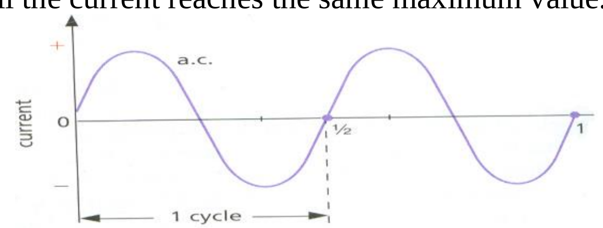
SCOPE OF WORK
GRADE: 11
UNIT: WAVES

TOPIC: ELECTROMAGNETIC SPECTRUM AND APPLICATIONS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe properties and applications/ uses of X-rays, gamma rays, UV rays, infrared, microwaves and radio waves. • Critically appraise applications of electromagnetic waves.	• Uses infrared radiation: anything that is hot but not glowing emits IR radiation alone, IR is detected by temperature sensitive photographic films used for taking photographs in the dark. Infrared sensors used on satellites and aircrafts for weather forecasting etc., ir lamps used for drying of paint on cars during manufacture, remote control keypads for tv. • Ultraviolet: cause sun tan, produce vitamins in skin, causes skin cancer, causes fluorescent paints and clothes washed in some detergents to fluorescence, UV lamps. • Radio waves: longest wavelengths in the spectrum, radiated from aerials, used to transmit sound, pictures etc. over long distances, radar detection of ships and aircrafts and missiles, • Microwaves: international telecommunications, television relay, mobile phone networks, satellite communications cooking, • X-Rays: X-Ray photography, imaging, • Gamma rays: kill cancer cells, sterilize food. • pg 52 GCSE Physics T. Duncan	• students research, collect photographs, construct charts, scrap books, etc. present on the uses and precautions of electromagnetic waves: gamma waves, x-rays, ultra violet, visible rays, infrared radiation, microwaves, • make models of the spectrum. • Debate the applications of electromagnetic waves eg in sterilization of foods, treatment of cancer, microwaves in communications (cell phones)	Internet Textbooks	Students research, presentations and models assessed for accuracy, creativity. Debates assessed for substantiated facts,

SCOPE OF WORK
GRADE: 11
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: DIRECT AND ALTERNATING CURRENT **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Distinguish between alternating (a.c.) and direct current (d. c.) • Represent both d.c. and a.c. on current-time & voltage - time graphs and deduce peak values and frequencies from a.c.	In a direct current, electrons flow in one direction only. **Direct current** may be steady or fluctuate (vary).  GCSE physics pg. 200 **Alternating current (a.c**) is an electric current whose magnitude and direction of flow is reversed in periodic cycles. Electrons first start to flow in one direction until the current reaches a maximum value, then the current slows down and stops. The electrons then start to flow in the opposite direction until the current reaches the same maximum value.  GCSE physics pg. 200 The peak voltage of an alternating current is the value of the crest/ peak or trough of its alternating waveform The number of cycles in one second (called the frequency) is given in a unit called Hertz (symbol Hz) where 1 Hz = 1 cycle per second.	**Interactive Simulation** https://phet.colorado.edu/en/simulation/legacy/circuit-construction-kit-ac **Demonstration** Use of the Cathode Ray Tube/ Oscilloscope to observe the of output of • Direct current (d.c) • Alternating current (a.c.) Sketching graphs of current against time and voltage against time for a.c and d.c. Worksheet Calculating: • period (T) and frequency (f) of an a.c. • peak voltage of a.c.	Cathode ray oscilloscope Power supply Signal generator Connecting wire	Probing questions during interactive simulation and demonstration Written Assessment • Quiz • Worksheet

SCOPE OF WORK
GRADE: 11
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: DIRECT AND ALTERNATING CURRENT **DURATION: 1 WEEK**

<table>
<tr><th>LEARNER OUTCOMES</th><th>CONTENT</th><th>ACTIVITIES</th><th>RESOURCES</th><th>METHOD OF ASSESSMENT</th></tr>
<tr>
<td>• State the advantages and disadvantages of alternating and direct current.</td>
<td>
<table>
<tr><th>d.c.</th><th>a.c.</th></tr>
<tr><td>Fixed direction</td><td>Reverses direction</td></tr>
<tr><td>May be steady in magnitude from a given source</td><td>Varies between reversals of polarity</td></tr>
<tr><td>Its value cannot be stepped up (increased) or stepped down (decreased) by a transformer</td><td>Its value can be stepped up (increased) or stepped down (decreased) by a transformer</td></tr>
<tr><td>Has an associated lighting, heating and magnetic effect</td><td>Has an associated lighting, heating and magnetic effect</td></tr>
<tr><td>Has an associated chemical effect (can be used in electrolysis, electroplating and battery charging)</td><td>Does not have an associated chemical effect (cannot be used in electrolysis, electroplating and battery charging)</td></tr>
<tr><td></td><td>Can be converted to d.c using rectifiers</td></tr>
</table>
</td>
<td>Demonstration of electrolysis using d.c.

Construction of simple electronic circuits using diodes in simple circuit</td>
<td>Internet
Projector
Laptop
a.c- d.c. Power supply
function generator
Cathode Ray Oscilloscope

Electrolysis kit

Junior electronic circuit kits
http://www.electronickits.com/kit/complete/science/sc300.htm</td>
<td>Practical Assessment: selection and use of materials; making measurements and observations; processing data; identifying sources of error, formulating conclusions and communicating information</td>
</tr>
</table>

SCOPE OF WORK
GRADE: 11
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: OHMIC & NON- OHMIC CONDUCTORS **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Design and construct test circuits to determine the resistance of a given circuit component, through the application of Ohm's Law.	A test circuit may be used to determine a range of voltages and currents for a given component.	Students design and construct test circuit to determine the resistance of a given circuit component by measuring the voltage across component and current in circuit as resistance is varied, then apply Ohm's Law to determine the resistance. Problem solving Worksheet: Students apply Ohm's Law to solve calculations **Interactive simulation:** https://phet.colorado.edu/en/simulation/ohms-law	Student electricity apparatus sets (circuit boards, connecting wire, bulb, switch, rheostat, d.c. ammeter, d. c. voltmeter, power supply/ battery pack) Worksheet	Practical skills assessed: selection and use of materials; making measurements and observations; processing data; identifying sources of error, formulating conclusions and communicating information Students complete worksheets with problems involving the application of Ohm's law (V=IR)
• Deduce how resistance varies from current versus voltage graphs (bulb, thermistors, LDR's) and explain their applications	Non-Ohmic conductors include: • **Filament lamp**..as temperature increases, the resistance of the filament wire increases and hence less current flows • **Thermistor** ... as temperature increases, the resistance of the thermistor decreases so more current flows. Thermistors are useful in circuits sensitive to temperature changes such as thermostats. • **Light dependent resistor (LDR)** ... as light increases, the resistance of the LDR decreases so more current flows. LDRs act as a light sensitive switches and are useful in light sensitive circuits such as burglar alarms, photographic equipment and automatic lighting and burglar alarms.	Construction of simple electronic circuits Drawing and interpreting graphs of V-I / I=V graphs for non-Ohmic conductors Drawing and interpreting resistance against temperature graphs for bulbs and thermistors Research and present applications of thermistors and LDR's	Junior electronic circuit kits http://www.electronickits.com/kit/complete/science/sc300.htm	Practical Assessment Students' research, presentations and simple electronic circuits assessed for accuracy, creativity.

SCOPE OF WORK
GRADE: 11
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: PARALLEL & SERIES CIRCUITS **DURATION: 2 WEEKS**

<table>
<tr><th>LEARNER OUTCOMES</th><th>CONTENT</th><th>ACTIVITIES</th><th>RESOURCES</th><th>METHOD OF ASSESSMENT</th></tr>
<tr>
<td>• Distinguish between parallel and series circuits (with reference to current, voltage and resistance), through construction of circuits

• Apply formulae to solve problems involving series and parallel resistors.
◦ $V_T = V_1 + V_2$ (series)
◦ $I_T = I_1 + I_2$ (parallel)
◦ $R_T = R_1 + R_2$ (series)
◦ $1/R_T = 1/R_1 + 1/R_2 + 1/R_3$ (parallel)</td>
<td>A series circuit is one that provides one complete conducting pathway, while parallel circuits provide alternative pathways for circuit current.
<table>
<tr><th>SERIES CIRCUIT</th><th>PARALLEL CIRCUITS</th></tr>
<tr><td>Supply voltage is shared between components. ($V_T = V_1 + V_2$…). The greater the resistance of a component, the greater its share of voltage.</td><td>Voltage across all components is same and equal to the supply voltage. ($V_T = V_1 = V_2$ …)</td></tr>
<tr><td>Total resistance is the sum of all the resistances. ($R_T = R_1 + R_2$ …)</td><td>The reciprocal of the total resistance is the sum of the reciprocals of all the resistances. ($1/R_T = 1/R_1 + 1/R_2 + 1/R_3$ …)</td></tr>
<tr><td>Current is same in all parts of the circuit. ($I_1 = I_2$ …)</td><td>Total current in the circuit is split into its separate branches, based on the resistance of each branch. ($I_T = I_1 + I_2$ …) The lower the resistance, the greater the current. Total current going into and leaving alternative branches is same.</td></tr>
</table>
</td>
<td>Laboratory Practical:
Students construct series circuit and parallel circuits and measure current in different parts of circuits and voltage across components.

Interactive simulations:
http://www.physicsclassroom.com/Class/circuits/u9l4b.cfm

https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc-virtual-lab

Problem Solving
Students apply formula to solve problems involving series and parallel circuits.</td>
<td>Student electricity apparatus sets (circuit boards, connecting wire, bulb, switch, ammeter, voltmeter, battery pack/ power supply)

Worksheets
Text</td>
<td>Practical skills assessed: selection and use of materials; making measurements and observations; processing data; identifying sources of error, formulating conclusions and communicating information

Students complete worksheets with problems finding current, voltage and resistance in series and parallel circuits</td>
</tr>
</table>

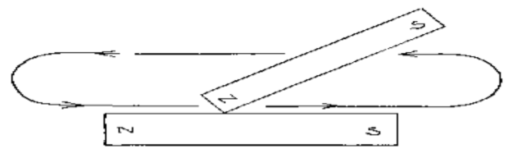
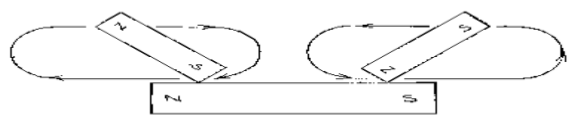
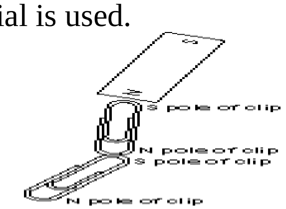
SCOPE OF WORK
GRADE: 11
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: PARALLEL & SERIES CIRCUITS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Justify the use of parallel circuitry for wiring buildings	Components in separate branches of parallel branches are unaffected if components in one branch is disconnected, whether blown or switched off. Components in Parallel circuits get full supply voltage and lower combined resistance when compared to series circuitry.	Wiring a model house using parallel circuitry. Debate Poster Jingle	Resources will vary	Students' research, presentations and models assessed for accurate presentation of concepts, (content), demonstrations, communicating information, formulating conclusions creativity in presenting, resourcefulness

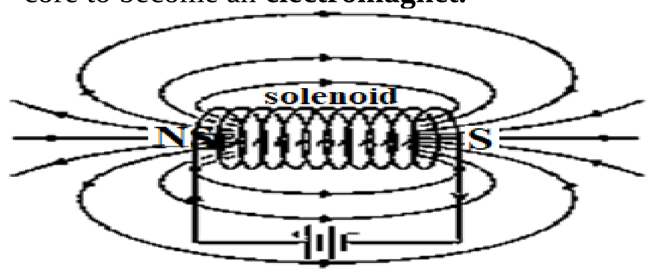
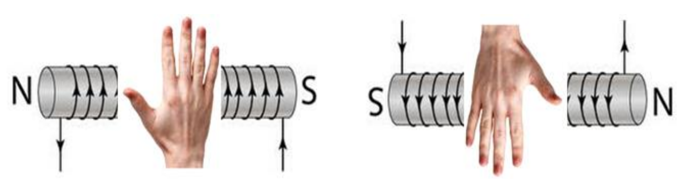
SCOPE OF WORK
GRADE: 11
UNIT: UNIT: ELECTRICITY AND MAGNETISM

TOPIC: MAGNETISM – MAKING MAGNETS **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe and explain the different methods of magnetization.	**Magnets may be made in the following ways:** 1. **By Stroking** … The act of stroking an un-magnetised material in one direction only, with a magnet, lines up each domain, so that they are all 'pointing' in the same direction. (i) Single touch method  (ii) Double touch method is a better method 	Stroke a piece of un-magnetised iron with the north pole of a bar magnet. Test it to see whether it attracts magnetic materials and use a plotting compass to determine the polarity. Repeat using a small un-magnetised steel bar or nail.	Un-magnetised steel, iron bar or nail, bar magnets, iron filings, plotting compasses	Use of Probing Questions Practical skills assessed: selection and use of materials; making observations; processing data;, formulating conclusions and communicating information
	2. **By Magnetic Induction** … In magnetic induction, a magnetic pole induces an unlike pole near to it and a similar pole away from it. When the ferromagnetic material is held close to a magnet, magnetism is induced into the material, allowing it to become a magnet. This induced magnetism is temporary if a magnetically soft material is used and permanent if a magnetically hard material is used.  	Attract a paper clip with a bar magnet, then use paper clip with induced magnetism to attract other paper clips.	Bar magnets, paper clips	

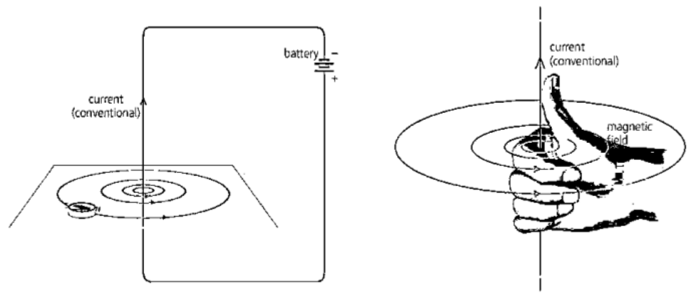
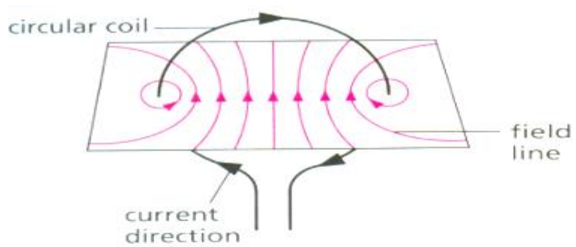
SCOPE OF WORK
GRADE: 11
UNIT: UNIT: ELECTRICITY AND MAGNETISM

TOPIC: MAGNETISM – MAKING MAGNETS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Construct an electromagnet and investigate the factors affecting its strength. • Predict the polarity of electromagnets.	3. **<u>By Electrical Method: using a Solenoid (long coil of wire (to make an electromagnet)</u>** An electromagnet (temporary) magnet is activated by an electric current. When a current is passed through the solenoid, it obtains a magnetic field (which is strongest inside the solenoid). If a bar of magnetically soft iron, called the **core**, is placed inside it, a much stronger magnetic field is attained, enabling the core to become an **electromagnet.**  The shape of the magnetic field is similar to that of a bar magnet and the polarity obtained by the electromagnet can be found by applying the Right Hand Grip Rule. The **Right Hand** Grip Rule: if the right hand grips the solenoid in the direction of the conventional current (positive to negative), the thumb points to the **north pole.** 	Wind about 0.5 m of insulated copper wire and round a large iron nail. Construct a simple circuit using suitable d.c. power supply (battery), ammeter, connecting wire and switch. Use electromagnet to attract magnetic materials such as iron filings, paper clips or staples. Students determine the polarity of electromagnet **Interactive simulation** https://phet.colorado.edu/en/simulation/legacy/magnets-and-electromagnets https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/magnetic-field-of-a-solenoid	Iron nail, insulated copper wire, connecting wires, ammeter, switches Magnetic materials (paper clips, staples, iron filings)	Use of Probing Questions Practical Assessment: selection and use of materials; making observations; measuring, recording and processing data; keeping variables constant; formulating conclusions; communicating information and making predictions Assessment of electromagnet for functionality and creativity Written Assessment • Quiz • Worksheet

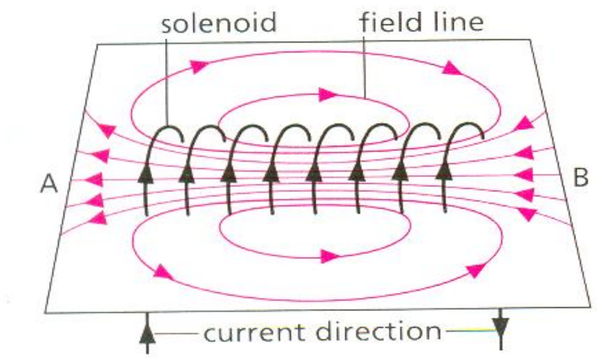
SCOPE OF WORK
GRADE: 11
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTROMAGNETISM – MAGNETIC FIELDS AROUND CURRENT CARRYING WIRES **DURATION: 1 ½ WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe the magnetic flux pattern for a straight wire, a circular coil and a solenoid each carrying a direct current.	The magnetic field pattern around a straight vertical wire is one of concentric circles. The direction of the magnetic field may be determined by plotting compasses or the by applying the Right Grip Rule, which states that if the right hand is used to grip the wire in the direction of conventional current, the fingers point in the same direction as the magnetic field lines.  Complete Physics for IGCSE. pg. 204 The magnetic field pattern due to a circular coil is shown below:  GCSE physics pg. 235	**Interactive simulations** https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/magnetic-field-around-a-wire-i https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/magnetic-field-around-a-wire-ii **Practical Activity:** • Pass a current through a vertical wire with iron filings sprinkled on a horizontal cardboard. Tap the card lightly and observe magnetic field pattern. • Place a small compass on the card to find the direction of the magnetic field • Apply the right hand grip rule to confirm the direction of the magnetic field • Reverse current direction and repeat • Sprinkle iron fillings on a horizontal cardboard into which a coil carrying current has been placed. • Tap the card lightly and observe magnetic field pattern. • Place a small compass on the card to find the direction of the magnetic field	Power source (d.c. power source/ 1.5 V D cells) Straight vertical wire Cardboard Compasses Iron filings Power source (d.c. power source/ 1.5 V D cells) Circular coil Cardboard Compasses	Practical Assessment selection and use of materials; making observations; measuring, recording and processing data; keeping variables constant; formulating conclusions; communicating information and making predictions Written Assessment • Quiz • Worksheet - Drawing magnetic fields around straight wires coils or solenoids that carrying current - Predicting the direction of the magnetic field Use of Probing Questions

SCOPE OF WORK
GRADE: 11
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTROMAGNETISM – CURRENT AND MAGNETISM

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe the magnetic flux pattern for a solenoid carrying a direct current.	A solenoid is a long cylindrical coil of wire. The field pattern is similar to a bar magnet as shown below:  GCSE Physics pg. 235	Sprinkle iron fillings on a horizontal cardboard into which a solenoid has been placed. Tap the card lightly and observe magnetic field pattern. Place a small compass on the card to find the direction of the magnetic field	Power source (d.c. power source/ 1.5 V D cells) solenoid Compasses	Probing Questions Practical Assessment selection and use of materials; making observations; measuring, recording and processing data; keeping variables constant; formulating conclusions; communicating information and making predictions

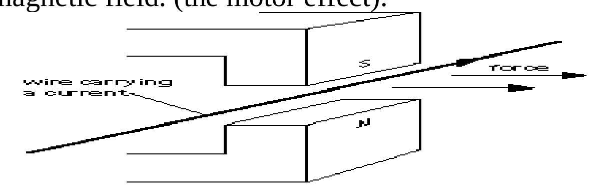
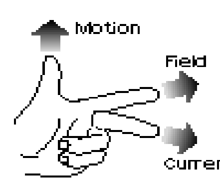
SCOPE OF WORK
GRADE: 11
UNIT: MAGNETISM & ELECTROMAGNETISM

TOPIC: ELECTROMAGNETISM – CURRENT AND MAGNETISM **DURATION: 1 ½ WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Distinguish between magnetically hard and soft materials.	**A Magnetically Hard** material is one that is difficult to magnetize, but retains its magnetism permanently, once magnetized e.g. steel. **A Magnetically Soft** material is one that is easy to magnetize, but loses its magnetism easily. The magnetism is temporary e.g. iron.	Practical Activity Construction of electromagnets using (soft) iron cores and (hard) steel cores	Iron nail, steel nails, insulated copper wire, connecting wires, ammeter, switches Magnetic materials (paper clips, staples, iron fillings)	Practical Assessment selection and use of materials; making observations; measuring, recording and processing data; keeping variables constant; formulating conclusions; communicating information and making predictions
• Describe and construct electromagnetic devices e.g. relays, electric bells, circuit breakers, scrap iron lifts.	Electromagnets (usually made of a soft iron core) become magnetised when a current flows through it, causing the soft-iron armature to be attracted to the pole of the electro-magnet. In the case of • an electric bell ... this action causes the hammer to strike the gong. • a relay ... this action completes a secondary circuit. (A relay is a magnetic switch, used so that a small current can switch on a large current).	Practical Activity Construction of simple electromagnetic devices such as relays and electric bells. Research and Present on electromagnetic devices	power supply or 1.5 D cells, iron rod, connecting wires, ammeters, bell	Probing Questions Students' research, presentations and simple electronic circuits using STREAM assessed using rubric for accuracy, functionality creativity.
• Describe and explain the different methods of demagnetization.	Methods of demagnetizing permanent magnets include: (1) Heating, (2) Banging or hitting and (3) Alternating Current Heating and hitting makes the particles move vigorously upsetting the alignment of the domains. Using an alternating current slowly breaks up the arrangement of the domains, as the current, and the direction of the magnetic field, are constantly changing direction. Domains arranged haphazardly have no overall magnetic effect.	Brain- storming: Why and how to demagnetize magnets? Students research and present methods of demagnetizing magnets and reasons why demagnetization may be necessary.	Textbooks Internet	Student presentations using visual aids of brain storming sessions and research findings

