

**CONVENT OF MERCY ACADEMY ‘ALPHA’**

**PHYSICS UNIT I PLAN**

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| **Subject:** | **Physics** | **Duration** | **14 weeks** |  |
| **Form:** | **603** | **Title** | **Mechanics** |  |
| **Term:** | **Christmas** | **Department** | **Science** |  |
| **Objectives** | * recall and show understanding of the facts, concepts, models and principles of physics, and the relationships between different topic areas in the curriculum framework; * apply knowledge, concepts and principles of physics to explain phenomena and observations, and to solve problems; * demonstrate understanding of the use of apparatus in performing experiments; * demonstrate understanding of the methods used in the study of physics; * make decisions based on the examination of evidence using knowledge and principles of physics | | | |

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| **SEMESTER ONE (CHRISTMAS)-MECHANICS** | | | | |
| **TOPICS** | **SUB-TOPICS** | **TIME TAKEN** | **AREAS TO BE COVERED** | **ASSIGNMENTS AND TESTS** |
| MECHANICS | 1. Physical quantities | 1 week | 1. Express physical quantities as a numerical magnitude 2. Distinguish between scalar and vector quantities 3. Measure physical quantities using appropriate instruments 4. Construct calibration curves. 5. Rearrange relationships between physical quantities so that linear graphs may be plotted 6. Distinguish between precision and accuracy 7. Estimate the uncertainty ina derived quantity fromactual, fractional orpercentage uncertainties. | **Supplement:**  **Practical:**  *Investigate the relationship between time period and length for a pendulum. Give students the opportunity to estimate uncertainties in the measurement of length and time.*   * Investigate the parallelogram law for combining vectors using three masses, string and pulleys.   **Worksheet:**   * Practise calculations combining vectors using vector triangles. * Construct free body diagrams to show equilibrium when two or three coplanar forces act at a point.     Resources:  <https://www.youtube.com/watch?v=1dTn2pt5PuA>  <http://physics.info/orders-magnitude/problems.shtml>  <http://powersof10.com/film> |
|  | 1. SI Units | 0.5 week | 1. State the base quantities including their symbols and SI units 2. Use base quantities or units to obtain expressions for derived quantities or units 3. Use prefixes and their symbols to express multiples and sub-multiples. 4. Use base units to check the homogeneity of physical equations | **Supplement:**  **Calculationsinvolving** **this methodshould be done.** |
| MECHANICS | 1. Motion along a straight line | 1.5 week | 1. Explain  * displacement * speed * velocity * acceleration   .   1. use graphs to represent  * displacement * speed * velocity * acceleration  1. use the gradient of the area under motion graphs to solve problems 2. derive equations representing uniformly accelerated motion in a single dimension 3. use the equations of motion to solve problems on uniformly accelerated motion | **Practical:**  To determine *g* using a free fall method.  **Worksheet:**   * Practise plotting and analysing motion graphs. * Highlight the link between displacement time, velocity time and acceleration time graphs. * Practise calculations using the equations of uniform acceleration.   **Supplement:**  What is the average velocity of a cyclist who cycles at a constant speed of 20 m s–1, around a circular track of circumference 400 m when they are a quarter of the way around the track? |
|  | 1. Projectile motion | 1 week | 1. Explain how the motion of a projectile can be analysed by treating its horizontal and vertical motion independently. 2. Analyse the motion of a projectile by considering the effect of gravity on horizontal and vertical motion. 3. Describe friction quantitatively. 4. Explain the nature of lift and drag forces. 5. Describe the effects of air resistance on the trajectory of a projectile. 6. Explain why falling objects can reach a terminal speed. 7. Discuss the factors that affect the maximum speed of a vehicle. | **Practical:**   * To investigate air resistance and terminal velocity using different numbers of stacked coffee filters or cupcake cases. * Investigate the motion of different shaped objects through a tall column of viscous fluid.   **Worksheet:**   * Practise examples of projectile motion.   **Extension:** |
|  | 1. Newton’s Laws of motion. | 2 weeks | 1. State Newton’s laws of motion 2. Explain ‘linear’ momentum 3. State the principle of conservation of momentum 4. Distinguish between inelastic and perfectly elastic collisions 5. Explain the concept of the impulse of a force 6. Use the concept of the impulse of a force 7. Draw F-t graphs 8. Interpret F-t graphs | **Worksheet:**   * Practise examples of free-body diagrams and relate these to Newton’s first and second laws. * Practise examples using the equation *F=ma .* * Practise examples involving the conservation of momentum.   **Practical Activity:**   * Investigate situations where mass is changing eg rocket motion. * Prove that an object of mass, *m*, must be stationary after an elastic collision with a stationary object also of mass *m.*   **Extension:**  How is the equation, *F=ma*, modified when mass is changing? |
|  | 1. Circular motion | 1 week | 1. Express angular displacement in radians 2. Apply the concept of angular displacement in radians 3. Apply the concept of angular velocity to problems 4. Use equations for centripetal acceleration and centripetal force 5. Use the equations of motion to solve problems. | **Research:** |
|  | 1. Gravitation | 1 week | 1. Use Newton’s Law of Universal Gravitation in problems involving attraction between masses. 2. Explain the term gravitational field strengths (at the Earth’s surface or above) 3. Solve problems involving circular orbits.   Discuss the motion of geostationary satellites and their applications | **Supplements:** |
|  | 1. Effects of forces | 1 week | 1. Explain the origin of upthrust on a body wholly or partially immersed in a fluid. 2. Explain the nature, cause and effects of resistive forces 3. Use the concept of terminal velocity to solve problems 4. Apply the principle of moments to solve problems 5. Use the concepts of static and dynamic equilibria to solve problems. | **Supplement:**  Distinguish between workdone on gas during acompression and work doneby gas in expanding.  **Worksheet:**  Draw graphs and find workdone with the differenttypes of systems, that is,isothermal, isobaric,isochoric, adiabatic. |
|  | 1. Conservation of Energy | 1 week | 1. Use the concept of work as a product of force and displacement in the direction of the force. 2. Use the formula for kinetic energy 3. Use the formula for potential energy 4. Apply the concept of power as the rate of doing work 5. Describe examples of energy conservation. 6. Apply the concept of energy conversion to Caribbean situations 7. Discuss the mechanisms for the efficient use of energy in the Caribbean.   . | **Worksheet:**   * Practise calculations for work done including situations where force and displacement do not act in the same direction. * Practise calculations using gravitational potential energy and kinetic energy   **Practical:**   * Investigate energy changes in a bouncing ball.   **Extension:**   * Estimate the energy that can be derived from food consumption. |