SCOPE OF WORK
GRADE: 11
UNIT: MAGNETISM & ELECTROMAGNETISM

TOPIC: ELECTROMAGNETISM – CURRENT AND MAGNETISM

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Explain why a rectangular, current carrying coil experiences a couple in a uniform magnetic field.	When a wire carrying a current is placed in a magnetic field, at right angles to the direction of the field, it experiences a force, at right angles to the direction of the current and the direction of the magnetic field. (the motor effect).  When a rectangular coil carries current in a magnetic field, the current in the coil flows in opposite directions. A couple (pair of forces, equal in size but opposite in direction) is experienced which pushes one side of the coil upwards and the other side of the coil downwards, causing the coil to rotate.	Student Research: • Why does the wire experience a force resulting in motion? • Why does the rectangular coil carrying current rotate when placed in a magnetic field? • How would the direction of motion or force on wire change? Practical Activity • Place a straight wire carrying a current between the opposite poles of a C-shaped magnet and observe movement • Place a coil carrying current between the curved opposite poles of a C-shaped magnet and observe movement	Textbooks Internet C –shaped magnet Straight wire Rectangular coil Power supply/ battery pack	Probing Questions Practical Assessment selection and use of materials; making observations; measuring, recording and processing data; keeping variables constant; formulating conclusions; communicating information and making predictions Written assessment (worksheets)
• Use Fleming's left hand rule to determine the direction of motion or force acting on a current-carrying conductor placed perpendicularly in a magnetic field.	The direction of motion or force acting on a current carrying conductor (wire) placed perpendicularly in a magnetic field may be predicted using Fleming's Left Hand Rule. Fleming's Left-hand Rule: If the thumb, the first finger, and the second finger of the left hand are held at right angles to each other, then: • The **F**irst finger points in the direction of the **F**ield (N to S) • The se**C**ond finger points in the direction of (Conventional) **C**urrent • The thu**M**b points in the direction of the **M**otion of the wire.  	Use Fleming's Left-hand Rule to predict the direction motion or force acting on a current-carrying conductor placed perpendicularly in a magnetic field. Think-pair-share: Worksheet applying Fleming's Left Hand Rule to predict direction of motion or force on wire or rectangular coils placed perpendicular to magnetic field	Text Internet Worksheets	

SCOPE OF WORK
GRADE: 11
UNIT: MODERN PHYSICS & ASTROPHYSICS

TOPIC: _RADIOACTIVITY - RADIOACTIVE DECAY EQUATIONS **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Write and balance equations for alpha, beta and gamma decay • Account for the changes if any in atomic number or mass number for alpha and beta and gamma decay	**Radioactive decay equations:** Two simple rules to follow when writing decay equations - the total mass number on the left-hand-side must be equal to the total mass number on the right-hand side (i.e. mass number must be conserved) - the total atomic number on the left-hand-side must be equal to the total atomic number on the right-hand side (i.e. charge must be conserved) **Alpha decay example** ${}^{226}_{88}Ra \longrightarrow {}^{222}_{86}Rn + {}^{4}_{2}He$ **(α particle)** **radium-226 radon-222 helium-4** Mass number check: 226 = 222 + 4 Atomic number check: 88 = 86 + 2 **Beta decay example** ${}^{14}_{6}C \longrightarrow {}^{14}_{7}N + {}^{0}_{-1}e$ **(β particle)** **carbon-14 nitrogen-14 beta** Mass number check: 14 = 14 + 0 Atomic number check: 6 = 7 + (-i) **Gamma decay example** ${}^{222}_{86}Rn \longrightarrow {}^{222}_{86}Rn + {}^{0}_{0}\gamma$ **(photon)** **radon-222 radon-222 gamma ray** Mass number check: 222 = 222 + 0 Atomic number check: 86 = 86 + 0 (gamma rays are electromagnetic waves and have no mass or charge)	**1 Balancing radioactive decay equations e.g.** - alpha decay of americium-241 (americium 241 is used in smoke-detector alarms) - beta decay of sodium-24 (a weak source of sodium-24 is used as a radioactive tracer to monitor blood flow) - gamma decay of cobalt-60 (cobalt-60 is used to "see through" baggage at airports and through the body the way x-rays work) **2 Simulation** Run the alpha particle decay simulation of polonium-211 **Simulation of beta decay** (showing random nature of decay) Run the simulation on 'beta decay' to show the random nature of radioactive decay.	Periodic Table Chart (to help students identify elements from their atomic numbers) **alpha decay simulation** Click on the link below. **http://phet.colorado.edu/simulations/** Then type 'alpha decay' in the search bar to find the alpha decay of polonium-211 **Simulation of beta decay** Click on the link below. **http://phet.colorado.edu/simulations/** Then type 'beta decay' in the search bar to find the beta decay simulation *Physics for CSEC*, by Farley and Trotz, ch. 37	Writing and balancing radioactive decay equations Predicting daughter elements produced from alpha, beta and gamma decay of given elements Inferring parent elements given nature of emission and daughter elements

SCOPE OF WORK
GRADE: 11
UNIT: THE ATOM & NUCLEAR PHYSICS

TOPIC: RADIOACTIVITY - HALF LIFE **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Define half-life • Solve radioactive decay problems based on numerical data of half-life	**Why half-life?** Radioactive decay is a random process. This means that we cannot tell exactly when a particular atom will decay (i.e. its 'life'). An atom might decay in 5 minutes; its neighbour might decay in 5 million years. However, for a large sample of atoms of a given element, the time taken for half the sample to decay is constant. This time is called the half-life of the sample. It has also been found that the rate of decay is proportional to the quantity of un-decayed atoms in a sample. Therefore half-life can be determined practically by measuring the time taken for the rate of decay of a sample to drop by half. We measure rate of decay in becquerels (Bq), where 1 Bq = 1 decay per second. Decay rate is also called 'activity'. Another unit of decay rate is the curie (Ci) where 1 Ci = 3.7×10^{10} decays per second. **Solving decay problems based on numerical data:** To find the half-life, we must divide the total time of decay by the number of half-lives that occurred during the decay. (See example on right.)	**1 Determining half-life from simulation** The simulation cited will give the half-life of the element (see the red line). Pause the simulation when half of the sample has decayed. Read the time taken and compare it with the given half-life. Do this several times using 10 atoms and find the average. Repeat with 100 atoms and find the average. Do we get more consistent results of half-life if the sample size is large or small? **2 Solving decay problems based on numerical data** The initial activity of a sample is 80 Bq. After 500 minutes, the activity drops to 20 Bq. Determine the half-life of the sample. Solution From 80 Bq to 40 Bq to 20 Bq represents 2 half-lives. Hence one half-life = 500 mins ÷ 2 = 250 mins.	Textbooks Internet (simulation) **http://phet.colorado.edu/simulations/** Worksheets	Defining 'half-life'. Determining half-life from a simulation which shows decays Solving problems based on half-life using numerical data

SCOPE OF WORK
GRADE: 11
UNIT: MODERN PHYSICS & ASTROPHYSICS

TOPIC: _RADIOACTIVITY

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Determine half-life of a radioactive isotope from a decay graph • Distinguish between observed and corrected count rate (subtracting background radiation)	**Experimental determination of half-life** This could be done by plotting a graph of corrected activity vs. time for a sample. (Corrected activity is observed activity minus background activity.) See graphs in textbook.	**3 Experimental determination of half-life** (not to be done experimentally at high-school level on account of dangers present) **4 Determining half-life graphically** **5 Determining age of a piece of ancient wood** An example of archaeological dating, using an activity per gram vs. time graph, is discussed in *Physics for CSEC*, by Farley and Trotz, pp 529-530.		Interpreting activity vs. time graphs - determining half life - predicting activity for a future time Defining 'corrected count rate' Using activity vs. time graphs to determine ages of samples
• Explain dating methods using carbon-14 and calculate age of dead organic materials	**Radioactive dating** Knowing the present activity per gram of a sample and the graph of activity per gram vs. time for the material, we can determine the age of the sample.	**6 Radioactive dating game simulation** Play the radioactive dating game.	**Radioactive dating game simulation** Click on the link below. **http://phet.colorado.edu/simulations/** Then type 'radioactive dating game' in the search bar to find the games and simulations.	

SCOPE OF WORK
GRADE: 11
UNIT: MODERN PHYSICS & ASTROPHYSICS

TOPIC: HISTORY & GREAT ASTRONOMERS **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Understand a historical approach from the geocentric model of our solar system to the heliocentric model. • Name great astronomers and describe their contribution to astronomy (Bruno, Copernicus, Galileo, Kepler, Hubble, Friedman, Hoyle, etc.)	• The development of astronomy has been deeply intertwined with the development of civilization. Revolutions in astronomy have gone hand in hand with the revolutions in science and technology. • In 1543, the Copernican revolution, revealed that the earth is not the center of the universe, but a planet orbiting the sun. Three later figures–Tycho Brahe, Johannes Kepler, and Galileo–provided the key evidence that eventually led to wide acceptance of the Copernican idea. The revolution culminated with Isaac Newton's uncovering of the laws of motion and gravity.	• In class discussions/Internet research Students can be asked to research the sciences of astronomy, astrophysics and cosmology to prepare for a 5 minute PowerPoint presentation/ role play convincing others that the earth is not flat.	*Cosmic Perspective* by Bennett, Donahue Internet access	Student 5 minute PowerPoint presentation to class.

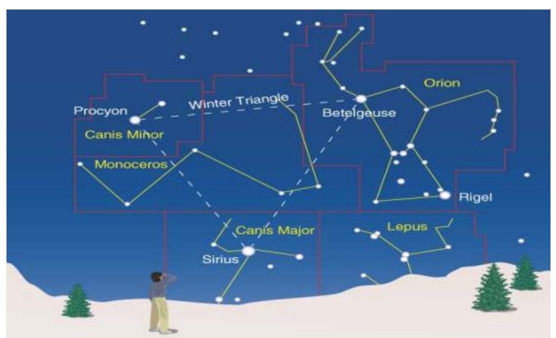
SCOPE OF WORK
GRADE: 11
UNIT: MODERN PHYSICS & ASTROPHYSICS

TOPIC: ASTRONOMY **DURATION: 1 ½ WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Define the terms: astronomical unit, light year, galaxy, star, planet, asteroid, moon, comet, meteor, meteorites	• An astronomical unit (abbreviated as **AU** or **au)** is a unit of length equal to approximately 149.60 million kilometres (93 million miles). It is defined by the International Astronomical Union, and is the mean (average) distance between the Earth and the Sun over one Earth orbit. • A light year is a unit of length, and it is the distance that light travels in one year. It is a little less than 10^{13} kilometres. • A galaxy is a numerous large-scale aggregates of stars, gas, and dust that constitute the universe, containing an average of 100 billion (10^{11}) stars and ranging in diameter from 1,500 to 300,000 light-years. • A star is a self-luminous celestial body consisting of a mass of gas held together by its own gravity in which the energy is generated by nuclear fusion in the interior • A planet is a celestial body that orbits the sun, has sufficient mass to assume nearly a round shape, clears out dust and debris from the neighborhood around its orbit. • An asteroid is any of the numerous small, often irregularly shaped rocky bodies that orbit the Sun primarily in the **asteroid belt**, a region between the orbits of Mars and Jupiter.	Make a vocabulary list of terms	Complete Physics – Pople Internet	Online quiz

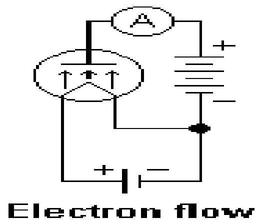
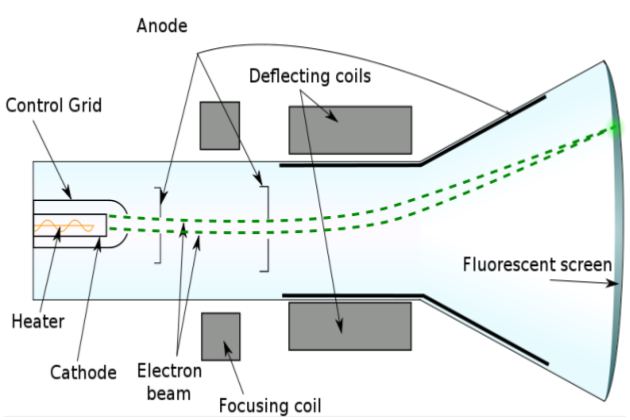
SCOPE OF WORK
GRADE: 11
UNIT: MODERN PHYSICS & ASTROPHYSICS

TOPIC: ASTRONOMY

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Define the terms: astronomical unit, light year, galaxy, star, planet, asteroid, moon, comet, meteor, meteorites	• A moon is a natural satellite revolving around a planet. • A comet is a relatively small extraterrestrial body consisting of a frozen mass that travels around the sun in a highly elliptical orbit • A meteor is a very small meteoroid that has entered the earth's atmosphere. Such objects have speeds approaching 70 kilometres per second. The friction with the air causes the meteor to glow with heat. Also called *shooting star*. • A stony or metallic mass of matter that has fallen to the earth's surface from outer space.	Make a vocabulary list or scrap book of terms.		Worksheets
• Identify some constellations such as: Orion, Ursa Minor, Ursa Major and Canis Major.	• A constellation is an area of the celestial sphere defined by exact boundaries. It can also be used loosely to refer to the more prominent, visible stars that seem to form a pattern in that area. The most recognized constellation is Orion. 	• Constellations can be shown to students by downloading a free software " Stellarium®" from www.stellarium.com • Nighttime observations • Observe and draw 2-3 constellations eg. Orion and classify stars according to the observation.	*Cosmic Perspective* by Bennett, Donahue • Free Stellarium® software	The Cosmic Perspective has teachers resources with lots of worksheets • Worksheets

SCOPE OF WORK
GRADE: 11
UNIT: ELECTRONICS

TOPIC: THERMIONIC EMISSION & THE CATHODE RAY OSCILLOSCOPE **DURATION: 1 ½ WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Define and explain thermionic emission.	Thermionic emission is the emission of **electrons or ions** by substances that are highly heated, the charged particles being called thermions. The number of thermions emitted increases rapidly as the temperature of the substance rises. The heated material may be in the form of a metal filament or of some compound that coats and is heated by the filament. 	• Teachers can show a video to demonstrate thermionic emission.	Suggested link: https://www.youtube.com/watch?v=QhG7u9PXG88 https://www.youtube.com/watch?v=tYCET6vYdYk	Worksheet
• Draw a diagram of a cathode ray tube and explain how it works.	Diagram of a CRT 	• Teachers can describe and explain how the CRO works using the apparatus provided	• A digital CRO	• Worksheets • This website has some great questions on the CRO: http://www.allaboutcircuits.com/worksheets/scope1.html

SCOPE OF WORK
GRADE: 11
UNIT: ELECTRONICS

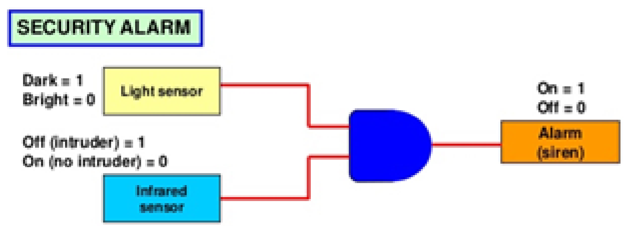
TOPIC: THERMIONIC EMISSION & THE CATHODE RAY OSCILLOSCOPE

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe and explain how the cathode ray oscilloscope works and state common uses.	In a cathode ray tube, the "cathode" , a heated filament, is in a vacuum created inside a glass tube. The "ray" is a stream of electrons that naturally pour off a heated cathode into the vacuum. Electrons are negative. The anode is positive, so it attracts the electrons pouring off the cathode. In a TV's cathode ray tube, the stream of electrons is focused by a focusing anode into a tight beam and then accelerated by an accelerating anode. This tight, high-speed beam of electrons flies through the vacuum in the tube and hits the flat screen at the other end of the tube. This screen is coated with phosphor, which glows when struck by the beam. The image formed on this screen can be used in oscilloscopes, televisions, computer monitors and radars. A cathode ray oscilloscope is an electronic measuring instrument that creates a visible two-dimensional graph of one or more electrical potential differences. The horizontal axis of the display normally represents time, making the instrument useful for displaying periodic signals. The vertical axis usually shows voltage. The display is caused by the electron beam hitting the phosphor and periodically sweeping the screen from left to right. Oscilloscopes are used in the sciences, medicine, engineering, telecommunications, and industry. Some are used for maintenance of electronic equipment and laboratory work. Special-purpose oscilloscopes may be used for such purposes as analyzing an automotive ignition system, or to display the waveform of the heartbeat as an electrocardiogram.	Research the operation, common uses and applications of the cathode ray oscilloscope Constructing models simulating the use of Cathode Ray Oscilloscopes Teacher demonstration of the use of the Cathode Ray Oscilloscope Students use output on screen of Cathode ray oscilloscope to determine peak voltage and frequency of a.c. and to distinguish between direct and alternating current	Internet Physics Texts	Research project Presentation Simulations Worksheet: • Determining peak voltage and frequency of alternating current waveforms generated by a CRO • Distinguishing between direct and alternating current

SCOPE OF WORK
GRADE: 11
UNIT: ELECTRONICS

TOPIC: SIMPLE ELECTRONIC CIRCUITS & LOGIC GATES **DURATION: 1 ½ WEEKS**

<table>
<tr><th>LEARNER OUTCOMES</th><th>CONTENT</th><th>ACTIVITIES</th><th>RESOURCES</th><th>METHOD OF ASSESSMENT</th></tr>
<tr>
<td>Design and use simple control and monitoring systems with electronic AND and OR gates</td>
<td>The diagram below shows a simple electronic control system that is used as a security alarm manual switch to switch on the street lights



Source:
https://www.slideshare.net/ryanko1612/25application-of-logic-gates

<table>
<tr><th>Light sensor</th><th>Infrared sensor</th><th>Alarm</th></tr>
<tr><td>Dark</td><td>Intruder</td><td>On</td></tr>
<tr><td>Dark</td><td>No intruder</td><td>Off</td></tr>
<tr><td>Bright</td><td>Intruder</td><td>Off</td></tr>
<tr><td>Bright</td><td>No intruder</td><td>Off</td></tr>
</table>
Truth Table</td>
<td>Student activities can include designing and testing these monitoring systems

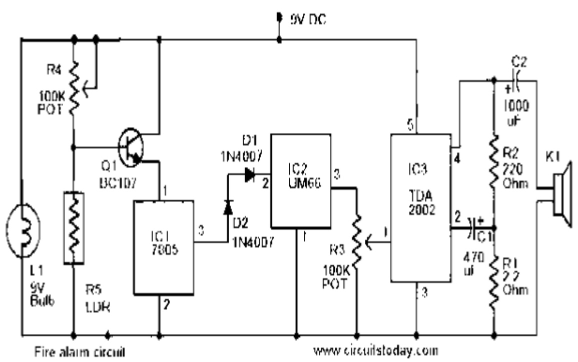
Students can design simple electronic circuits using readily available materials.</td>
<td>Snap Circuits®

Internet access</td>
<td>• Students can draw circuit diagrams for types of electronic circuits and then construct them.

• Worksheets exercises can be found on: http://www.scribd.com/doc/5370651/9-4-Logic-Gates-doc</td>
</tr>
</table>

SCOPE OF WORK
GRADE: 11
UNIT: ELECTRONICS

TOPIC: SIMPLE ELECTRONIC CIRCUITS & LOGIC GATES

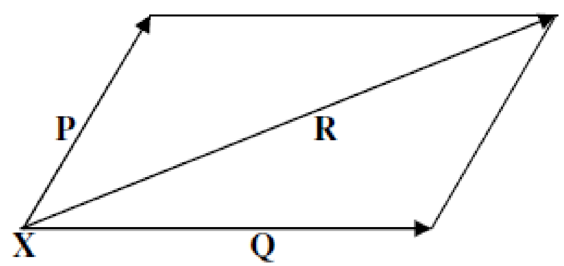
LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
✓ Design and construct simple electronic circuits such as motor control, light-operated switches, fire alarms and burglar alarms.	A simple fire alarm circuit based on a LDR and lamp pair could be used for sensing the fire. The alarm works by sensing the smoke produced during fire. The circuit produces an audible alarm when the fire breaks out with smoke. When there is no smoke the light from the bulb will be directly falling on the LDR. The LDR resistance will be low and so the voltage across it (below .6V).The transistor will be OFF and nothing happens. When there is sufficient smoke to mask the light from falling on LDR, the LDR resistance increases and so do the voltage across it. Now the transistor will switch to ON. This gives power to the IC1 and it outputs 5V.This powers the tone generator IC UM66 (IC2) to play a music. This music will be amplified by IC3 (TDA 2002) to drive the speaker. Read more: http://www.circuitstoday.com/fire-alarm-circuit#ixzz0qMtR1Eu1 Here is a circuit diagram of the above fire alarm system:  Source: http://www.circuitstoday.com/fire-alarm-circuit	Student activities can include designing and testing these monitoring systems Students can design simple electronic circuits using readily available materials.	Snap Circuits® Internet access	• Students can draw circuit diagrams for types of electronic circuits and then construct them. • Worksheets. Exercises can be found on: http://www.scribd.com/doc/5370651/9-4-Logic-Gates-doc

SCOPE OF WORK

GRADE: 12

UNIT: FORCES

TOPIC: RESOLVING FORCES **DURATION: 1 ½ WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Add parallel forces along a line. • Determine the resultant of perpendicular forces (parallelogram law, Pythagoras Theorem scale drawings, trigonometry)	**Resultant of parallel and anti parallel forces.** The resultant, F, of two parallel forces, **P** and **Q**, is given by: **F = P + Q** For anti-parallel forces, **P** and **Q**: **F = P - Q.** **Parallelogram of forces rule** The resultant, **R**, of two forces, **P** and **Q**, acting at an angle to each other on an object can be found by: • drawing the forces, **P** and **Q** to scale, acting at a point, X, and • completing the parallelogram The resultant is the diagonal of the parallelogram, drawn from X. 	This should help convey the idea that F is the resultant, and that F = P + Q. If a mass of known weight, W, is suspended by a spring balance and a force, P, registers on the spring, then, since the mass is stationary, it means that the net force F = 0. Therefore, for the two anti-parallel forces: **F = P – W**. **1 Finding the resultant of two forces acting at an acute angle by scale drawing** Students are shown how to draw parallelograms. Then they can be guided into finding the resultant (magnitude and direction) of a 70-N force and an 80-N force acting at angle of 60$_{o}$ between them **2 Demonstrating resultant direction for mutually perpendicular forces** The teacher holds a small, folded paper about the middle of a rubber band. Two students exert pull on the rubber band with forces at right angles to each other.		**Determining resultant:** • Correctly drawing a parallelogram • Determining magnitude and direction of resultant and specifying units correctly

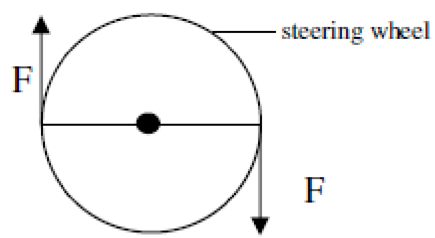
SCOPE OF WORK
GRADE: 12
UNIT: FORCES

TOPIC: RESOLVING FORCES

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Resolve a force into its perpendicular components and determine the components	**Components of a force** Rectangular components of a force are two forces, acting at right angles to each other, that together produce the same effect as the single force. Since **P** and **Q** together produce the same effect as **R** in the diagram above, then **P** and **Q** are the components of **R**. From simple trigonometry, it can be shown that: $\mathbf{Q} = \mathbf{R}\cos\theta$, and $\mathbf{P} = \mathbf{R}\sin\theta$	**Finding the resultant of two forces acting at a right angle to each other (practical method)** Three strings are tied to a form a knot at a point X. The free ends of the strings are connected to spring balances such that three students exert forces P, Q and E to keep the knot stationary. (The angle between the forces **P** and **Q** is kept at 90^{o}) When the knot is stationary, the magnitude of E is equal to the magnitude of **R**. (**E** is called the *equilibrant*, since it keeps the knot in equilibrium.) By drawing lines under the strings on a paper below, the direction of the resultant **R** can be obtained. **3 Finding components** Students can be asked to identify and calculate components in the following situations: • The horizontal and vertical components of a force of 75 N pulling at an angle of 40^{o} to the horizontal on a suitcase. The components of a weight of 60 N along and perpendicular to a plane inclined at 30^{o}.	Strings Spring balances *Physics for CSEC*, by Farley and Trotz, ch. 5 Demonstration using a box and a string Demonstration using a ball on an inclined plane	**Identification and calculation of components**

UNIT: FORCES

TOPIC: PRINCIPLE OF MOMENTS DURATION: 1 WEEK

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Apply the principle of moments to solve problems. •	**Principle of moments** For rotational equilibrium, the sum of the clockwise moments about an axis must be equal to the sum of the anti-clockwise moments about the same axis. **Couple** A *couple* is a pair of forces, equal in magnitude, applied on opposite sides of and the same distance from an axis of rotation, that produce the same type of moment (clockwise or anti-clockwise). The forces on the steering-wheel shown below form a couple.  The moment of a couple in which each force is a distance, r, from the axis (in the steering-wheel, the axis is at the centre of the circle) is given by **M = F r + F r = F x 2r**	**Applying the principle of moments** Types of practice exercises can include: . children on a see-saw . a wheelbarrow lifting a load . a crow-bar overcoming a load - (Note: Caution students that moment due to a mass is not mass x d, but weight x d, since moment deals with forces and weight, not mass, is a force.) **Balancing moments** 1. Place a metre rule on a pivot (e.g. the side of a pencil) so that the ruler balances (approximately). Note the balance point and use this pivot at this point throughout the experiment. 2. Place a 100-g mass on the ruler at a distance of 20.0 cm from the pivot. The ruler becomes overbalanced. 3. Balance the ruler using - a smaller mass (e.g. 50 g) - a larger mass (e.g. 200 g)	See end-of chapter questions, *Physics for CSEC*, by Farley and Trotz, ch. 6. *Physics for CSEC*, by Farley and Trotz, ch. 6 Metre rule Pencil as pivot (or hang by a string) Masses (50 g, 100 g 200 g)	**Solving numerical problems** **Calculating moments** Rubric for assessing **Conducting an investigation** - correct placement of masses - identifying factors affecting moment - Solving numerical problems

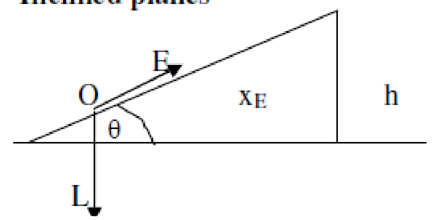
SCOPE OF WORK
GRADE: 12
UNIT: FORCES

TOPIC: MACHINES **DURATION: 2 WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
MACHINES • Describe the use of inclined planes, screws & gears as machines. • Determine and use the relationship between mechanical advantage, efficiency and velocity ratio for pulley systems and inclined plane. • Calculate mechanical advantage, velocity ratio and efficiency of given simple machine.	**Machine** A machine is a device that makes doing work easier. This is achieved either by - using a small force to overcome a large load, or - applying a force from a convenient position **Mechanical advantage (MA), velocity ratio (VR) and efficiency (Eff) of a machine** - Mechanical advantage is defined as the ratio of the load (L) to the effort (E). Thus: $MA = L / E$ - Velocity ratio is the ratio of the distance (x_E) moved by the effort to the distance (x_L) moved by the load in the same time. Thus: $VR = x_E / x_L$ - Efficiency is the ratio of useful work W_L done on the load to the work W_E done by the effort. Thus: $Eff = W_L / W_E$ (To obtain *percentage* efficiency, we multiply Eff by 100%.)	Numerical problem solving	See text and end-of chapter questions, *Physics for CSEC*, by Farley and Trotz, ch. 10.	Rubric for assessing oral/viewed presentations. Relationship clearly shown **Lab report** Rubric for assessing processing data.

SCOPE OF WORK
GRADE: 12
UNIT: FORCES

TOPIC: MACHINES

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	Relationship among MA, VR and Eff Since $W_L = L\ x_L$ and $W_E = E\ x_E$, Then, $\text{Eff} = \frac{L\ x_L}{E\ x_E} = (L/E)\ x\ (x_L / x_E)$ Hence, **Eff = MA / VR** **Inclined planes** Inclined planes make work easier by requiring a smaller force to overcome a larger load. See activity in column on right. **Screws** Screws make work easier through an effort that travels a large distance (the circumference of a circle e.g. the circumference of a screwdriver handle) while the load advances a tiny distance. This tiny distance is called the *pitch* (p) of the screw i.e. the distance between successive threads. Assuming an efficiency of 1, $E\ x_E = L\ x_L = L\ p$ Hence, $L / E = x_E / p = 2\pi R / p$ Or, $\mathbf{MA = 2\pi R / p}$	**Inclined planes**  The idea involved in using an inclined plane is to raise a load (L) a certain height (h), by means of an effort that is smaller than the load. Students measure: L, E, h, θ, and xE. They compute MA, VR and Eff from the data. (Note that Eff can be calculated in two ways: Eff = MA/VR and Eff = L h / E xE = MA sinθ.) Screws Students observe the action of screws penetrating wood or car jacks. They identify: pitch, the radius R, the effort and the load.		Quiz

SCOPE OF WORK
GRADE: 12
UNIT: FORCES

TOPIC: MACHINES

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	In other words, a large MA is obtained by using a screw with a small pitch (p) and a screwdriver handle with a large radius (R). **Pulleys** Single fixed pulley The load is equal to the effort since the force throughout a tight string is the same. This arrangement makes work easier through being able to apply the effort from a convenient position.	**Pulleys** Single fixed pulley - Students set up a single fixed pulley arrangement and determine MA, VR and Eff. Students verify that MA ≈ 1. - Students draw forces E and L. Single movable pulley - Students set up a single movable pulley arrangement and determine MA, VR and Eff. - Students observe that there are two portions of string that support the movable pulley and load and that therefore MA ≈ 2. - Students draw forces E and L. One pulley in the upper, fixed block and two in a lower, movable block - Students draw the arrangement to show that three portions of strings support the lower block and the load - Students set up the arrangement and determine MA, VR and Eff. - Students verify that MA ≈ 3.	Laboratory pulleys Clothes-line pulleys Pulley systems made by students (using thread reels, stiff wire and ribbons) Block and tackle pulleys	**Numerical Problem-S**olving Solving problems involving inclined planes, pulleys and gears

SCOPE OF WORK
GRADE: 12
UNIT: FORCES

TOPIC: MACHINES

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	Gears Gear A, radius R, no. of teeth N.  Gear B, radius r, no. of teeth n. Velocity ratio (Let us consider A as the driving gear.) When the effort at A moves through1revolution, the load at B makes $2\pi R$ / $2\pi r$ revolutions i.e. R/r revolutions. Since number of teeth on a gear is proportional to the radius of the wheel, then the load gear (B) makes N/n revolutions. Considering 1 revolution of A, we get **VR = 1/(N/n) = n/N**	Two pulleys in the upper, fixed block and one in a lower, movable block - Students draw the arrangement to show that three portions of strings support the lower block and the load - Students set up the arrangement and determine MA, VR and Eff. - Students verify that MA ≈ 3. Two pulleys in the upper, fixed block and two in a lower, movable block - Students draw the arrangement to show that four portions of strings support the lower block and the load - Students set up the arrangement and determine MA, VR and Eff. - Students verify that MA ≈ 4. *Students should observe that the velocity ratio in all cases is equal to the number of strings supporting the load.*		

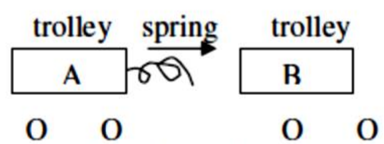
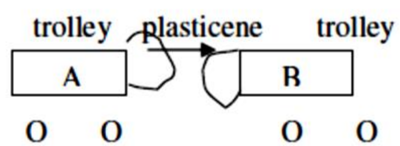
SCOPE OF WORK
GRADE: 12
UNIT: FORCES

TOPIC: MACHINES

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	Thus, when A (with the larger number of teeth) is the driving gear, the velocity ratio is less than 1. Mechanical advantage For the above arrangement, assuming Eff = 1, we get MA = VR and hence, **MA = n/N** The MA is less than 1, meaning that a large effort is applied where the gears meet to overcome a smaller load. As far as forces are concerned, this is a mechanical disadvantage. However, the smaller gear spins faster than the larger gear. The reverse is true. To overcome a large load at A, a smaller effort is applied at B. In other words, B must be the driving gear. A will spin at a slower rate than B. Bicycles and car engines make use of these facts.			

SCOPE OF WORK
GRADE: 12
UNIT: FORCES

TOPIC: CONSERVATION OF MOMENTUM **DURATION: 1 ½ WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
COLLISIONS AND MOMENTUM • State the law of conservation of linear momentum • Differentiate between elastic and inelastic collisions	or $F \alpha \frac{mv - mv_0}{t}$ Therefore $\mathbf{F = \frac{mv - mv_0}{t}}$ **……… (2)** (since the unit of force i.e the newton is defined in such a way that the constant of proportional is 1). Note that equation (2) shows that if the change in momentum takes place in a short time, the force is large. That is why cars are built with crumple zones at the front and back. In a crash, the car folds and this increases the time taken for the car's momentum to change to zero and come to a stop. The overall force on the car and the occupants therefore becomes reduced. From equation (2) we also get (assuming that the mass of the object is constant) $F = m(\frac{v - v_0}{t})$, that is, $F = ma$ which is the equation for Newton's Second Law in terms of acceleration.	**1 Investigation of packaging required** - e.g. for a stick of chalk dropping from a height of 1 m without breaking **2 Demonstrations of elastic and inelastic collision**  (a) Elastic collision  (b) Inelastic collision	Sticks of chalk Packaging material Metre rule Two trolleys A and B Compression spring. Plasticine	**Statement of laws and definitions** • Law of conservation of momentum • Elastic collision • Inelastic collision **Solving numerical problems of the type** • Two objects colliding • A person jumping from a small boat. • Kinetic energy in collisions **Student presentations to class on careers in which Newton's Laws or an understanding of collisions are useful.**

SCOPE OF WORK
GRADE: 12
UNIT: FORCES

TOPIC: CONSERVATION OF MOMENTUM

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Use the law of conservation of linear momentum to solve problems involving elastic and inelastic collisions CAREERS • describe careers which rely on the study of physics • describe the use of physics in various careers (including emerging careers)	**Law of Conservation of Momentum** ***In any system where there is no net external force, the total momentum of the system remains constant***, In equation form, $\mathbf{m_A v_A + m_B v_B = m_A v_A' + m_B v_B'}$ ………… (3) (initial condition) (final condition) **Elastic and Inelastic collision** In all collisions involving no net external force, momentum is conserved. In an <u>elastic collision</u>, kinetic energy is also conserved. Thus total KE before collision = total KE after collision. That is $\mathbf{\frac{1}{2} m_A v_A^2 + \frac{1}{2} m_B v_B^2 = \frac{1}{2} m_A (v_A')^2 + \frac{1}{2} m_B (v_B')^2}$ In an <u>inelastic</u> collision, kinetic energy is not conserved. Some or all of the initial kinetic energy ends up as heat.	**1 Numerical problem solving** Discuss problems of the following types. • Car a collides with car B • A person jumping from a small boat Students can be shown how to calculate: 1. final velocity of one object or of two objects (if they stick together); 2. initial and final KE of the system and hence determining if the collision is elastic or inelastic. **2 Student research activity** Students find out specifically how Newton's Laws or an understanding of collisions apply (e.g. athletics and athletic coaching, motor vehicle design, packaging material design.)		

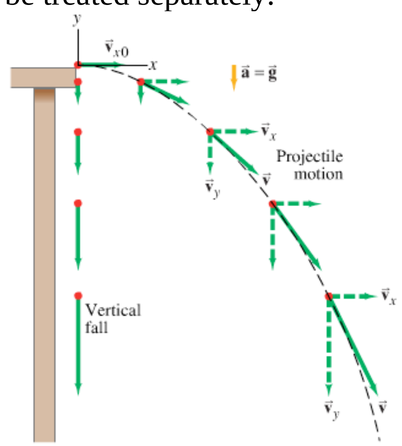
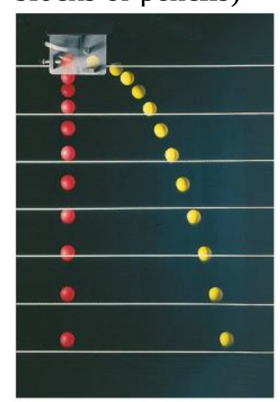
SCOPE OF WORK
GRADE: 12
UNIT: WORK, ENERGY AND POWER

TOPIC: WORK AND ENERGY **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Power • Manipulate and use the equation: Power = $\frac{energy}{time}$ • Manipulate and use the equation: Power = force x velocity	**Power** Power is the rate of doing work or converting energy. Thus, power, P = work done, W (or energy converted, E) divided by the time taken, t. In terms of an equation: **P = W/t (or P = E/t)** Power is measured in joules per second. 1 J/s is called a watt (W). **P**ower is the product of force and velocity; since, P = W/t and W = Fd therefore P = Fx d/t i.e. **P = Fv** Large amounts of power is measured in horsepower (hp). I hp = 746 watts **Efficiency** The efficiency (Eff) of an energy conversion is defined by: **Eff = $\frac{\textbf{Useful work done}}{\textbf{Total work put in}}$ x 100%** ….. (6) Energy conversions are never 100% efficient, since some of the energy put in is invariably wasted as heat or some other form of energy.	**Measurement of power** - The teacher can demonstrate how to measure power of a small motor lifting a mass a height, h. (P = mgh /t) - The class can calculate the power of a student of mass m by measuring his/her mass and time taken to walk up a flight of stairs of vertical height, h, at normal pace. **(Note: In the interest of safety, do NOT let the student run up the stairs!)** **Problem Solving** **Calculation of Power:** What must the power output be of an elevator motor that can lift a mass of 1250 kg and gives the elevator a constant speed of 5 m/s. **Calculation of efficiency** - e.g. the efficiency of a pulley system if a 100 N force, applied using a rope pulled a distance of 1.2 m, lifts a 20 kg mass a height of 40 cm. (Discuss the apparent "loss" of energy.)	Small d.c. motor and battery Mass, thread Clock Metre rule Bathroom scale Means of measuring height of stairs (e.g. string and metre rule or measuring tape) Clock	Practical Assessment: selection and use of materials; making observations; processing data; formulating conclusions and communicating information Problem solving / Critical thinking (Solutions to worksheets)

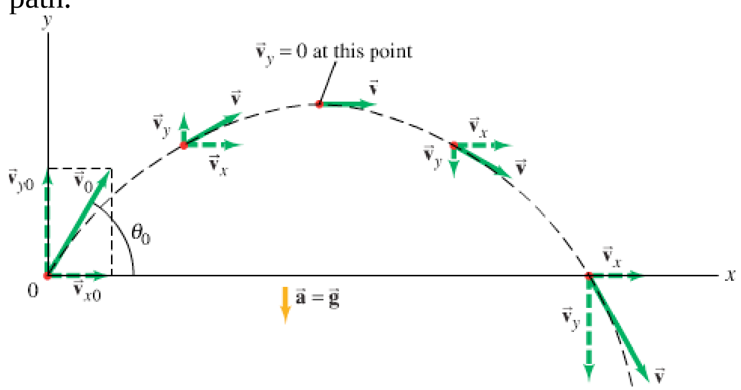
SCOPE OF WORK
GRADE: 12
UNIT: KINEMATICS IN TWO DIMENSIONS

TOPIC: PROJECTILE MOTION **DURATION: 2 WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
PROJECTILE MOTION • State examples of projectile motion in everyday life. (sports- shot putt, soccer, discus, missiles) • Show experimentally that the horizontal and vertical motion are independent (drop an object vertically while projecting another horizontally, note time taken by each to drop.)	**Projectile motion** A projectile is any object that is either launched horizontally or at an angle to the horizontal. The forces acting on the object are the force of gravity and the force of friction or drag (which we will ignore). In projectile motion, horizontal velocity remains constant (assuming negligible friction through the air). The vertical motion is just like free-fall; the object accelerates downward with the acceleration due to gravity. The two motions are **independent** of each other and can be treated separately. 	**1 Discussion** Discuss with the class whether the following are examples of projectiles or not as they move through the air; - shot putt ball - soccer ball - high jumper - long jumper - discus - airplane - rocket taking off - other examples from students **2 Demonstration** Have two students each hold an object, A and B, of the same size (e.g. small block of wood, a tennis ball or a pencil) at the same height. A third student counts down 3 – 2 – 1- 0. At zero, one throws the object horizontally while the other drops the object – at the same time. The rest of the students note whether A falls first, B falls first, or they fall together. The experiment is repeated about 3 times and the class results tallied and discussed. (They take the same time to reach the floor **if the object thrown forward is thrown <u>horizontally</u>**	Two similar objects (e.g. tennis balls, wooden blocks or pencils) 	Communicating Information Discussion of examples and results of Demonstration 2

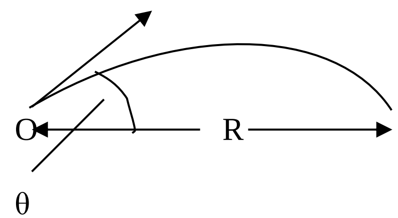
SCOPE OF WORK
GRADE: 12
UNIT: KINEMATICS IN TWO DIMENSIONS

TOPIC: PROJECTILE MOTION

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Investigate how the range of a projectile varies with angle of projection. (Catapult expt.)	Projectile motion: vertical velocity, v_y, increases; horizontal velocity, v_x, remains constant. The time taken to fall a distance is equal to the time taken to cover a horizontal distance. **Objects projected at an angle** When an object is projected with an initial velocity of v_0 at an angle θ_0 to the horizontal, it travels in a parabolic path.  -the initial horizontal velocity $v_{x0} = v_0 \cos\theta_0$, this velocity remains constant throughout - the initial vertical velocity $v_{y0} = v_0 \sin\theta_0$, this velocity v_y decreases until it reaches its maximum height, at which point $v_y = 0$. As the object moves downward v_y increases.	**3 Numerical problem-solving** Discussion and practice in solving problems (and variations) like: A tiger leaps horizontally with a speed of 5.0 m/s from a 4.0 m hign tree. (a) How much time is the tiger in the air? (Use $y = \frac{1}{2} gt^2$) (b) How far from the base of the tree does the tiger land? (Use $x = v_x t$) **4 Investigation** A toy pop-gun shoots a relatively safe "bullet" (e.g. a foam dart or a ping-pong-like ball) at various angles of projection, θ, The range, R, is measured. A graph plotted of R against θ to find the angle for which the range is largest. This investigation also provides good opportunity to discuss control of variables and the need to take averages of data.	Toy pop-gun (or rubber band and paper pellet) **Safety goggles** Large protractor (could be made from cardboard and graduated in 10° steps).	**Numerical problem-solving** Solving problems (and variations) like those shown in Activity 3: **Student Lab Report** Even if Investigation 3 is done as a class exercise, students could write a lab report with the following sections: - Title - Purpose - Diagram - Method - Tabulated Results - Discussion - Conclusion