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| **SEMESTER ONE (EASTER)-THERMAL AND MECHANICAL PROPERTIES OF MATTER** | | | | |
| **TOPICS** | **SUB-TOPICS** | **TIME TAKEN** | **AREAS TO BE COVERED** | **ASSIGNMENTS AND TESTS** |
| THERMAL PHYSICS | 1. Design and use of thermometers | 1 week | 1. Discuss how a physical property may be used to measure temperature. (linear and non-linear variation) 2. Describe the physical features of specific thermometers 3. Discuss the advantages and disadvantages of these thermometers. 4. Recall that the absolute thermodynamic scale of temperature does not depend on property of any particular substance. 5. Use the equations   or | **Supplement:**  Explanation of the reason why different thermometers do not agree when using the empirical centigrade scale.  **Practical:**  Calibrate a thermometerusing a ruler using thefollowing points: steampoint, ice point and water atroom temperature.  Plot a calibration graph(resistance vs temperaturefor a thermistor with anegative temperaturecoefficient. |
|  | ii. Thermal Properties | 1 week | 1. Express the internal energy of a system as the sum of kinetic and potential energies associated with the molecules of the system. 2. Relate a rise in temperature to an increase in internal energy. 3. Explain  * Heat capacity * Specific heat capacity * Latent heat * Specific latent heat | **Practical:**  Perform experiments to determine the specific heat capacity of liquids and metals by electrical methods and by the method of mixtures  **Supplement:**  The Callender and Barnescontinuous flow calorimeterfor finding specific heatcapacity of a liquid can bediscussed. Mention that themain advantage is that theheat capacity of theapparatus itself need not beknown. **Calculationsinvolving** **this method should be done.**  **Supplement:**  You can put out a candle with moist fingers (800 °C) but putting your hand in boiling water is very dangerous (100 °C). Explain.  Fire proof balloon demonstration |
| THERMAL  PHYSICS | 1. Heat Capacity | 1.5 weeks | 1. Explain the concepts  * melting * boiling   relate to changes in internal energy.   1. Solve problems using the equations | **Practical:**  Perform experiments to determine the specific latent heats.  **Worksheet:**  Conversion of Joules to Ek |
|  | 1. Heat Transfer | 1 week | 1. Discuss the mechanism of thermal conduction 2. Use the equation 3. Solve numerical problems involving composite conductors. 4. Discuss the principles involved in the determination of thermal conductivity of good and bad conductors. 5. Explain the process of convection as a consequence of a change of density. 6. Discuss thermal radiation | **Supplement:**  Discussion on both Searle’s bar and Lee’s disc.  **Practical:**  Use Searle’s apparatus |
|  | 1. Heat Transfer | 0.5 week | 1. Solve problems using Stefan’s equation  * For a black body * Net rate of radiation  1. Relate Stefan’s equation to the greenhouse effect and to climate change. | **Worksheet:**  Calculations using Stefan’s equation |
|  | 1. Heat Transfer | 0.5 week | 1. Discuss the development of heating and cooling systems to reduce the Caribbean dependency on fossil fuels. | **Research:**   * Solar water heaters * Vacuum flask * *Improving the design of a building to take advantage of natural resources and reduce dependence on fossil fuels.* |
|  | 1. The kinetic Theory Gases | 2 weeks | 1. Use the Avogadro constant (the number of atoms in 0.012 kg of the C-12 isotope) as a numerical entity 2. Use the concept of mole as the quantity of substance containing a number of particles equal to Avogadro’s constant. 3. Use the equation of state for an ideal gas expressed as   pV= nRT and pV = NkT   1. Discuss the basic assumptions of the kinetic theory of gases 2. Explain how molecular movement | **Worksheet:**  Kinetic Theory |
|  | 1. First Law of Thermodynamics | 2 weeks | 1. Use the term ‘molar heat capacity’ 2. Discuss why the molar heat capacity of a gas at constant volume is different from a gas at constant pressure 3. Calculate the work done on a gas using the equation W = p ΔV 4. Deduce work done from a p-V graph 5. Express the first law of thermodynamics 6. Solve problems involving the first law of thermodynamics | **Supplement:**  Distinguish between workdone on gas during acompression and work doneby gas in expanding.  **Worksheet:**  Draw graphs and find workdone with the differenttypes of systems, that is,isothermal, isobaric,isochoric, adiabatic. |
|  | Mechanical properties of Materials | 2 weeks | 1. Explain the terms  * density * pressure  1. Derive the equation Δp = ρgΔh 2. Relate the difference in the structures and densities of solids, liquids and gases to simple ides of the spacing, ordering and motion of their molecules 3. Describe a simple kinetic model behavior of solids, liquids and gases 4. Distinguish between the structure of crystalline and non-crystalline solids 5. Discuss the stretching of springs and wires in terms of load extension 6. Define Young’s Modulus, E 7. Deduce the strain energy in deformed material from a force-extension graph 8. Distinguish between elastic and inelastic deformations of a material 9. Discuss the importance of elasticity in structures. | **Worksheet:**  Use the equation Δp = ρgΔh to solve problems  **Supplement:**  Make particular reference to metals, polymers and glasses  **Practical:**  perform experiments to determine the Young modulus of a metal in the form of a wire.  perform experiments based on knowledge of the force-extension graphs for typical ductile, brittle and polymeric materials; |