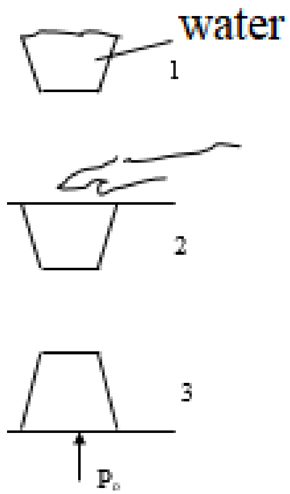
SCOPE OF WORK
GRADE: 12
UNIT: KINEMATICS IN TWO DIMENSIONS

TOPIC: PROJECTILE MOTION

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	Projectile range The range, R, of a projectile is the horizontal distance travelled from the starting point to the landing point at the same level.  $R = v_0 \cos\theta_0 t$, where t is the time of flight			

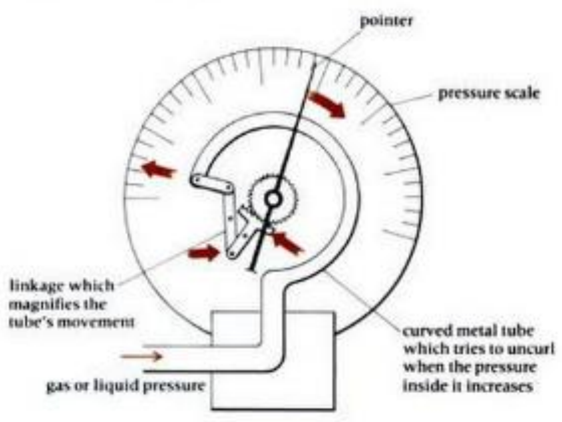
SCOPE OF WORK
GRADE: 12
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: ATMOSPHERIC PRESSURE **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
ATMOSPHERIC PRESSURE • Perform experiments to demonstrate atmospheric pressure • Describe how atmospheric pressure varies with height and from day to day e.g. weather systems	**Pressure of the atmosphere** The weight of air above the Earth exerts a pressure on all objects on the Earth. This pressure is called atmospheric pressure. We shall use the symbol, P_o, to represent this pressure. On the average, at sea-level, $\mathbf{P_o = 1.01 \times 10^5 N/m^2}$ As we go higher up the atmosphere, there is less air above us. Hence the pressure of the atmosphere gets less. Thus, the atmospheric pressure on mountain tops is lower than the pressure at sea level. The pressure of the atmosphere varies from day to day, due to factors such as temperature. When the atmospheric pressure is high, the weather tends to be fair or sunny. A low pressure is usually associated with rainy conditions. Some parts of the atmosphere may also be at high pressures and others at low pressures. Winds rush from areas of high pressure to areas of low pressure, sometimes giving rise to hurricanes. Weather stations usually measure pressures in milli-bars, where 1 bar = 1.01×10^5 N/m^2. There are 1000 milli-bars in 1 bar.	**Demonstrating atmospheric pressure** Fill a cup (or plastic bottle) with water (diagram 1). Place a smooth cardboard over the mouth of the filled cup of water so there are no air spaces between the cardboard and the water. Press the cardboard in place with your fingers (diagram 2). Invert the cup with your fingers on the cardboard, then remove your fingers. The cardboard remains in place and water does not run out of the cup. Ask students why. (The pressure of the atmosphere presses on the cardboard and keeps it in place.) **Making and using a simple barometer** Students can make a simple barometer by following instructions on the link below. Students can calibrate their barometers on a scale of 1 to 5, 1 being low pressure and 5 being high pressure. They can make measurements just before rain, just after rain and when it is sunny. They can also make charts of atmospheric pressure variations at regular intervals throughout a day. http://www.k12science.org/curriculum/weatherproj2/en/docs/barometer.shtml	Plastic cup (or water bottle) Smooth cardboard 	**Construction of barometer** **Charts of variation of pressure readings** - using home-made barometer - using laboratory barometer

SCOPE OF WORK
GRADE: 12
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: **ATMOSPHERIC PRESSURE**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	Aneroid barometers have a sealed, air-tight flat metal box inside which is sensitive to changes in atmospheric pressure. When the gas pressure inside the curved metal tube increases, it tries to straighten out. Any increase in pressure squashes the box very slightly which is magnified by a system of levers is to be seen clearly. The end of the tube is linked to a pointer which reads pressure on a circular scale. Aneroid barometers are suitable for use in gas pressure gauges which are fitted to gas cylinders and gas laws apparatus. They are also used as altimeters in aircraft as their scales can be calibrated in height above sea level based on the reduction in atmospheric pressure with increasing height.  Physics for CXC Avison Pg.88	**Listening to weather reports** Students plot daily readings of atmospheric pressure from weather reports. Daily readings from the local weather station could be compared with readings done in the lab using the laboratory barometer. Viewing Simulation and Explaining how the aneroid barometer works: https://www.explainthatstuff.com/barometers.html	Laboratory barometer A simple aneroid barometer can work.	Charts of daily atmospheric pressure readings Probing Questions

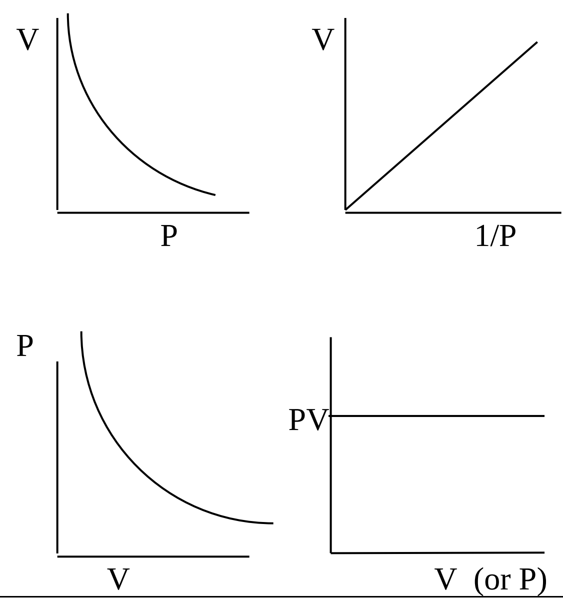
SCOPE OF WORK
GRADE: 12
UNIT: STRUCTURE AND BEHAVIOUR OF MATTER

TOPIC: SCIENTISTS/CAREERS **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
HISTORY/SCIENTISTS • Describe the importance of one aspect of the work of each of the following scientists: Boyle, Charles. • Select scientists of interest including at least one Bahamian/ Caribbean scientist and describe their contribution(s) to the field of physics		**Reading / Internet Research** Students can be asked to find out a little about Boyle and Charles and their respective contributions to the understanding of the behaviour of gases.	Text books Internet	Student presentations to class or student reports
CAREERS • Describe careers which rely on the study of physics • Describe the use of physics in various careers (including emerging careers)		**Reading / Internet Research** Students can be asked to find out about careers that require an understanding of pressure, volume and temperature of gases, or in which such understanding is helpful.		Student presentations to class or student reports

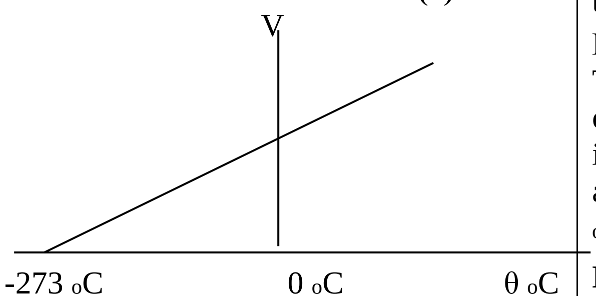
SCOPE OF WORK
GRADE: 12
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: GAS LAWS - BOYLE'S LAW **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
GAS LAWS BOYLE'S LAW • Relate volume of a fixed mass of gas to its pressure at constant temperature.(Boyle's law) • Express relationship between volume and pressure of a fixed mass of gas at constant temperature as an equation and use equation to solve problems. ($P_1 V_1 = P_2 V_2$) Make graphical representations of the relationships between volume, temperature and pressure for each gas law.	**Boyle's Law** According to Boyle's Law: *The volume, V, of a fixed mass of gas is inversely proportional to the pressure, P, exerted on it, providing the temperature is kept constant.* This can expressed as follows: $V \ \alpha \ 1/P$, or $V = \text{constant} \times 1/P$, or $PV = \text{constant}$, and therefore, $\mathbf{P_1V_1 = P_2V_2}$ **....... (1)**  	**Gas syringe demonstration** Students can be shown that if pressure is increased on air trapped in a gas syringe, the volume decreases and vice-versa. **Boyle's Law experiment** Students use a Boyle's Law apparatus to investigate Boyle's Law. **Discussion of Boyle's Law graphs** The teacher discusses the graphs shown on the left with the students. **Numerical problem-solving** Students solve simple problems involving the equation, $P_1V_1 = P_2V_2$. **Interactive simulations:** https://phet.colorado.edu/en/simulation/legacy/gas-properties https://teachchemistry.org/periodical/issues/november-2015/gas-laws https://pages.uoregon.edu/tgreenbo/boyles_law.html	Gas syringe Boyle's Law apparatus (See diagrams and experimental details, including precautions, in *Physics for CSEC* by A. Farley and C. Trotz, pages 218-221.) .	**Student solutions in a logical format** e.g To find, Given, Solution, Ans.

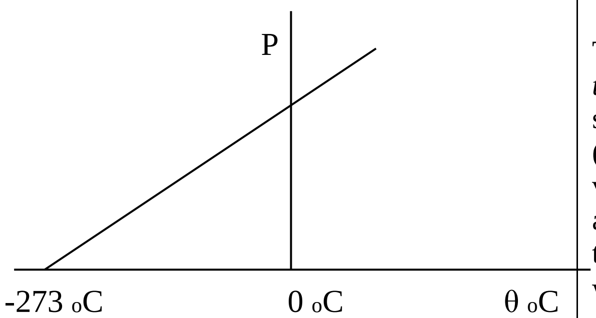
SCOPE OF WORK
GRADE: 12
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: GAS LAWS - CHARLES' LAW **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
CHARLES' LAW • Relate volume of a fixed mass of gas to its' absolute temperature at constant pressure (Charles' Law) • Express relationship between volume and absolute temperature of a fixed mass of gas at constant pressure, as an equation and use equation to solve problems. ($V_1 / T_1 = V_2 / T_2$) • Make graphical representations of the relationships between volume, temperature and pressure for each gas law.	**Charles' Law** According to Charles' Law: *The volume, V, of a fixed mass of gas is directly proportional to its absolute temperature, T, providing the pressure is kept constant.* This can expressed as follows: $V \; \alpha \; T$, or $V = \text{constant} \times T$, or $V/T = \text{constant}$, and therefore, $\mathbf{V_1/T_1 = V_2/T_2}$ **……. (2)**  The graph implies that, upon extrapolation, there is an absolute zero of temperature at -273 $_o$C.	**Gas syringe demonstration** Students can be shown that if pressure of air trapped in a gas syringe is kept constant and the temperature is increased, the volume increases, and vice-versa. **Charles' Law experiment** The teacher can carry out an experiment to investigate Charles' Law, using capillary tube equipment described on the right. **Discussion of Charles' Law graph** The teacher discusses the graph shown on the left with the students. The graph implies that, upon extrapolation, there is an absolute zero of temperature at -273 $_o$C. **Numerical problem-solving** Students solve simple problems involving the equation, $\mathbf{V_1/T_1 = V_2/T_2}$ **Interactive simulations:** https://phet.colorado.edu/en/simulation/legacy/gas-properties https://pages.uoregon.edu/tgreenbo/charles_law.html https://teachchemistry.org/periodical/issues/november-2015/gas-laws	See page 560, *Physics for CSEC* by A. Farley and C. Trotz for a simple experiment (Investigating Charles' law using air.) Charles' Law apparatus (See diagrams and experimental details, including precautions, in *Physics for CSEC* by A. Farley and C. Trotz, pages 222-223.)	**Student solutions in a logical format** e.g To find, Given, Solution, Ans.

SCOPE OF WORK
GRADE: 12
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: GAS LAWS - PRESSURE LAW **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
PRESSURE LAW • Express relationship between pressure and absolute temperature of a fixed mass of gas when volume is constant, as an equation and use equation to solve problems. ($P_1 / T_1 = P_2 / T_2$) • Relate pressure of a fixed mass of gas to its absolute temperature when volume is constant. (Pressure Law) • Express absolute zero in Kelvins and degrees Celsius. • Make graphical representations of the relationships between volume, temperature and pressure for each gas law.	**Pressure Law** According to the Pressure Law: The pressure, P, of a fixed mass of gas is directly proportional to its absolute temperature, T, providing the volume is kept constant. This can expressed as follows: $P \;\alpha\; T$, or $P = \text{constant} \times T$, or $P/T = \text{constant}$, and therefore, $\mathbf{P_1/T_1 = P_2/T_2}$ **……. (3)**  As with Charles' Law, the graph of pressure against Celsius temperature implies that, upon extrapolation, there is an absolute zero of temperature at -273 $_o$C. If the temperature of -273 $_o$C is called zero, and if 1 Celsius degree change is the same as 1 Kelvin change, then Kelvin temperature, T is given by $\mathbf{T(K) = \theta\,(_oC) + 273}$ **…… (4)** Temperatures on the *constant volume gas thermometer* are based on the Pressure Law, since pressure is directly proportional to (absolute) temperature.	**Pressure Law experiment** The teacher can carry out an experiment to investigate the Pressure Law, using the equipment described on the right. **Discussion of Pressure Law graph** The teacher discusses the graph shown on the left with the students. The graph implies that, upon extrapolation, there is an absolute zero of temperature at -273 $_o$C. Temperatures on the *constant volume gas thermometer* are based on the Pressure Law, since pressure is directly proportional to (absolute) temperature. The constant-volume gas thermometer is deemed the most accurate thermometer since the behaviour of the gas in the thermometer is in conformity with the Kinetic Theory of gases. **Interactive simulations:** https://phet.colorado.edu/en/simulation/legacy/gas-properties https://teachchemistry.org/periodical/issues/november-2015/gas-laws0 **Numerical problem-solving** Students solve simple problems involving the equations, $\mathbf{V_1/T_1 = V_2/T_2}$, and $\mathbf{T(K) = \theta\,(_oC) + 273.}$	See pages 224-225, *Physics for CSEC* by A. Farley and C. Trotz for apparatus.	**Student solutions in a logical format** e.g To find, Given, Solution, Ans.

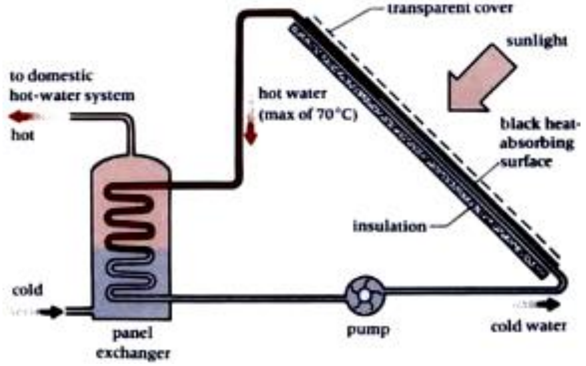
SCOPE OF WORK
GRADE: 12
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: COMBINED GAS LAW **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
COMBINED GAS LAW • Express the relationship between volume, pressure and temperature of a gas when number of particles is constant, as the general gas law equation and use this equation to solve problems ($P_1V_1 / T_1 = P_2V_2 / T_2$) Predict changes in gas pressure due to changes in temperature, volume and number of particles (observe models)	**According to the Combined Gas Law**: *The (pressure* x *volume)/absolute temperature of a fixed mass of gas is constant.* This can be expressed as follows: PV/T = constant, and therefore $\mathbf{P_1V_1 / T_1 = P_2V_2 / T_2}$ **…… (5)** It can be shown also that $\mathbf{PV = nRT}$ **…………………..(6)** for n moles of any gas, where R is the gas constant, given by, $R = 8.31$ J/mol.K.	**Numerical problem-solving** Students solve simple problems involving the equations, $\mathbf{P_1V_1 / T_1 = P_2V_2 / T_2}$ **,** and $\mathbf{PV = nRT}$**.** **Interactive simulations:** https://phet.colorado.edu/en/simulation/legacy/gas-properties https://teachchemistry.org/periodical/issues/november-2015/gas-laws0		**Student solutions in a logical format** e.g To find, Given, Solution, Ans.

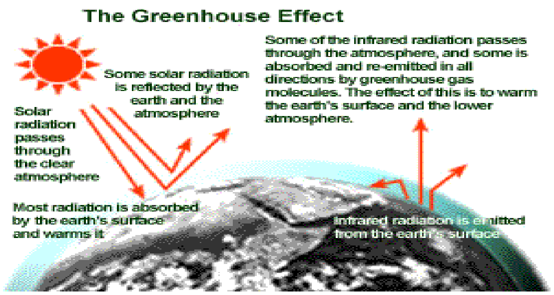
SCOPE OF WORK
GRADE: 12
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: APPLICATIONS OF HEAT TRANSFER **DURATION: 1 ½ WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Apply methods of heat transfer in the design and construction of model water heating systems, (thermosyphon - solar water heater solar water heating systems, solar ovens/ cookers, complete solar homes, solar cars etc)	A solar water heating panel is a successful radiant energy absorber, used by some houses and hotels in the Caribbean. The transparent cover traps solar radiation in the manner is a greenhouse and a black surface improves the rate of absorption of radiation. Water pumped through a network of pipes in the panel absorbs heat energy and carries it to a heat exchanger. Here the heat is passed on to the hot water pipes in the house. A simple solar water heater for homes needs neither a heat exchanger nor a water pump. The solar panels are connected directly to a storage tank placed about 0.5 m above the panels. In thermo-syphon systems, convection currents carry the heated water up to the tank and cold water down to the solar panels.  pg 390 Physics for CXC Avison	Students construct - solar ovens and cookers -solar panels and make simple solar water heaters. -model solar cars -model solar homes	Using their own resources: cartoon boxes, newspaper, spray paint, foil, etc. copper pipes & fittings,	Model to demonstrate greenhouse effect assessed for effectiveness, creativity, functionality and resourcefulness Uses thermometer and heat source safely Practical skills assessed. Assessing of Presentations: accurate presentation of concepts, (content), demonstrations, answering questions, creativity in presenting, resourcefulness.

SCOPE OF WORK
GRADE: 12
UNIT: MATTER AND THERMAL EFFECTS

TOPIC: APPLICATIONS OF HEAT TRANSFER

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Explain the greenhouse effect in terms of changes in wavelength of UV radiation • Construct models to demonstrate the greenhouse effect. • Discuss the greenhouse effect and its implications for global warming. Critically analyze choices which contribute to global warming, • Predict changes associated with global warming and propose viable solutions with special reference to small island developing countries such as The Bahamas.	Short-wavelength radiation from the sun enters the earth's atmosphere. The earth absorbs some of this radiation. The radiation that is re-emitted by the Earth is long-wavelength infra-red. This heat is absorbed and trapped by carbon dioxide and other greenhouse gases such as water vapour, methane, ozone, nitrous oxide and chlorofluorocarbons. The energy produced is then reflected back to the earth, which then heats up. This is known as the greenhouse effect.  Atmospheric concentrations of greenhouse gases have increased significantly due to human activities (fossil fuel combustion, deforestation, coal mining, drilling for oil and natural gas, decomposition of garbage in landfills). The greenhouse effect could result in global warming/ climate change, melting of polar icecaps, sheets, and glaciers, increase in sea levels causing floods and submergence of low-lying areas, ocean acidification, biodiversity changes, -more frequent and intense storms	Students will: Propose and design models demonstrating the use of solar energy sources as alternative to fossil fuel use. To raise public awareness of the need to use alternative sources of energy, present advertisements using STREAM: record jingles, make posters, etc. to encourage the public to use solar energy. Conduct debates, science talks and discussions. Interactive simulation: https://phet.colorado.edu/en/simulation/legacy/greenhouse	Textbooks Internet Varied resources	Students' personal choices surveyed before and after activity. Assessing effectiveness of various student activities in encouraging others to make wise choices. Models, items assessed for functionality, creativity presentation of items- concepts clearly outlined,

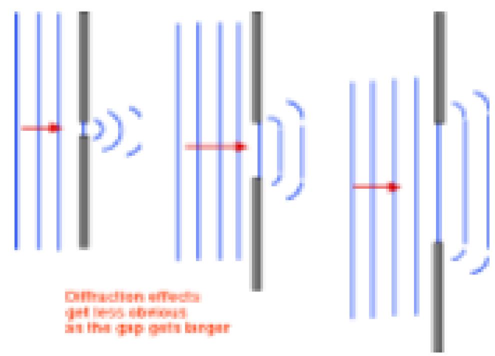
SCOPE OF WORK
GRADE: 12
UNIT: Waves

TOPIC: INTERFERENCE OF WAVES **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Define and demonstrate interference of waves	• Interference of waves: interference is the name given to the effects which occur when two separate wave fronts overlap. Waves pass through each other and merge or combine their effects. The ability of waves to combine is called superposition and the effects of the combination are called interference. • The principle of superposition of waves: the displacement of any particle caused by overlapping waves is the sum of the separate displacements caused by each wave at a particular moment. • Constructive interference: when 2 waves meet, and the vibrations are in phase (particles move in the same direction at same time) the amplitude at that point increases. • Destructive interference: when 2 waves meet and the vibrations are out of phase (particles move in opposite directions at that time), the amplitude becomes smaller.	• Set up gaps in the ripple tank and observe and sketch interference. • Demonstrating destructive interference of sound waves. • Tuning forks of same frequency (about 400Hz), stethoscope: carefully strike tuning forks and hold them about 10 cm apart. Using a stethoscope about 20 cm from the tuning forks, move it to find a node where the volume is greatly reduced. • *Prentice Hall Physical Science Concepts in action Teachers edition 2006 pg 522* •	Tuning forks of same frequency (about 400Hz), stethoscope, metre rule Ripple tank	Probing Questions Practical Assessment selection and use of materials; making observations; formulating conclusions; communicating information and making predictions Written assessment (worksheets)

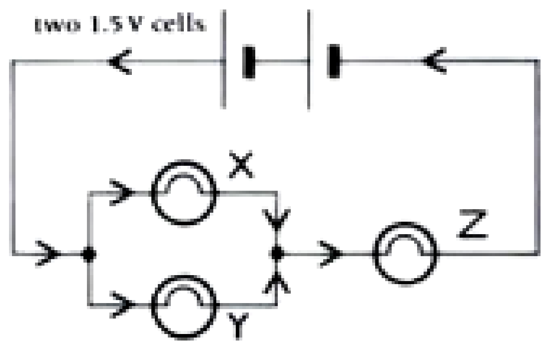
SCOPE OF WORK
GRADE: 12
UNIT: WAVES

TOPIC: DIFFRACTION OF WAVES **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Define and demonstrate diffraction of waves • Observe and sketch diagrams to show diffraction of water waves in ripple tank by setting up gaps of various sizes and creating plane wave fronts to pass through the gaps.	• Diffraction: the spreading out of waves around corners and edges of barriers. The ratio of the wavelength of the wave to the width of the opening indicates the extent of the diffraction (spreading out). Wider gaps produce less diffraction. • The diffraction increases becoming more circular as the ratio increases. When the ratio is equal to 1, there is maximum diffraction. The smaller the ratio, the less the diffraction.  Waves bend round the sides of an obstacle, or spread out as they pass through a gap.	• Demonstrate diffraction of sound: • CXC Physics Alec Farley & Clarence Troz Macmillan Publishers Limited 2007. pg 282. • Observe and sketch diagrams to show diffraction of water waves in ripple tank by setting up gaps of various sizes and creating plane wave fronts to pass through the gaps. • Observe and sketch diagrams to show diffraction of water waves in ripple tank by setting up gaps of various sizes and creating plane wave fronts to pass through the gaps.	Ripple tank Ruler	Probing Questions Practical Assessment selection and use of materials; making observations; formulating conclusions; communicating information and making predictions Written assessment (worksheets)

SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: COMBINATION CIRCUITS **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Distinguish among series, parallel and combination circuits (with reference to current, voltage and resistance), through construction of circuits • Apply formulae to solve problems involving combination circuits	A combination circuit involves the dual use of series and parallel connections in a circuit.  In this combination circuit, lamps X and Y are parallel to each other but are in series with lamp Z. When analysing combination circuits, it is important to apply the concepts that pertain to both series circuits and parallel circuits. Since both types of connections are used in combination circuits, the concepts associated with both types of circuits apply to the respective parts of the circuit. **In series:** $I_t = I_1 = I_2 = I_3 \ldots$ $R_t = R_1 + R_2 + R_3 \ldots$ $V_S = V_{R1} + V_{R2} + V_{R3} \ldots$ **In parallel:** $V_{supply} = V_{R1} = V_{R2} = V_{R3} \ldots$ $I_t = I_1 + I_2 + I_3 \ldots$ $1/R_t = 1/R_1 + 1/R_2 = 1/R_3 \ldots$	Laboratory Practical: Students construct combination circuits and measure current in different parts of circuits and voltage across components. **Interactive simulations:** http://www.physicsclassroom.com/Class/circuits/u9l4b.cfm https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc-virtual-lab Problem Solving Students apply formula to solve problems involving combination circuits.	Student electricity apparatus sets (circuit boards, connecting wire, bulb, switch, ammeter, voltmeter, battery pack/ power supply) Worksheets Textbooks Internet	Practical skills assessed: selection and use of materials; making measurements and observations; processing data; identifying sources of error, formulating conclusions and communicating information Students complete worksheets with problems finding current, voltage and resistance in combination circuits

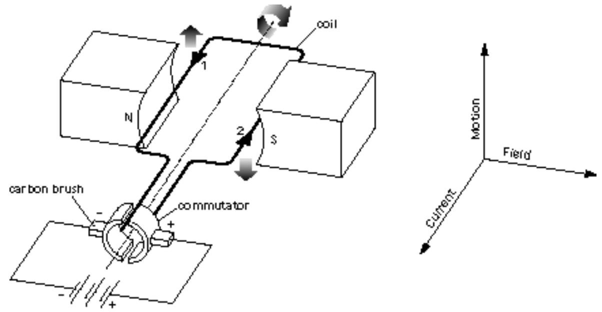
SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTRICAL POWER **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Express electrical power, (rate of energy transferred) as a product of voltage and current (P = VI) and apply relationship in solving numeric problems	(Electrical) power refers the amount of (electrical) energy that is transferred every second. P = Power is measured in watts (W) or joules/ second (J/s). The power of an appliance is related to the potential difference (v) across it and the current (I) flowing through it, by the equation: Power, P (in watts) = Current, I (in Amperes) x Potential difference, V (in volts) **P =IV**	Problem solving using P = $\frac{E}{t}$ and P =IV to solve problems related to power, energy and time Problem solving using P = IV to solve problems related to power, current and voltage	Worksheet	Written Assessment • Quiz • Worksheet Probing Questions
• Recognize that the current drawn by each appliance at a given instance is dependent on its' power rating and voltage, provided other factors remain constant and apply concept in solving numeric problems (I = P/V)	Students should be able to solve problems involving the formula Current = Power/Voltage(I = P/V) $P = \frac{\mathrm{W}}{\mathrm{t}} = \frac{\mathrm{ItV}}{\mathrm{t}} = \frac{\mathrm{I^2Rt}}{\mathrm{t}} = \frac{\mathrm{V^2t}}{\mathrm{Rt}}$ $P = \mathrm{IV} = I^2R = \frac{\mathrm{V^2}}{\mathrm{R}}$			

SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: THE MOTOR EFFECT, ELECTRIC MOTORS & METERS **DURATION: 2 WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe the operation of a d.c. electric motor. • State and describe ways of increasing efficiency of electrical motors (increase current, # of coils, strength of magnet field).	A motor is a rotating device, which converts electrical energy into mechanical/ kinetic energy. Electric motors create motion from an electric current.  A simple direct current (d.c.) motor consists of a rectangular coil of wire mounted on an axle allowing it to rotate between the poles of a c-shaped magnet. Two carbon brushes are connected to an electrical supply. The two ends of the coil are soldered to the two halves of a copper split ring commutator, which reverses the current direction in the coil on each half cycle, ensuring that the motion of the coil is continuous. A couple is formed on each side of the coil which causes the coil to rotate. The momentum of the coil keeps it moving round, even when the coil is in the vertical position and brushes in space between the commutator halves. The two commutator halves automatically change contact from one brush to the other, which reverses the direction of the forces on the sides of the coil.	Simulations: https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/dc-motor http://www.s-cool.co.uk/gcse/physics/magnetism-and-electromagnetism/uses-of-electromagnetism.html Construction of simple d. c. motors http://coen.boisestate.edu/k-12/files/2011/06/How-to-Make-a-Simple-DC-Motor.pdf Construction of simple circuits using 1.5 V d.c. motors.	1.5 V D cell Cell holder Magnet copper wire 2 paper clips 2 rubber bands Led lamps Small rotating fan blades	Practical Assessment: selection and use of materials; making measurements and observations; processing data; identifying sources of error, formulating conclusions and communicating information Assessment of model for functionality and creativity

SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: THE MOTOR EFFECT, ELECTRIC MOTORS & METERS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• State and describe ways of increasing efficiency of electrical motors (increase current, # of coils, strength of magnet field)	1. Increase the number of turns or loops of wire to make a coil 2. Increase the strength of the magnetic field (use stronger magnets) 3. Increase the current flowing through the loop of wire	Construction of a simple d.c. motor, varying • Magnetic field strength • number of turns • current	1.5 V D cells Cell holders Magnets copper wire 2 paper clips 2 rubber bands	Practical Assessment: selection and use of materials; making measurements and observations; processing data; identifying sources of error, formulating conclusions and communicating information
• Apply the motor effect to the operation of the moving coil loudspeaker	The moving coil loudspeaker uses the motor effect to change electrical energy into sound energy. It converts electrical energy to mechanical energy, which vibrates air molecules producing sound. When a current is passed through the coil, it experiences a force, according to Fleming's Left hand rule which makes it and the attached paper cone move in and out, vibrating air molecules.	Simulations: http://www.s-cool.co.uk/gcse/physics/magnetism-and-electromagnetism/uses-of-electromagnetism.html Demonstration using Moving Coil loudspeaker	Moving coil loudspeaker	Probing Questions
• Describe the operation of the moving coil galvanometer	Electric meters are based on the motor principle that a turning effect can be produced by a passing current through a coil which is in a magnetic field. ➢ Current enters and leaves the coil which is pivoted on jeweled bearings between the poles of a permanent magnet by hairsprings above and below it. This action causes the coil to turn in the magnetic field and the attached pointer to move across the scale.	Correct use of electric meters • Ammeters • Voltmeters • Milliammeters (galvanometers) including centre zero galvanometers Interactive simulation: https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/galvanometer	Ammeters Voltmeters Milliammeters (galvanometers including centre zero galvanometers) Simple electrical kits	Practical Assessment: measuring current using ammeter and milli-ammeter and voltage using voltmeter Probing Question after engaging in interactive simulation and demonstration

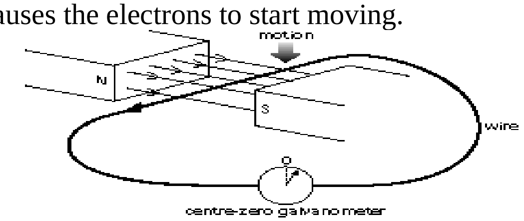
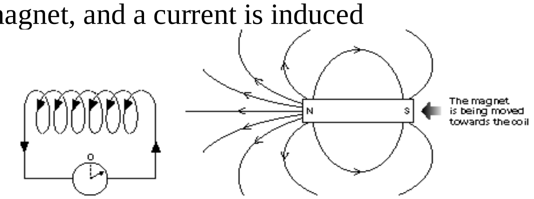
SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: THE MOTOR EFFECT, ELECTRIC MOTORS & METERS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	• The rotation of the coil is resisted by two spiral springs (called hairsprings) and the coil comes to rest when the couple turning it is balanced by an opposing couple from the springs. • The higher the current the greater the deflection of the coil (the angle turned) and the further the pointer moves on the scale. Electric meter has a linear scale, with numbers evenly spaced. The deflection of the pointer is therefore directly proportional to the current. The linear scale is achieved by: ➢ Hooke's Law and ➢ The radial magnetic field (i.e. the field lines are directed to the centre of the cylinder). The coils turn in a radial magnetic field of constant strength. This is achieved by using curved (concave) poles with a cylinder of soft iron fixed between them. The sensitivity of a galvanometer (i.e. the deflection per unit current) is increased by: 1. increasing the number of turns on the coil 2. using a stronger magnet 3. using weaker hairsprings or wire suspension (so that springs must be turned further to produce any given opposing couple) 4. using a long beam of light reflected from a mirror on the coil as a pointer.			

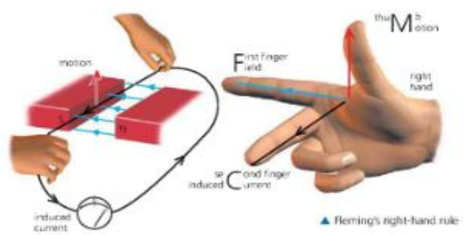
SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTROMAGNETIC INDUCTION & GENERATORS **DURATION: 2 WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Electromagnetic induction • Explain electromagnetic induction as an energy transfer process	Electromagnetic induction is an energy transfer process whereby mechanical/ kinetic energy is converted to electrical energy. Electro-magnetic induction is the process whereby an electromotive force (e.m.f.) or voltage is induced when a conductor moves relative (at right angle) to a magnetic field. If the circuit is a complete one, then a current is also induced.	**Interactive Simulations:** https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/electromagnetic-induction https://phet.colorado.edu/en/simulation/legacy/faraday http://www.s-cool.co.uk/gcse/physics/magnetism-and-electromagnetism/generating-electricity.html	Internet Computer LCD Projector	Probing Questions after viewing interactive simulations
• Describe and demonstrate the induction of an e.m.f. (and hence current in a complete circuit) based on the relative motion of a conductor perpendicular to a magnetic field (& motion of magnet in solenoid)	An electromotive force (e.m.f.) or voltage is induced when a conductor moves at right angles to a magnetic field. The changing magnetic field causes the electrons to start moving.  A voltage can be induced if a magnet is dipped into a coil or solenoid. As a magnet is moved into the coil, the coil cuts field lines all around the magnet, and a current is induced  	**Practical Activity** • moving a conductor through the jaws of a horseshoe magnet to a galvanometer (milli-ammeter) or LED lamp • dipping a bar magnet into and out of a solenoid connected to a galvanometer (milli-ammeter) or LED lamp	Straight wire Connecting wires U shaped magnets milliammeter Solenoid Bar magnets	Practical Assessment: selection and use of materials; making observations; formulating conclusions and communicating information

SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTROMAGNETIC INDUCTION & GENERATORS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• State Faraday's Law	Faraday's Law: The magnitude of the induced e.m.f. (voltage) is proportional to the rate at which the wire cuts magnetic field lines (magnetic lines of flux).	**Practical Activity** Connect a solenoid to a centre zero ammeter (milliammeter) and move bar magnet into coil. Observe effect on deflection of pointer of meter when the speed of motion of the bar magnet increases **Interactive simulations:** https://phet.colorado.edu/en/simulation/faradays-law	Solenoid Connecting wires milliammeter Bar magnet Internet	Practical Assessment: selection and use of materials; making observations; formulating conclusions and communicating information Probing questions after engaging in inter-active simulation
• Use Fleming's right hand rule to determine direction of induced voltage (current) in a conductor moving in a magnetic field.	The direction of the induced current for a straight conductor can be predicted using Fleming's Right Hand Rule. If the thumb, the first finger, and the second finger of the right hand are held at right angles to each other, then; the first finger points in the direction of the Field (N to S), the second finger points in the direction of conventional Current (+ve to –ve), the thumb points in the direction of the Motion of the conductor.  Complete Physics for IGCSE. pg. 214	Apply Fleming's right hand rule to predict the direction of induced current.		

SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTROMAGNETIC INDUCTION & GENERATORS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• State and explain Lenz's Law. (predicting direction of induced current)	Lenz's Law: The direction of an induced current in a circuit is always such as to oppose the change that caused it.	**Practical Activity** Connect a solenoid to a centre zero ammeter (milliammeter) and move bar magnet quickly into coil. Observe effect on deflection of pointer of meter when bar magnet: • Is pushed into solenoid • Is stationary • Is pulled out or removed from solenoid	Solenoid Connecting wires milliammeter Bar magnet	Practical Assessment: selection and use of materials; making observations; formulating conclusions and communicating information Probing questions
• State and demonstrate factors that affect the magnitude of induced e.m.f. and current in a complete circuit (strength of magnetic field, # of turns on solenoid, speed of motion, cross sectional area of the conductor)	The induced voltage, and therefore the induced current in a circuit, increases if: • The strength of the magnetic field (the stronger the magnetic field, the bigger the induced e.m.f.) • The number of turns of coil for solenoids (the greater the number of coils, the bigger the e.m.f.). • The speed at which wire cuts through the conductor or solenoid (the greater the speed, the greater the induced e.m.f.) • The type of core (a soft iron core increases the value of the e.m.f. since soft iron concentrates field lines and makes an electro-magnet.	**Practical Activity** Connect a solenoid to a centre zero ammeter (milliammeter) and move bar magnet into coil. Observe effect on deflection of pointer of meter when the speed of motion of the bar magnet, number of turns and strength of magnet is altered **Interactive simulations:** https://phet.colorado.edu/en/simulation/faradays-law	Solenoid Connecting wires milliammeter Bar magnet Internet	Practical Assessment: selection and use of materials; making observations; formulating conclusions and communicating information Probing questions after engaging in inter-active simulation

SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTROMAGNETIC INDUCTION & GENERATORS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe and demonstrate applications of electromagnetic induction in alternators (a.c. generators) and (d.c generators/dynamos, Eddy-heating stoves, furnaces)	A generator is a machine which converts rotational (mechanical) energy into electrical energy. A generator consists of loops or coils of wire, which rotates in a magnetic field. As the coil(s) rotates, it cuts the magnetic field and a voltage is induced across it. This voltage causes a current to flow. • In a.c. generators (alternators), slip rings are connected to carbon brushes. The reason the slip rings are used is so that the wire does not get tangled when it rotates. • In d.c. generators or dynamos, the slip ring is segmented (i.e. split ring commutator is used like the electric motor).	Practical Demonstration Construction of simple generators Connecting a bicycle dynamo to a lamp Students research the applications of electromagnetic induction in: ✓ a.c generators ✓ d.c generators ✓ eddy-heating stoves and furnaces Interactive simulation https://phet.colorado.edu/en/simulation/legacy/generator	Magnets Coils of wire Connecting wire Carbon brushes Slip rings Lamps	Assessment of model of for functionality, resourcefulness and creativity

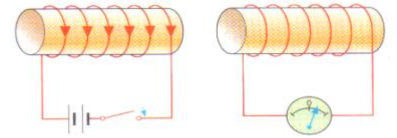
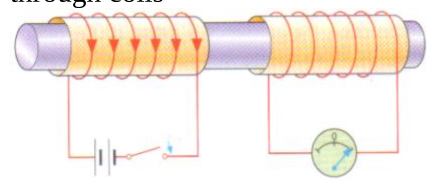
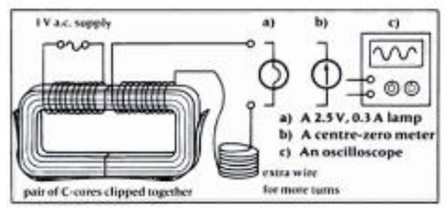
SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTROMAGNETIC INDUCTION & GENERATORS – ALTERNATIVE ENERGY SOURCES **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe local methods of power production (wind, fossil fuels).	Solar … energy received directly from the sun mainly in the form of light, infrared and ultraviolet radiation, may be converted into electrical energy photovoltaic panels and solar thermal collectors. Wind … windmills can be used to convert wind energy into electrical energy. Hydro-electric …water stored in dams can be used to generate electricity Bio-fuels refer to fuels derived from plant and animal materials or their waste, due to the chemical energy stored in their tissues.	Construction of Models utilizing alternative energy sources in the generating of electrical energy (STREAM) Debates Presentations Designing of posters and pamphlets	Resources and materials are student generated and will therefore vary	Assessment of model for functionality, resourcefulness and creativity Using rubric to assess STREAM projects
• Research and compare mains voltage & frequencies used in homes. (mainly 110 V and 60 Hz in the Bahamas).	Mains electricity in The Bahamas is mainly supplied at 110 V and 60 Hz (60 cycles per second), whereas in the UK, it is supplied as 240 and 50 Hz (50 cycles per second).	Research Visit to BPL's power plant		Field Trip Report

SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: TRANSFORMERS & OTHER APPLICATIONS OF ELECTROMAGNETIC INDUCTION **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Explain the principle of operation of transformers. (mutual induction)	A transformer changes the voltage of an alternating current without changing the frequency of the supply. Transformers operate on the principle of electromagnetic induction. When an alternating p.d. is applied to the primary coils, the resulting current produces a large alternating magnetic field or flux which reaches the secondary coils and induces an e.m.f. in it. The magnitude of the induced e.m.f. depends on: (1) the p.d. applied to the primary and (2) the relative number of turns Np and Ns, comprising the primary and secondary coils, respectively.	**Demonstrations:** electro-magnetic Induction with two coils side by side.  New Physics for you (page 301) Repeat placing a soft-iron core through coils  New Physics for you (page 301) Making a simple transformer:  Physics For CXC (page 303) **Interactive Simulation:** https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/transformers	Solenoid C Shaped iron cores Insulated copper wire Centre-zero galvanometer A.C./D.C Power supply 2.5 V.0.3 A Filament lamp Oscilloscope	Practical Assessment: selection and use of materials; making observations; formulating conclusions and communicating information Probing Questions

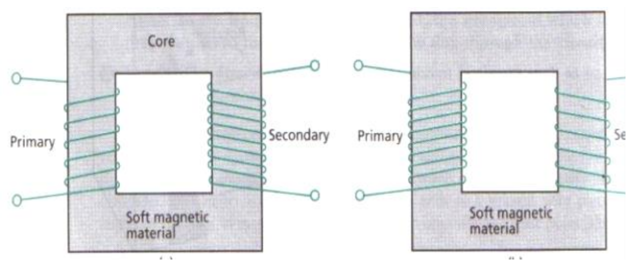
SCOPE OF WORK

TOPIC: TRANSFORMERS & OTHER APPLICATIONS OF ELECTROMAGNETIC INDUCTION

LEARNER OUTCOMES	CONTENT		ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe the sources of power losses in real transformers and ways of minimizing these losses.	**SOME CAUSES OF POWER LOSS IN TRANSFORMERS**	**DESIGN FEATURES TO REDUCE POWER LOSS (INCREASE EFFICIENCY)**	Research power losses in transformers and design features to improve efficiency Creating Graphic Organisers/ Concept maps Examination of concrete models	- Resources will vary -	Students' research, presentations and portfolios assessed for accuracy and creativity
	Heating effect of the current in the wires of the coils. (power loss in each coil = I_2R where R is the resistance of the wire in each loop)	Thick copper wire of low resistance			
	Heating effect of "eddy" currents (swirling, circular current) induced in the iron core. (power loss in each coil = I_2R where R is the resistance of a closed loop in the iron core where eddy currents flow)	The iron core is laminated (layered) cutting across the path of any eddy current. The high resistance between the laminations greatly reduces the eddy currents and the heat they would produce.			
	Energy is used in the process of magnetizing the iron core and reversing the magnetization every time the current reverses. This energy appears as heat.	The core is made of soft iron which is very easily magnetised and demagnetized by the magnetic field of the primary coil.			
	Some of the magnetic field lines produced by the primary coil do not link with the secondary coil, reducing the e.m.f. in the secondary coil.	The core is designed for maximum linkage between the primary and secondary coils. The common method is to wind the secondary coil over the primary coil. The iron core must always be in the form of a closed loop.			

SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: TRANSFORMERS & OTHER APPLICATIONS OF ELECTROMAGNETIC INDUCTION

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Distinguish between real and ideal transformers	An ideal transformer is defined as one for which the input and output powers are equal. i.e. $P_{out} = P_{in}$ $\therefore \quad P_s = P_p$ (since the secondary circuit is the output circuit and the primary circuit is the input circuit) **[Since P= IV]** $\mathbf{I_sV_s = I_pV_p}$	Worksheet Finding power, current and/or voltage on primary or secondary coil, assuming transformers are ideal. Examination of step-up and step down transformers	Textbook Worksheet Assortment of step –up and step-down transformers	Written Assessment • Quiz • Worksheet Probing questions
• Distinguish between step up and step down transformers	 **Step Up Transformer** **Step Down Transformer** Lett's Revise GCSE Physics Review pg. 116 The transformer is said to be a **step-up** one if n_s is greater than n_p. The voltage in the secondary coil exceeds that on the primary if there are more turns on the secondary coil, the current in the secondary is less than in the primary since power is same. The transformer is said to be a **step-down** one if n_s is less than n_p. The voltage in the secondary coil is less than in the primary if there are fewer turns on the secondary coil, but the current in the secondary is greater than in the primary.			

SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: TRANSFORMERS & OTHER APPLICATIONS OF ELECTROMAGNETIC INDUCTION

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Apply the relationship $\frac{Vs}{Vp} = \frac{Ns}{Np}$ to solve turns ratio & voltage problems	$\frac{Vs}{Vp} = \frac{Ns}{Np}$ where V_s - voltage across secondary coil V_p - voltage across primary coil N_s - number of turns on secondary coil N_p - number of turns on primary coil	Problem solving using $\frac{Vs}{Vp} = \frac{Ns}{Np}$ to solve turns ratio and voltage problems	Worksheet	Written Assessment • Quiz • Worksheet Probing Questions
• Apply the relationship $V_p I_p = V_s I_s$ to perform current/ voltage calculations for an ideal transformer	An ideal transformer is defined as on for which the input and output powers are equal**. i.e.** $\mathbf{P_{out} = P_{in}}$ $\therefore$ $\mathbf{P_s = P_p}$ (since the secondary circuit is the output circuit and the primary circuit is the input circuit) [**Since P= IV**] $\mathbf{I_s V_s = I_p V_p}$	Solve problems assuming transformers are ideal	Worksheet	Written Assessment • Quiz • Worksheet Probing Questions

SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: TRANSFORMERS & OTHER APPLICATIONS OF ELECTROMAGNETIC INDUCTION

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe common uses of transformers (in the home, long distance transmission of power-national grid).	Transformers are used for long distance transmission of electrical power. The National Grid system uses high voltages in power cables to save on energy losses. The high voltages are produced using step-up transformers, and at the end of the line, step-down transformers in substations are used to bring the voltage down to 120V. Energy could be lost due to: 1. heat loss due to resistance in coils 2. leakage of magnetic field lines between primary and secondary coils 3. heat loss due to eddy currents induced in iron core 4. the flipping of magnetic dipoles in the iron core due to the a.c. Other uses of transformers include • To get low voltages from the mains 120V a.c., e.g. for radios. • To get high voltages from the mains, e.g. for TV. • Computer network interface cards, • Modems, • Power amplifiers • Microwave ovens, • Car and marine ignition systems, • Tesla coils and moving coil	Student based research on use of transformers Making models of the National Grid System (GCSE Physics page 253) Interactive Simulation: https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/transmission-lines	Power supply Retort stand and clamps Transformers Lamps	Written Assessment • Quiz • Worksheet Probing Questions

SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTRICAL SAFETY **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Explain the importance of electrical safety in buildings and describe how fuses and circuit breakers are used to protect from circuit overloads and short circuits • Justify why fuses, circuit breakers, cables must have a suitable current rating for a given use.	A **circuit breaker** is an automatically-operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. Its basic function is to detect a fault condition and, by interrupting continuity, to immediately discontinue electrical flow. Unlike a fuse, which operates once and then has to be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation. Circuit breakers are made in varying sizes, from small devices that protect an individual household appliance up to large switchgear designed to protect high voltage circuits feeding an entire city. A **fuse** is a type of sacrificial overcurrent protection device. Its essential component is a metal wire or strip that melts when too much current flows, which interrupts the circuit in which it is connected. Short circuit, overload or device failure is often the reason for excessive current. Sources: http://en.wikipedia.org/wiki/Circuit_breaker http://en.wikipedia.org/wiki/Fuse_%28electrical%29 Fuses, circuit breakers and cables should always have amperage rating a little higher than the appliance that they are connected to. As a general multiply the amperage of the appliance by 1.25 to calculate the rating of the fuse, circuit breaker or cable to use, eg. if an appliance requires 20 amp use a 25 ampere fuse	• Group Projects: Designing and presenting Informational Posters on electricity safety • Demonstration of how fuses and circuit breakers work	circuit breakers Fuses of different current ratings	Assessing of Presentations: accurate presentation of concepts, (content), demonstrations, communicating information, creativity in presenting, resourcefulness.

SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTRICAL SAFETY

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Explain the use of earthing (grounding), insulation, double insulation and correct wires as safety measures	Some electrical safety measures: ✓ The grounding of an appliance is a means to protect that appliance from the build-up of hazardous voltages. ✓ Insulation on current-carrying wires is protect the user from coming into direct contact with electric current, thus avoiding harm. ✓ Double insulation protects the user of the appliance from an electrical shock by preventing any possibility of the external casing becoming live (the live wire cannot touch the casing even if wires inside become loose), thus eliminating the need for an earth connection e.g. electric kettles and hair dryers ✓ To avoid overheating and possibly fires, the correct wiring should always be used.	• Students can conduct research on energy conservation methods both in the home and in the office. • Group Projects: Designing and presenting Informational Posters on electricity safety	Internet Textbooks	Assessing of Presentations: accurate presentation of concepts, (content), demonstrations, communicating information, creativity in presenting, resourcefulness.

SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTRICAL POWER, ENERGY AND DOMESTIC APPLICATIONS **DURATION: 1½ WEEKS**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
Electricity in the home • Explain the importance of the use of standard colour codes in electrical wiring. • State the colour codes used for electrical wiring in the Bahamas and research colour codes used in other parts of the world.	Here are the colour coding for wiring in homes: UK • Live Brown • Neutral Blue • Earth Green and Yellow Bahamas • Live Black or red • Neutral White • Earth Green	Student can conduct research on: ✓ the importance of the use of standard colour codes in electrical wiring. ✓ the colour codes used in other parts of the world	Internet access	Student write up
• Describe with the aid of diagrams or suitable models a domestic wiring system, justifying the use of ring circuits, two way switches for lightning, the relative positioning of switches, fuses, circuit breakers and earth		• Student can conduct research on domestic wiring systems, especially in the Bahamas.	• Text books • Internet access	Student Research and presentation

SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTRICAL POWER, ENERGY AND DOMESTIC APPLICATIONS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Compare energy consumption of various appliances in the home, e.g. light bulbs, cooker, air conditioner, toaster oven, water heaters etc.	The energy consumed by an appliance (in kilowatt-hour) is given by the formula Energy = Power(kilowatt-hour) x time(h) The greater the wattage an appliance has, the more energy it consumes in a given time period. Power consumption (household appliances): • 60W Incandescent light bulb (Light equivalent to a 16W CFL & 4 - 5W LED): • 100W Incandescent light bulb (Light equivalent to a 30W CFL & 9-13 W LED) • Toaster : 800-1500W • Microwave : 600-1500W • Dishwasher : 1200-1500W • Washing Machine : 500W • Vacuum Cleaner : 200-700W • Iron : 1000W • Clothes dryer : 4000W • Ceiling Fan : 10-50W • Table Fan : 10-25W • Hair Blow dryer : 1000W • Electric Shaver : 15W • Laptop Computer : 20-50W • Desktop Computer : 80-150W • Plasma TV: 138W (average) • LCD/CCFL TV: 139.5 W (average) • LCD/LED: 91.5 W (average) • Clock radio : 1W • Fridge / Freezer : 500W • Electric Kettle : 2000W	• Students can conduct research on the energy consumption of various electrical appliances.	• Internet access.	• Student write up.

SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTRICAL POWER, ENERGY AND DOMESTIC APPLICATIONS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Interpret electricity bills and perform calculations of the cost of electrical energy in joules and kilowatt-hours [Energy consumption = Power (kilowatt) x time (h) Cost = kWh x cost per unit (i.e. cost per kWh)]	Energy = Power(kilowatt-hour) x time(h) For example: If a 500 W freezer is left on continuously for 3 weeks then the energy it consumes during that time is: Energy = (500W/1000W/kW) x (3 weeks x 2352h/week) = 3528 kWh Note if a freezer is on for 3 weeks, it will not be using 1000W of power for the full 3 weeks. kWh = (1kW x 1000W/kW) x (1h x 3600s/h) = 3 600 000 Ws = 3 600 000J The kilowatt-hour is the SI unit for electrical energy. This conversion factor of 1kWh/ 3 600 000J can be used to interconvert between Kilowatt-hour and Joule In the above example if a utility company charges 10¢ per kilowatt-hour the cost of running the freezer for 3 weeks would be: Cost = 10¢/kilowatt-hour x 3528 kWh = 3 528¢ = $35.28	Problem solving: Solving problems involving the cost of electricity Converting between kilowatt-hour and joules using:: 1 kWh = 3 600 000J Numerical problem solving Discussion and practice in solving problems involving the use of the formulae: E = Pt (E = IVt) Cost = # of kWh x cost per kWh	Worksheets Texts	Worksheets involving numerical problem solving

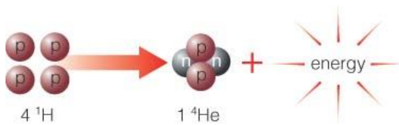
SCOPE OF WORK
GRADE: 12
UNIT: ELECTRICITY AND MAGNETISM

TOPIC: ELECTRICAL POWER, ENERGY AND DOMESTIC APPLICATIONS

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Discuss ways of conserving electrical energy in homes (reducing wastage).	Energy saving tips for homes and offices include: ✓ **Computer**: Keep the monitor and the computer switched off when not in use ✓ **Light bulbs**: As a power-saving measure, use energy efficient lamps such as LEDs since their power rating is less, less energy is used in a given time ✓ **Air Conditioning**: Put the temperature at the minimum or maximum strongest you are comfortable with, depending on the season. to conserve energy, try not to put it at too high or too low temperatures. ✓ **Washers**: Minimize the number of washings – wash a full load of garments when possible. ✓ **Television**: Unplug the power plug of your television set when not using it. ✓ **Water Heater**: use energy efficient heaters and keep the thermostat at the minimal heat. ✓ Refrigerator: Bring cooked food to room temperatures before placing it into the refrigerator. Also bring cold or frozen food out of the freezer a great deal ahead of the mealtime, thereby conserving energy in heating it. Source: http://www.squidoo.com/save_energy_now	• Students can conduct research on energy conservation methods both in the home and in the office. • Group Projects: Designing and presenting Informational Posters on conservation of electrical energy	Internet Textbooks	Assessing of Presentations: accurate presentation of concepts, (content), demonstrations, communicating information, creativity in presenting, resourcefulness.

SCOPE OF WORK
GRADE: 12
UNIT: MODERN PHYSICS & ASTRO PHYSICS

TOPIC: NUCLEAR ENERGY **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
7 ENERGY FROM THE NUCLEUS • Distinguish between nuclear fission and nuclear fusion (with the use of equations) • Recognize that energy released from fission or fusion is obtained from mass being converted to energy according to $E = mc^2$. • Explain how nuclear chain reactions occur.(including criteria for sustained chain reactions-purity of radioactive fuel, critical mass- the minimum amount of substance required for a sustained chain reaction)	**Albert Einstein and $E = mc^2$** In 1905, Einstein proposed the mass-energy equivalence equation, $\mathbf{E = mc^2}$ **Energy by nuclear fusion** In nuclear fusion, two light nuclei (e.g. hydrogen-2, also called 'deuterium') are made to collide and fuse. Energy is released, as the equation shows below: ${}^{2}_{1}H + {}^{2}_{1}H \longrightarrow {}^{3}_{2}He + {}^{1}_{0}n$ + energy It has not yet been possible to control nuclear fusion so that energy can be obtained at a safe rate. The sun produces energy through a process called nuclear fusion. This is the process of combining nuclei to make a nucleus with a greater number of protons or neutrons. The nuclear fusion in the sun is summarized below  **Energy by nuclear fission** Otto Hahn, Lise Meitner and Fritz Straussmann demonstrated that a large nucleus (e.g. ${}^{235}_{92}U$), when bombarded with a slow-moving neutron, broke into two large pieces (i.e. underwent fission) and released, not only other neutrons, but also large amounts of energy. The equation for this reaction is shown below: ${}^{235}_{92}U + {}^{1}_{0}n \longrightarrow {}^{144}_{56}Ba + {}^{90}_{36}U + 2\,{}^{1}_{0}n$ + energy	**1 Calculation of energy from mass** Calculations of energies obtained from given masses **2 Discussing pictures showing fission** **3 Viewing and discussing simulation of nuclear reaction** **4 Calculating energy released from a nuclear reaction** By inserting atomic masses in the fission equation shown in column 2, it can be shown that the total mass on the right is less than the total mass on the left. The mass that has 'disappeared' has been converted into energy which can be calculated using $E = mc^2$.	**Pictures showing nuclear fission** Taken from textbooks or internet **Nuclear fission simulation** Click on the link below. **http://phet.colorado.edu/simulations/** Then type 'nuclear fission' in the search bar to find the simulation. The following can be done: - fission of one nucleus - chain reaction (you can manipulate the 'purity' of the sample by mixing ${}^{235}_{92}U$ and ${}^{238}_{92}U$ in different ratios to demonstrate the concept of 'critical mass'	**Defining terms** fission, fusion, chain-reaction and critical mass **Calculating nuclear energy** - using $E = mc^2$ - from nuclear fission equations - from nuclear fusion equations

SCOPE OF WORK
GRADE: 12
UNIT: MODERN PHYSICS & ASTRO PHYSICS

TOPIC: NUCLEAR ENERGY

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
	Chain reaction The 2 neutrons liberated in the above reaction could produce fission in other uranium-235 nuclei present, resulting in a chain reaction, since these nuclei would also be liberating neutrons during fission. However, the fuel ore is a mixture of uranium-235 (which undergoes fission) and uranium-238 (which does not). To sustain a chain reaction, there must be enough of uranium-235 atoms i.e. a critical mass of uranium-235 present. That is why the ore must be purified (using centrifuges) so as to increase the percentage of uranium-235 present in the fuel such that a critical mass of uranium-235 is present.			

SCOPE OF WORK
GRADE: 12
UNIT: MODERN PHYSICS & ASTRO PHYSICS

TOPIC: NUCLEAR ENERGY

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe the main design features of a fission nuclear power plant	**Nuclear power plant** The main design features are described in *Physics for CSEC*, by Farley and Trotz, pp 538-539 as follows: - The r**eactor** (fuel rods are used rather than one block of ore to reduce the chance of an uncontrolled nuclear reaction; - the moderator slows down the neutrons so that they can be captured by the uranium-235 nuclei; - the control rods are raised or lowered to control the number of neutrons reaching the fuel, and hence the rate of the reaction rate; - the coolant carries heat generated in the core to the heat exchanger; - the pressure vessel is made of steel to withstand pressures built up in the reactor; - the concrete casing is there in case pressure builds up in the reactor and also serves a shield preventing radiation from escaping to the environment). - The **heat exchanger** receives heat from the reactor via the coolant and uses this heat energy to convert water into steam at high pressure; The steam from the exchanger causes the **steam turbine** to spin. - The spinning turbine is connected to a **generator** which converts the rotational kinetic energy of the turbine into electrical energy	**5 Viewing / manipulating a nuclear power plant simulation** http://www.dalton.manchester.ac.uk/connect/learn/nrs/	**Nuclear power plant simulation** Click on the link below. **http://phet.colorado.edu/simulations/** Then type 'nuclear fission' in the search bar to find the simulation. Then click on the tab 'nuclear reactor' when the simulation appears. - nuclear reactor (you actually get to raise or lower the control rods and see the effect on the reaction rate and power output)	**Describing how a nuclear power plant works** - drawing and labeling of structure - describing features of the design (including safety features)

SCOPE OF WORK
GRADE: 12
UNIT: MODERN PHYSICS & ASTRO PHYSICS

TOPIC: NUCLEAR ENERGY

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
8 THE NUCLEAR ENERGY DEBATE • Critically analyse the use of nuclear energy as an alternative source of energy	**World's current dependence on fossil fuel energy** - The world is currently heavily dependent (approximately 90%) on fossil fuels for its energy. - With more countries undergoing development, with world population growing and therefore with more demands for energy, the fossil fuel supplies are expected to run out soon (oil, for example, in about 100 years' time) - Fossil fuels also produce severe pollution when used (and even when spilled during transportation) The nations of the world are therefore stepping up development of other sources of energy. One such source is <u>nuclear energy</u> **Nuclear energy as a source** It is estimated that the known reserves of nuclear fissionable material will last for a few hundred years. This time could be extended to about a thousand years using 'breeder' reactors. However, dangers are involved in every stage of obtaining this energy: mining the ore, transporting the ore, refining the ore, using the ore in the reactor and getting rid of nuclear waste.	1 Identifying major producers of - Oil - Coal - Natural gas 2 Describing pollution effects due to fossil fuel use 3 Identifying nations using nuclear energy as a source 4 Discuss disasters associated with using nuclear power plants, Chernobyl and Fukkushima. 5 Discuss global shift away from nuclear power in favour of renewable energy sources like wind and solar.	**Map of the world** Show places where oil, coal and gas are produced. **Map of the world** Show countries currently using nuclear energy and the number and location of nuclear power plants each has **Pictures of nuclear power plant disasters** e.g. Chernobyl, Three Mile Island	**Presenting / sharing of current information gathered from various sites** (e.g. on the internet from news sites, National Geographic sites, energy sites, environmental sites, government sites, United Nations sites, search engines like Google) **Presenting / sharing of current information gathered from various sites** (e.g. on the internet from news sites, National Geographic sites, energy sites, environmental sites, government sites, United Nations sites, search engines like Google)

SCOPE OF WORK
GRADE: 12
UNIT: MODERN PHYSICS & ASTRO PHYSICS

TOPIC: APPLICATIONS OF NUCLEAR ENERGY **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
9 APPLICATIONS OF NUCLEAR PHYSICS • Evaluate the use of radioactive isotopes in medicine, archaeology, industry and food processing etc. • Outline useful and harmful effects of radioactive isotopes in terms of their half-lives and radiation emitted	**How to evaluate an application** - What is physical property of the radiation is being used (e.g. range, half-life, penetrating ability, energy) in the given application? - What are some of the dangers associated with the application (especially in terms of half-life, penetrating ability, energy) - How effective is the application? Is there a better way of producing the same desired results? - What are some of the symptoms produced in living things associated with the use of the application - What safety precautions are being used and how effective these are; what other safety precautions should be used The following applications could be considered: **Uses of radioisotopes in medicine** **Uses of radioisotopes in archaeology** **Uses of radioisotopes in industry** **Uses of radioisotopes in food processing** **Other uses of radioisotopes**	Visit to Bahamas Heart Centre on a field trip to learn about the injection of a radioactive tracer and monitor its progression throughout the human body. (A Positron Emission Tomography (PET) scan of the heart is a non-invasive nuclear imaging test)	Internet sites Textbooks Complete Physics by Stephen Pople	Write a report of the field trip identifying one new concept learned.

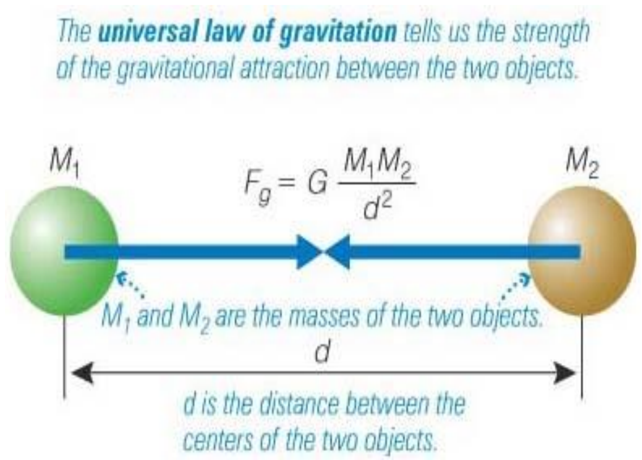
SCOPE OF WORK
GRADE: 12
UNIT: MODERN PHYSICS & ASTRO PHYSICS

TOPIC: APPLICATIONS OF NUCLEAR ENERGY

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
9 APPLICATIONS OF NUCLEAR PHYSICS • Evaluate the use of radioactive isotopes in medicine, archaeology, industry and food processing etc. • Outline useful and harmful effects of radioactive isotopes in terms of their half-lives and radiation emitted	**How to evaluate an application** - What is physical property of the radiation is being used (e.g. range, half-life, penetrating ability, energy) in the given application? - What are some of the dangers associated with the application (especially in terms of half-life, penetrating ability, energy) - How effective is the application? Is there a better way of producing the same desired results? - What are some of the symptoms produced in living things associated with the use of the application - What safety precautions are being used and how effective these are; what other safety precautions should be used The following applications could be considered: **Uses of radioisotopes in medicine** **Uses of radioisotopes in archaeology** **Uses of radioisotopes in industry** **Uses of radioisotopes in food processing** **Other uses of radioisotopes**	Visit to Bahamas Heart Centre on a field trip to learn about the injection of a radioactive tracer and monitor its progression throughout the human body. (A Positron Emission Tomography (PET) scan of the heart is a non-invasive nuclear imaging test)	Internet sites Textbooks Complete Physics by Stephen Pople	Write a report of the field trip identifying one new concept learned.

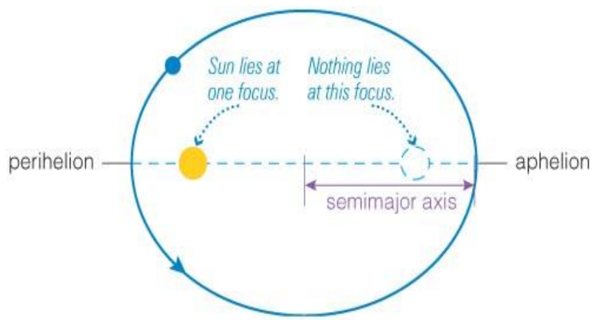
SCOPE OF WORK
GRADE: 12
UNIT: MODERN PHYSICS & ASTROPHYSICS

TOPIC: NEWTON'S LAW OF UNIVERSAL GRAVITATION **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• State Newton's law of universal gravitation (inverse square law) and describe the qualitative relationship between force, mass, distance.	$F_g = G\frac{M_1 M_2}{d^2}$ ✓ where F_g is the force of gravitational attraction, M_1 and M_2 are the masses of the two objects, and d is the distance between their centers. The symbol G is a constant called the gravitational constant, and its numerical value has been measured to be $G = 6.67 \times 10^{-11}$ $m^3/(kg \times s^2)$  Source: *Cosmic Perspective* by Bennett, Donahue	Students manipulate the equation to determine the force of attraction between objects.		Worksheets

SCOPE OF WORK
GRADE: 12
UNIT: MODERN PHYSICS & ASTROPHYSICS

TOPIC: KEPLER'S FIRST LAW OF PLANETARY MOTION **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• State Kepler's first law of planetary motion.	Kepler's first law tells us that the orbit of each planet around the Sun is an ellipse with the Sun at one focus. (Nothing is at the other focus.) In essence, this law tells us that a planet's distance from the Sun varies during its orbit. It is closest at the point called perihelion (from the Greek for "near the Sun") and farthest at the point called aphelion (from the Greek for "away from the Sun").  Source: *Cosmic Perspective* by Bennett, Donahue	• Use pictures/slide presentations to depict/communicate Kepler's First law of planetary motion		

SCOPE OF WORK
GRADE: 12
UNIT: MODERN PHYSICS & ASTROPHYSICS

TOPIC: SPACE EXPLORATION **DURATION: 1 WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Name 2 main types of telescopes (reflecting, refracting) used in astrophysics.	A reflecting telescope uses a precisely curved primary mirror to gather light, which is reflected to a secondary mirror which lies in front of it and further reflects the light to a focus at the place where the eye or instruments can observe it. Refracting telescopes use transparent glass lenses to focus light from distant objects. The Hubble space telescope is the most famous observatory in space.	Using a concave mirror and a sheet of white paper, students can form a real image of a distant object. This simple demonstration illustrates how a reflecting telescope works. Using a biconvex lens and a sheet of white paper, students can form a real image of a distant object. This simple demonstration illustrates how a refracting telescope works.	A concave mirror, a biconvex lens and a sheet of white paper.	
• Classify stars based on colour.	Astronomers classify stars according to surface temperature by assigning a spectral type determined from the spectral lines present in a star's spectrum. The hottest stars, with the bluest colors and coolest stars appear reddish in colour. Source: *Cosmic Perspective* by Bennett, Donahue	Students can use the naked eye or a telescope to observe stars of different colours, For example the star Betelgeuse in the Orion constellation appears red to the naked eye.	telescope	Worksheets
• Discuss the efforts of different countries in the execution of their space projects.	• India's Lunar mission, the Mars Rover project • The Orion project	Students will present a 2 minute PowerPoint presentation outlining ongoing space projects.	**Internet**	PowerPoint Presentation.

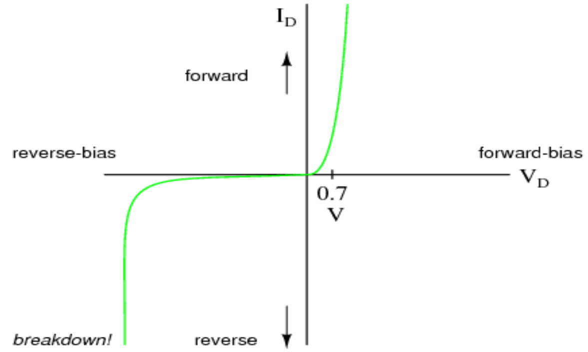
SCOPE OF WORK
GRADE: 12
UNIT: ELECTRONICS

TOPIC: THE SEMI-CONDUCTOR DIODE **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe the structure of a semiconductor diode (p-type, n-type semiconductors). • Perform experiments to show that current passes basically in one direction through a semiconductor diode.	A diode is a device that blocks current in one direction while letting current flow in another direction. Diodes can be used in a number of ways. For example, a device that uses batteries often contains a diode that protects the device if you insert the batteries backward. Semi-conducting diodes are semi-conductors of the p-type or n-type, typically made silicon mixed with small amounts of impurities. Silicon is a nonmetal because all four of its outer electrons are involved in **perfect covalent bonds**, so they can't move around. A pure silicon crystal is nearly an **insulator** -- very little electricity will flow through it. The behaviour of silicon can be changed into a conductor by doping it, In doping, a small amount of an impurity is mixed into the silicon crystal. There are two types of impurities: • **N-type -** In N-type doping, phosphorus or arsenic is added to the silicon in small quantities. Phosphorus and arsenic each have five outer electrons, so they're out of place when they get into the silicon lattice. The fifth electron has nothing to bond to, so it's free to move around. It takes only a very small quantity of the impurity to create enough free electrons to allow an electric current to flow through the silicon. N-type silicon is a good conductor. Electrons have a negative charge, hence the name N-type. • **P-type -** In P-type doping, boron or gallium is the dopant. Boron and gallium each have only three outer electrons. When mixed into the silicon lattice, they form "holes" in the lattice where a silicon electron has nothing to bond to. The absence of an electron creates the effect of a positive charge, hence the name P-type. Holes can conduct current. P-type silicon is a good conductor. When the N-type and P-type are put together, interesting behavior at the junction occurs, which represents what happens in a diode.	• Teachers can demonstrate the action of semiconducting diodes using kits that can be ordered from: www.elenco.com • Teachers can use the Snap Circuits ® to demonstrate a diode only allows current to flow in one direction	• A semiconducting diode • Snap Circuits kits ® can be ordered from : www.elenco.com	• Classroom discussions/ Worksheets • Classroom discussion/ Worksheets

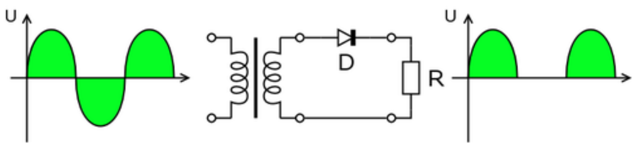
SCOPE OF WORK
GRADE: 12
UNIT: ELECTRONICS

TOPIC: THE SEMI-CONDUCTOR DIODE

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Draw and interpret current vs. voltage graphs for a semiconductor diode. • State and explain the limitations of the semiconductor diode with respect to reverse p.d. and forward current.	A diode blocks current in one direction while letting current flow in another direction.  ✓ When voltage is applied across a diode in such a way that the diode allows current, the diode is said to be *forward-biased.* The voltage dropped across a conducting, forward-biased diode is called the *forward voltage*. Silicon diodes have a forward voltage of approximately 0.7 volts. • When voltage is applied across a diode in such a way that the diode prohibits current, the diode is said to be *reverse-biased*. The ability of a diode to withstand reverse-bias. Voltage is limited, as it is for any insulator. If the applied reverse-bias voltage becomes too great, the diode will experience a condition known as *breakdown* (Figure above), which is usually destructive.	Draw the V/I characteristics of a diode, set up suitable circuit, take measurements, analyse and draw conclusions.	diode, voltmeter and ammeter. Snap Circuits kits ® can be ordered from : www.elenco.com	Response to Probing Questions and Demonstration • Making observations • Communicating Information

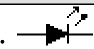
SCOPE OF WORK
GRADE: 12
UNIT: ELECTRONICS

TOPIC: SEMI-CONDUCTOR DIODE - HALF-WAVE RECTIFICATION OF AN AC CURRENT

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe the use of a single diode in half wave rectification of a.c and draw graphs to illustrate.	•  Source: http://en.wikipedia.org/wiki/Rectifier ✓ Diode symbol:  ✓ During the first half cycle of the waveform shown in the left hand diagram (AC), the diode is forward biased and current flows around the circuit formed by the diode, the transformer winding and the load ✓ Since the current through the load, and the voltage across the load are in the same proportions, then the voltage across the load is as shown in the right hand diagram, during the first half cycle. ✓ During the second half cycle, the diode is reverse biased and no current flows. This is indicated by the horizontal line in the right hand diagram. ✓ The diode only conducts on every other half cycle. Hence the name half-wave rectification. ✓ The rectified voltage is DC (it is always positive in value). However, it is not a steady DC but PULSATING DC. It needs to be smoothed before it becomes useful.	Half-wave rectification can be demonstrated using an AC source, a diode and an oscilloscope	A diode and an oscilloscope	Worksheets on Half-Wave Rectification

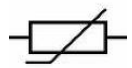
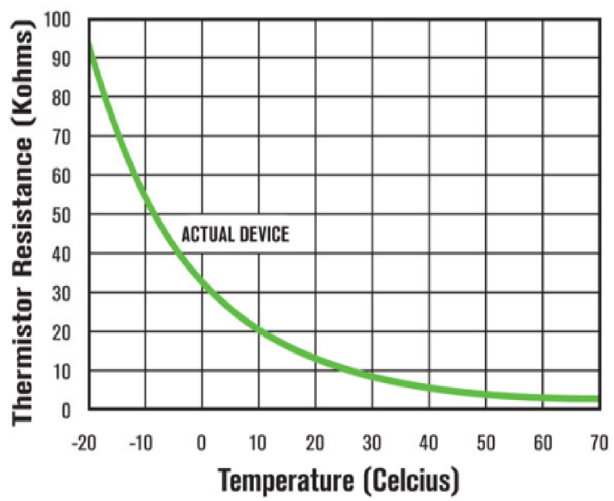
SCOPE OF WORK
GRADE: 12
UNIT: ELECTRONICS

TOPIC: LIGHT EMITTING DIODE **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe how the light-emitting diode (LED) works.	✓ LED symbol:  LED lights work very similarly to standard light bulbs except for the fact that LEDs are much smaller and contain no filament. Instead of a filament, an LED creates light using nothing but the movement of electricity along the path of its semiconductor. As the electrons stream across the semiconductor, they create electromagnetic radiation. This can be of infrared, ultraviolet or in the form of visible light, which humans can perceive. LEDs have may uses, which include: they form the numbers on digital clocks, transmit information from remote controls, light up watches and tell you when your appliances are turned on. Collected together, they can form images on a jumbo television screen or illuminate a traffic light.	• Demonstration using Snap Circuits®	• Snap Circuits® .	• Worksheets • Students should list appliances where LED are found

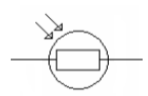
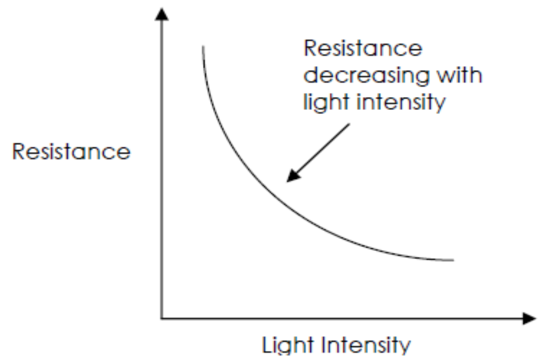
SCOPE OF WORK
GRADE: 12
UNIT: ELECTRONICS

TOPIC: THERMISTORS **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe the variation of resistance of the thermistor with temperature and represent on graphs.	• Thermistor symbol:  • Thermistors are temperature sensitive resistors Thermistors are constructed of semiconductor material. • Unlike most other resistive devices, the resistance of a thermistor decreases with increasing temperature • Below is a graph of a thermistor showing variation of resistance with temperature: 	• Demonstration using Snap Circuits® • Teacher design activity. Here is a link to thermsitor activity: http://www.technologystudent.com/elec1/therm1.htm	• Snap Circuits® • Thermistors, thermometers, ammeters, voltmeters, wires	• Worksheets • Discussion on uses/applications of thermistors. Some questions can be found on the link to the left.

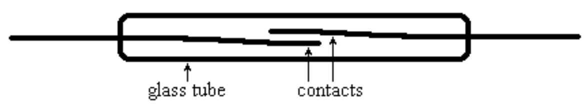
SCOPE OF WORK
GRADE: 12
UNIT: ELECTRONICS

TOPIC: LIGHT DEPENDENT RESISTORS **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
• Describe the variation of resistance of the light-dependent resistor with light intensity and represent on graphs.	Light Dependent Resistor (LDR) symbol:  • A light dependent resistor or a photo-resistor is a resistor whose resistance decreases with increasing incident light intensity. Light dependent resistors are vital components in any electric circuit which is to be turned on and off automatically according to the level of incident light - for example, solar powered garden lights, and night security lighting. • Below of a graph of a LDR showing variation of resistance with light intensity:  	• Link to a LDR activity: http://www.technologystudent.com/elec1/ldr1.htm	• Snap Circuits® • LDR, variable light source, ammeter, voltmeter, wires, power source (battery).	• Worksheets • Discussion on uses/ applications of LDRs. Some questions can be found on the link to the left.

SCOPE OF WORK
GRADE: 12
UNIT: ELECTRONICS

TOPIC: THE REED SWITCH **DURATION: ½ WEEK**

LEARNER OUTCOMES	CONTENT	ACTIVITIES	RESOURCES	METHOD OF ASSESSMENT
✓ Describe the operation of the reed switch and simple applications	A reed switch consists of two magnetic contacts in a glass tube filled with protective gas:  When a magnet comes close to a reed switch the two contacts become magnetized and attracted to each other allowing an electrical current to pass through. When the magnet is moved away from the reed switch the contacts demagnetize, separate, and move to their original position. Reed switches commonly used in door and window sensors in burglar alarm systems and in modern laptops which puts the laptop on sleep/hibernation mode when the lid is closed.	• Students can examine the operation of a reed switch on their school campus	• Reed switch • Snap Circuits®	

APPENDIX I

GLOSSARY

Acceleration - the change of velocity per unit of time.

Alternating current - an electric current that first moves one direction, then the opposite direction with a regular frequency

Amplitude - the maximum displacement of a particle from its rest position. (measure of the energy of the wave)

Asteroid - is any of the numerous small, often irregularly shaped rocky bodies that orbit the Sun primarily in the **asteroid belt**, a region between the orbits of Mars and Jupiter.

Astronomical unit (abbreviated as **AU** or **au)** is a unit of length equal to approximately 149.60 million kilometres (93 million miles). It is defined by the International Astronomical Union, and is the mean (average) distance between the earth and the sun over one Earth orbit.

Atom is a particle of matter indivisible by chemical means. It is the fundamental building block of elements. An atom is the smallest unit of an element that can exist alone or in combination with other elements

Atomic number -the number of protons found in an element's nucleus.

Atomic weight (atomic mass) - the weighted average of the masses of the naturally-occurring isotopes.

Audible sound – sound waves with a frequency of 20 Hz to 20 kHz

Average speed is the total distance divided by the time elapsed.

Background radiation - The radiation of man's natural environment originating primarily from the naturally radioactive elements of the earth and from the cosmic rays. The term may also mean radiation extraneous to an experiment.

Barometer - an instrument that measures atmospheric pressure, used in weather forecasting and in determining elevation above sea level

Beta particle (beta radiation, beta ray) - An electron of either positive charge (ß+) or negative charge (ß-), which has been emitted by an atomic nucleus or neutron in the process of a transformation. Beta particles are more penetrating than alpha particles but less than gamma rays or x-rays.

Boiling point - the temperature at which a phase change of liquid to gas takes place through boiling. It is the same temperature as the condensation point

Cathode rays – negatively charged particles (electrons) emitted from a negative terminal in an evacuted tube

Comet is a relatively small extraterrestrial body consisting of a frozen mass that travels around the sun in a highly elliptical orbit

Condensation – process whereby more vapor or gas molecules are returning to the liquid state than are evaporating

Condensation point - the temperature at which a gas or vapor changes back to a liquid

Conduction - the transfer of heat from a region of higher temperature to a region of lower temperature by increased kinetic energy moving from molecule to molecule

Constellation is an area of the celestial sphere defined by exact boundaries. It can also be used loosely to refer to the more prominent, visible stars that seem to form a pattern in that area. The most recognized constellation is orion

Contamination - Radioactive material deposited or dispersed in materials or places where it is not wanted.

Convection - transfer of heat from a region of higher temperature to a region of lower temperature by the displacement of high-energy molecules-for example, the displacement of warmer, less dense air (higher kinetic energy) by cooler, denser air (lower kinetic energy)

Conventional current - Opposite to electron current-that is, considers an electric current to consist of a drift of positive charges that flow from the positive terminal to the negative terminal of a battery

Critical angle - the angle of incidence that provides an angle of refraction of 90-degrees.

Daughter - A nucleus formed by the radioactive decay of a different (parent) nuclide.

Decay (radioactive) - The change of one radioactive nuclide into a different nuclide by the spontaneous emission of alpha, beta, or gamma rays, or by electron capture. The end product is a less energetic, more stable nucleus. Each decay process has a definite half-life.

Density – the property of a substance which is expressed by the ratio of its mass to its volume

Diffraction - the spreading out of waves around corners and edges of barriers

Displacement is the change in position of an object or how far the object is from its starting position.

Drag is a force, like friction, that opposes motion. Drag is experienced when an object moves through a fluid

Dynamics. a branch of mechanics that deals with forces and their relation primarily to the motion

Electric circuit - consists of a voltage source that maintains an electrical potential, a continuous conducting path for a current to follow, and a device where work is done by the electrical potential; a switch in the circuit is used to complete or interrupt the conducting path

Electric current - the flow of electric charge electric field force field produced by an electrical charge

Electric field lines - represents the direction of the force that charges experience; the direction of an electric field shown by lines of force

Electric generator -a mechanical device that uses wire loops rotating in a magnetic field to produce electromagnetic induction in order to generate electricity

Electrical force - a fundamental force that results from the interaction of electrical charge and is billions and billions of times stronger than the gravitational force; sometimes called the

Electrical insulators - Electrical nonconductors, or materials that obstruct the flow of electric current

Electrical resistance - the property of opposing or reducing electric current

Electrolyte - solution of ionic substances that conducts an electric current

Electromagnet - a magnet formed by a solenoid that can be turned on and off by turning the current on and off

Electromagnetic induction -process in which current is induced by moving a loop of wire in a magnetic field or by changing the magnetic field

Electromagnetic radiation – consists of of electric and magnetic waves that travel at the speed of light. Examples: light, radio waves, gamma rays, x-rays.

Electromagnetic waves - Waves: no medium needed, travel through a vacuum.

Electron - subatomic particle that has the smallest negative charge possible and usually found in an orbital of an atom, but gained or lost when atoms become ions

Electrostatic precipitators - filters that apply charges to particles in the air, then attract those charges to a filter, removing them from the airstream

Electrostatics - the study of electric forces that are static or slow-moving

Energy – the capacity of a body to do work

Evaporation - process whereby more molecules leaving a liquid for the gaseous state than returning from the gas to the liquid. It can occur at any given temperature from the surface of a liquid.

Fission products - Nuclei formed by the fission of heavy elements. They are of medium atomic weight and almost all are radioactive. Examples: strontium-90, cesium-137.

Fission -The splitting of a heavy nucleus into two roughly equal parts (which are nuclei of lighter elements), accompanied by the release of a relatively large amount of energy in the form of kinetic energy of the two parts and in the form of emission of neutrons and gamma rays.

Fluids - matter that has the ability to flow or be poured; the individual molecules of a fluid are able to move, rolling over or by one another

Focal length -the distance between the centre of a lens or curved mirror and its focus

Force - the push or pull on an object with mass that tends to causes it to change velocity (to accelerate).

Fossil fuel- Any fuel produced by the slow decay of dead things and which, therefore, is not renewable.

Frequency - the number of waves/vibrations/oscillations, cycles that pass a given point in

Friction - the resistance to motion of one object moving relative to another

Galaxy - is a numerous large-scale aggregates of stars, gas, and dust that constitute the universe, containing an average of 100 billion (10^{11}) stars and ranging in diameter from 1,500 to 300,000 light-years.

Gamma ray - A highly penetrating type of nuclear radiation, similar to x-radiation, except that it comes from within the nucleus of an atom, and, in general, has a shorter wavelength.

Gases - a phase of matter composed of molecules that are relatively far apart moving freely in a constant, random motion and have weak cohesive forces acting between them, resulting in the characteristic indefinite shape and indefinite volume of a gas

Geiger counter - A Geiger-Müller detector and measuring instrument. It contains a gas-filled tube which discharges electrically when ionizing radiation passes through it and a device that records the events.

Gravitational potential energy- The change of energy of object when moved in a gravitational field.

Greenhouse effect - the process of increasing the temperature of the lower parts of the atmosphere through redirecting energy back toward the surface; the absorption and reemission of infrared radiation by carbon dioxide, water vapor, methane and other greenhouse gases in the atmosphere

Grounding connected to the ground with a conductor, so that charge flows freely to and from the Earth to the grounded object

Half-life - The time in which half the atoms of a particular radioactive nuclide disintegrate. The half-life is a characteristic property of each radioactive isotope.

Heat - form of energy, which makes a body hot or cold. Heat is measured by the temperature-effect it produces in any material body. The SI unit of heat is Joule (J).

Horse power (hp)- is a practical unit of power which equal to 550 foot-pound per second or 746 watts

Hypermetropia - a defect of the eye that causes light to focus behind the retina instead of directly on it, resulting in an inability to see near objects clearly. Also called farsightedness

Inertia - the tendency of an object to remain at rest, if originally at rest, or to continue its state of uniform motion in a straight line.

Infrasound - sound whose wave frequency is too low (under 15-20 hertz) to be heard by humans

Ink-jet printer - small ink droplets sprayed with an electric charge are controlled by electrostatic plates to create images on paper

Instantaneous speed is simply the magnitude of the instantaneous velocity

Instantaneous velocity is the average velocity during a very small time interval

Interference of waves - interference is the name given to the effects which occur when two separate wave fronts overlap.

Inverse proportion - the relationship in which the value of one variable increases while the value of the second variable decreases at the same rate (in the same ratio)

Ionized - an atom or a particle that has a net charge because it has gained or lost electrons

Ionizing radiation - radiation that is capable of producing ions either directly or indirectly.

Irradiate- to expose to some form of radiation.

Isotope -Isotopes of a given element have the same atomic number (same number of protons in their nuclei) but different atomic weights (different number of neutrons in their nuclei). Uranium-238 and uranium-235 are isotopes of uranium.

Isotope -atoms of an element with identical chemical properties but with different masses; isotopes are atoms of the same element with different numbers of neutrons

Joule- SI unit used to measure work and energy; equivalent to the newton-meter

Kinematics - the branch of mechanics concerned with the motion of objects without reference to the forces which cause the motion.

Kinetic Energy – Energy possessed by a body by the virtue of its motion is called kinetic energy.

Laser printer uses a laser to create a photoconductive image on a drum, which attracts dry ink particles that are then rolled onto a sheet of paper to print a high-quality copy of the image

Latent heat of fusion the quantity of heat required to convert one kilogram of a substance from solid to the liquid state at its melting point (without any change in its temperature) is called its latent heat of fusion (L). The SI unit of latent heat of fusion is J kg-1.

Latent heat of vaporization - the quantity of heat absorbed when one kilogram of a substance changes from the liquid phase to the gaseous phase at its boiling point, or the heat released when one kilogram of gas changes from the gaseous phase to the liquid phase.

Latent heat -refers to the heat hidden in phase changes

Light year - a unit of length, and it is the distance that light travels in one year. It is a little less than 1013 kilometres.

Lines of force - lines drawn to make an electric field strength map, with each line originating on a positive charge and ending on a negative charge; each line represents a path on which a charge would experience a constant force and lines closer together mean a stronger electric field

Liquids - a phase of matter composed of molecules that have interactions stronger than those found in a gas but not strong enough to keep the molecules near the equilibrium positions of a solid, resulting in the characteristic definite volume but indefinite shape of a liquid

Longitudinal waves - cause the particles over which they pass to vibrate parallel to the direction in which the waves are moving.

Loudness -the attribute of a sound that determines the magnitude of the auditory sensation produced

Magnetic domain - tiny physical regions in permanent magnets, approximately 0.01 to 1 mm, that have magnetically aligned atoms, giving the domain an overall polarity

Magnetic field - describes how magnetic forces on moving charges act at a distance

Magnetic poles - the ends, or sides, of a magnet about which the force of magnetic attraction seems to be concentrated

Mass number- the sum of the number of protons and neutrons in the nucleus of an atom

Mass - the quantity of matter contained in a body is called its mass. The SI unit of mass is kg. The mass of a body remains the same everywhere. It is a measure of inertia, which means a resistance to a change of motion

Matter - anything that has mass and occupies space

Mechanical advantage - ratio of the load (L) to the effort (E).

Mechanical energy - The sum of potential and kinetic energy.

Mechanical waves - need media for transmission.

Mechanics- The study of the motion of objects and the related concepts of force and energy

Melting point - the temperature at which a phase change of solid to liquid takes place; the same temperature as the freezing point for a given substance

Meteor is a very small meteoroid that has entered the earth's atmosphere. Such objects have speeds approaching 70 kilometres per second. The friction with the air causes the meteor to glow with heat. This is also called *shooting star*.

Moment - the turning effect of a force

Momentum -the quantity of motion that an object has

Moon - is a natural satellite revolving around a planet.

myopia -occurs when the eyeball is too long, relative to the focusing power of the cornea and lens of the eye. This causes light rays to focus at a point in front of the retina, rather than directly on its surface.

n-type semiconductor - The semiconductor in which current is carried by electrons.

Nuclear reactor -A device in which a fission chain reaction can be initiated, maintained, and controlled. Its essential components are fissionable fuel, moderator, shielding, control rods, and coolant.

Nucleon - A constituent of the nucleus; that is, a proton or a neutron.

Nucleons - name used to refer to both the protons and neutrons in the nucleus of an atom

Nucleus - tiny, relatively massive and positively charged center of an atom containing protons and neutrons; the small, dense center of an atom numerical constant a constant without units; a number

Ohm - unit of resistance; equivalent to volts/amps

Ohm's law - the electric potential difference is directly proportional to the product of the current times the resistance

Period - the time it takes for 1 wave, oscillation to be completed.

Phase change - the action of a substance changing from one state of matter to another; a phase change always absorbs or releases internal potential energy that is not associated with a temperature change

Phases of matter - the different physical forms that matter can take as a result of different molecular arrangements, resulting in characteristics of the common phases of a solid, liquid, or gas

Photon - A quantity of electromagnetic energy. Photons have momentum but no mass or electrical charge.

Pitch -The sensation of a frequency

Planet - a celestial body that orbits the sun, has sufficient mass to assume nearly a round shape, clears out dust and debris from the neighborhood around its orbit.

Plasma - a phase of matter; a very hot gas consisting of electrons and atoms that have been stripped of their electrons because of high kinetic energies

Potential energy- It is stored energy.

Power - the rate of doing work or the amount of energy being transferred in a given period of time

Pressure – amount of force per unit area

Pressure - force per unit area

Primary coil - part of a transformer; a coil of wire that is connected to a source of alternating current

Projectile range, R, of a projectile is the horizontal distance travelled from the starting point to the landing point at the same level.

p-type semiconductor - The semiconductor in which conduction is the result of motion of holes.

Quality -describes those characteristics of sound which allow the ear to distinguish sounds which have the same pitch and loudness.

Radiation - the transfer of heat from a region of higher temperature to a region of lower temperature by greater emission of radiant energy from the region of higher temperature

Radioactive dating -A technique for estimating the age of an object by measuring the amounts of various radioisotopes in it.

Radioactive Source - A radioactive material that produces radiation for experimental or industrial use.

Radioactivity -The spontaneous decay of disintegration of an unstable atomic nucleus accompanied by the emission of radiation.

Radioisotope – is a radioactive isotope. A common term for a radionuclide.

Radionuclide – is a radioactive nuclide; that is, an unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation.

Rate meter - An electronic instrument that indicates, on a meter, the number of radiation induced pulses per minute from radiation detectors such as a Geiger-Muller tube.

Reflection -the change in direction of a wavefront at an interface between two different media so that the wavefront returns into the medium from which it originated.

Refraction -the change in direction of a wave passing from one medium to another caused by its change in speed.

Refractive index - measure of the bending of a ray of light when passing from one medium into another.

Scalar - quantities that are fully described by a magnitude (or numerical value) alone.

Secondary coil - part of a transformer, a coil of wire in which the voltage of the original alternating current in the primary coil is stepped up or down by way of electromagnetic induction

Semiconductors - elements that have properties between those of a metal and those of a nonmetal sometimes conducting an electric current and sometimes acting like an electrical insulator depending on the conditions and their purity; also called metalloids

Solenoid - a cylindrical coil of wire that becomes electromagnetic when a current runs through it

Solids - a phase of matter with molecules that remain close to fixed equilibrium positions due to strong interactions between the molecules, resulting in the characteristic definite shape and definite volume of a solid

Specific Heat Capacity - the quantity of heat required to raise the temperature of 1 kilogram of substance by one degree (1K or 1_oC).

Stable - Non-radioactive.

Star- a self-luminous celestial body consisting of a mass of gas held together by its own gravity in which the energy is generated by nuclear fusion in the interior

Temperature is a numerical measure of hotness or coldness of a body. According to the molecular model, it is a measure of the average kinetic energy of the molecules of the body. Heat flows from a body at higher temperature to a body at lower temperature.

Thermal Expansion - the increase in the size of an object on heating is called thermal expansion.

Thermometer - a device used for numerical measurement of temperature. The commonly used thermometer is mercury thermometer.

Thermosyphon - is a method of passive heat exchange, based on natural convection, which circulates a fluid without the necessity of a mechanical pump. It is used for circulation of liquids and volatile gases in heating and cooling applications such as heat pumps, water heaters, boilers and furnaces.

Tracer - A small amount of radioactive isotope introduced into a system in order to follow the behavior of some component of that system.

Ultrasound - acoustic (sound) energy in the form of waves having a frequency above 20,000 Hz

Van de Graaff generator - a machine that produces a large amount of excess charge, used for experiments with high voltage

Vector -a quantity that has both magnitude and direction

Velocity ratio - the ratio of the distance (xE) moved by the effort to the distance (xL) moved by the load in the same time.

Volt -unit of potential difference equivalent to joules/coulomb

Voltage drop - the electric potential difference across a resistor or other part of a circuit that consumes power

Wave - each crest and its adjacent trough make up a wave.

Wave front - an imaginary line which joins a set of particles which are in phase in a wave motion.

Wavelength - the distance between two successive crests or two successive troughs.

Weight - the force exerted on a body by gravity.

Work energy theorem - The work done on object is equal to the change in its kinetic energy.

Work is done when a force acting on a body displaces it

APPENDIX II

REFERENCES

Avison J.H., Neeranjan, D. and Henry D. (2014). Physics for CSEC. (2nd Ed.) Oxford University Press

Avison, J. (1998). The World of Physics (5th Ed.). UK: Thomson Learning.

Bennett, J.O., Donahue, M., Schneider, N. & Voit, M. (2008) Cosmic Perspective (5th Ed.) USA: Addison-Wesley/ Prentice Hall

Duncan, T. & Kennett, H. (2001). GCSE Physics (4th Ed.). London, UK: John Murray Publishers Ltd.

Farley, A. & Trotz, C. (2009). Physics for CSEC (2nd Ed.). London, UK: Macmillan Publishers Ltd.

Giancoli, D. C. (1985). Physics: Principles with applications. (6th Ed.). USA: Prentice-Hall

Hewitt, P. G. (2006). Conceptual Physics (10th Ed.). USA: Addison-Wesley/ Prentice Hall

Jackson B. & Whiteley P. (2007). Longman Physics for CSEC (3rd Ed.) London, UK: Longman Publishers.

Johnson, K. (2006). New Physics for You (6th Ed.). London, UK: Nelson Thornes Publishers.

Lambert, N., Lewis dos Santos, N., & Samuel, T.A. (2000) Physics for CXC. Oxford, UK: Heinemann educational Publishers.

Pople S. (2015) Complete Physics for IGCSE. (3rd Ed.) London, UK: Oxford University Press

Shepherd M., & Lovat, I. (1997). Lett's Revise GCSE Physics (2nd ed.) London, UK: Lett's Educational.

Wysession, M., Frank, D. & Yancopoulos, S. (2006). Physical Science: Concepts in Action Teachers' Edition USA: Pearson Prentice Hall.

Encyclopedia Britannica

http://en.wikipedia.org/wiki/Binocular_vision

http://en.wikipedia.org/wiki/Circuit_breaker

http://en.wikipedia.org/wiki/Fuse_%28electrical%29

http://en.wikipedia.org/wiki/Rectifier

http://faculty.washington.edu/chudler/chvision.html

http://phet.colorado.edu/en/simulation/travoltage

http://phet.colorado.edu/simulations

http://sciencewithkids.com/Experiments/Energy-Electricity-Experiments/how-to-make-a-capacitor.html

http://spaceplace.nasa.gov/en/kids/goes/hurricanes/

http://starryskies.com/try_this/baro1.html

http://tutor4physics.com/glossary.htm

http://www.acoustics.salford.ac.uk/feschools/waves/super.htm#phase

http://www.allaboutcircuits.com/worksheets/scope1.html

http://www.bbc.co.uk/schools/gcsebitesize/physics

http://www.britannica.com/

http://www.circuitstoday.com/fire-alarm-circuit

http://www.circuitstoday.com/fire-alarm-circuit#ixzz0qMtR1Eu1

http://www.electronickits.com/kit/complete/science/sc300.htm

http://www.euwfd.com/html/hydrological_cycle.html

http://www.musicwithmelissa.com/index_files/Page892.html http://www.ohaus.com/products/education/weblab/TBBentry.html

http://www.oup.co.uk/oxed/children/oise/pictures/atoms/ice/

http://www.phschool.com/webcodes10/index.cfm?wcprefix=cch&wcsuffix=2173&fuseaction=home.gotoWebCode&x=16&y=12

http://www.physicsclassroom.com/Class/circuits/u9l4b.cfm

http://www.physicsclassroom.com/Class/waves/u10l1a.cfm

http://www.physik.uni-augsburg.de/exp6/imagegallery/afmimages/atoms.jpg

http://www.sam.usace.army.mil/en/wra/Bahamas/BAHAMASWRA.pdf

http://www.s-cool.co.uk/gcse/physics/magnetism-and-electromagnetism/generating-electricity.html

http://www.s-cool.co.uk/gcse/physics/magnetism-and-electromagnetism/uses-of-electromagnetism.html

http://www.s-cool.co.uk/gcse/physics/magnetism-and-electromagnetism/generating-electricity.html

http://www.scribd.com/doc/5370651/9-4-Logic-Gates-doc

http://www.scribd.com/doc/5370651/9-4-Logic-Gates-doc

http://www.squidoo.com/save_energy_now

http://www.studyphysics.ca/30/charging.pdf

http://www.technologystudent.com/elec1/ldr1.htm

http://www.technologystudent.com/elec1/therm1.htm

http://www.wsc.com.bs/waterandsewerage.asp

https://nationalmaglab.org/education//magnet-academy/watch-play/interactive/magnetic-field-of-a-solenoid

https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/capacitor

https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/van-de-graaff-generator

https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/simple-electrical-cell

https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/rheostat

https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/magnetic-field-around-a-wire-i

https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/magnetic-field-around-a-wire-ii

https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/dc-motor

https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/galvanometer

https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/electromagnetic-induction

https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/transformers

https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/

https://phet.colorado.edu/en/simulation/capacitor-lab-basics

https://phet.colorado.edu/en/simulation/charges-and-fields

https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc-virtual-lab

https://phet.colorado.edu/en/simulation/faradays-law

https://phet.colorado.edu/en/simulation/legacy/battery-voltage

https://phet.colorado.edu/en/simulation/legacy/circuit-construction-kit-ac

https://phet.colorado.edu/en/simulation/legacy/electric-hockey

https://phet.colorado.edu/en/simulation/legacy/faraday

https://phet.colorado.edu/en/simulation/legacy/greenhouse

https://phet.colorado.edu/en/simulation/legacy/magnet-and-compass

https://phet.colorado.edu/en/simulation/legacy/magnets-and-electromagnets

https://phet.colorado.edu/en/simulation/legacy/magnets-and-electromagnets

https://phet.colorado.edu/en/simulation/legacy/travoltage

https://phet.colorado.edu/en/simulation/resistance-in-a-wire

https://phet.colorado.edu/sims/html/coulombs-law/latest/coulombs-law_en.html

https://phet.colorado.edu/sims/html/energy-forms-and-changes/latest/energy-forms-and-changes_en.html

https://phet.colorado.edu/sims/html/states-of-matter-basics/latest/states-of-matter-basics_en.html

https://www.cengage.com/physics/phet/simulations/simsf2c4.html?sim=Balloons_and_Static_Electricity

https://www.explainthatstuff.com/barometers.html

https://www.explainthatstuff.com/batteries.htmltransmission-lines

www.crocodile-clips.com

www.elenco.com

www.microsoft.com

www.nationalgeographic.com

www.stellarium.com

APPENDIX III

STANDARDS AND BENCHMARKS

Grade 10

Planning (Creativity)

- Predict the properties of an image formed by a pinhole camera due to changes to the aperture.
- Plan an investigation to show density and depth affect pressure in fluids.
- Formulate a hypothesis to investigate the factors that determine magnetic field strength.

Conducting and Recording

- Conduct an experiment to investigate the ease of floatation in fluids of different densities.
- Construct test circuits to determine the resistance of a given circuit component, through the application of Ohm's Law.
- Safely set up and use a water bath to perform experiments to plot heating/cooling curves and identify phase changes (for wax, naphthalene-only in fume chamber!) from constant temperature.

Analyzing & interpreting (critical thinking)

- Interpret simple displacement-time and displacement position graphs to find amplitude, frequency and wavelength of waves.
- Investigate the relationship between mass, applied force and acceleration.
- Process information by applying and manipulating the equation $p = h\rho g$.

Communicating

- Illustrate on diagrams, all forces acting on an object.
- Demonstrate and explain the relationship between pressure exerted, the area and force applied.

Units or vocab

Collaborating

- As a group, explain the importance of the Earth's magnetic field to life on Earth (bird navigation, deflection of charged particles from the sun) and make a presentation.
- Debate the efficiency of applications/ uses of X-rays, gamma rays, UV rays, infrared, microwaves and radio waves in medicine and industry.
- As a group, research reports of current events involving use of energy renewable and non-renewable and make a visual presentation.

Problem Solving

- Apply the principle of moments to solve problems.
- Solve problems involving force and pressure in hydraulic systems.
- Determine the resultant of perpendicular forces (parallelogram law, Pythagoras Theorem scale drawings, trigonometry).

Innovating

- Construct a musical instrument.
- Make a model braking system of cars (may be based on Pascal's Principle)
- Make a model to demonstrate the use or production of an alternative (renewable) source of energy.

Grade 11

Planning (Creativity)

- Plan an investigation to show the relationship between mass, applied force and acceleration.
- Plan an investigation to show the relationship between angles of reflection and angles of incidence for light reflected by a plane surface.
- Plan an investigation to show the effect of dissolved solids (impurities) and pressure changes (e.g. altitude, pressure cookers) on the boiling point of liquids.

Conducting and Recording

- Perform an experiment to determine the center of mass of an irregularly shaped object.
- Experimentally locate the principal focus of a concave mirror (rough method using screen).
- Accurately measure current, voltage and resistance to distinguish between parallel and series circuits.

Analyzing & interpreting (critical thinking)

- Conclude that an object changing direction in a circle is accelerating.
- Using experimental observations and data, recognize and demonstrate that different materials expand by different amounts for the same change in temperatures (linear expansivity).
- Apply knowledge of phase changes to account for the cooling effect of evaporation, and justify how phase changes are useful in the operation of refrigerators and air conditioners.

Communicating

- Graphically represent motion as velocity-time or distance-time
- Describe the anomalous expansion of water between 0_oC and 4_oC.
- Interpret the words or phrases rest, uniform, constant rate in the context of an object's motion

Collaborating

- As a group, research the use of environmentally safe refrigerants, proposing legislation/ strategies for preventing/dealing with pollution by refrigerants and make a presentation.
- As a group, make a presentation comparing designs of car seats and other automobile safety features.
- List the uses of radioactive isotopes in medicine, archaeology, industry and food processing etc.

Problem Solving

- Apply formulae to solve problems involving series, parallel and combination resistors
- Solve radioactive decay problems based on numerical data of half-life.
- Solve problems involving concave and convex mirrors by constructing ray diagrams (and scale drawings)

Innovating

- Design and make a model of a simple optical device.
- Design and make a toy based on one of Newton's laws of motion.
- Design and construct a model of an electromagnetic device.

Grade 12

Planning (Creativity)

- Recognize the variables to be controlled when investigating the speed of objects after collisions.
- Predict changes associated with global warming and propose viable solutions with special reference to small island countries like The Bahamas.
- Plan an experiment to investigate the effect of placing a current-carrying conductor perpendicular to a magnetic field (Fleming's left hand rule) and draw the resultant lines of force for the current carrying conductor in a uniform magnetic field.

Conducting and Recording

- Observe the double slit experiment with water waves.
- Conduct an investigation to show the relationship between volume and pressure of a gas (constant temperature and number of particles) ($P_1 V_1 = P_2 V_2$).
- Safely use test circuits to demonstrate how fuses and circuit breakers protect from circuit over load and short circuits.

Analyzing & interpreting (critical thinking)

- Demonstrate and communicate at least 1 application of electromagnetic induction in alternators (a.c. generators) and (d.c generators/dynamos, Eddy- heating stoves, furnaces).
- Conclude that kinetic energy is conserved in an elastic/inelastic collision.
- Conclude that kinetic energy is not conserved in an inelastic collision.

Communicating

- Draw a crude diagram to represent the physical relationships given in worded problems
- Advocate the importance of using phone in airplane mode (not calling or texting) while flying
- Communicate through oral presentation using diagrams/simulations the principle of operation of transformers (mutual induction).
- Debate the implications of conserving/not conserving electrical energy in homes.

Collaborating

- As a group, research and make a presentation on the use of physics in various careers (including emerging careers).
- As a group, make a presentation explaining the use of earthing (grounding), insulation, double insulation and correct wires as safety measures.
- As a group, discuss and make a presentation justifying the statement: the modern world is the world of digital electronics.

Problem Solving

- Solve uniform acceleration motion problems using the kinematic equations of motion
- Apply the law of conservation of linear momentum to solve problems involving elastic and inelastic collisions.
- Use the relationship sin c= 1/n to solve problems.

Innovating

- Design and construct a model water heating system (e.g. solar water heating system, solar ovens/ cookers, solar cars etc).
- Design and construct a simple electronic circuit to be used in a device (such as motor control, light operator switches, fire alarm and burglar alarms)
- Design and use a simple control and monitoring system with electronic AND, NOT and OR, NOR and NAND gates.