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| **TERM TWO (Easter)-OSCILLATIONS AND WAVES** | | | | |
| **TOPICS** | **SUB-TOPICS** | **TIME TAKEN** | **AREAS TO BE COVERED** | **ASSIGNMENTS AND TESTS** |
|  | 1. Harmonic Motion | 2 weeks | 1. Use the equations of simple harmonic motion to solve problems 2. Recall the conditions necessary for simple harmonic motion   describe graphically the changes in displacement, velocity and acceleration during simple harmonic motion   1. Use the period of the simple pendulum as and 2. Describe the interchange of kinetic and potential energies of an oscillating system during simple harmonic motion 3. Calculate the energy of a body undergoing simple harmonic 4. Describe examples of forced oscillations and resonance 5. Discuss cases in which resonance is desirable and cases which it is not 6. Describe damped oscillations and represent such motion graphically 7. Explain how damping is achieved in some real-life examples. |  |
|  | 1. Properties of waves | 1 week | 1. Use the following terms:  * Displacement * Amplitude * Period * Frequency * Velocity  1. Differentiate between transverse and longitudinal mechanical waves 2. Explain ‘polorisation’ 3. Use the equation to solve problems involving wave motion 4. Use the relationship intensity is proportional to (amplitude)2 | **Practical:**   * *Investigate the variation of the speed of a water wave with depth of water in a plastic tray.* * *Measure the speed of sound in air*.   **Worksheet:**   * Practise calculations to calculate frequencies, periods and wavelengths of waves.   **Extension:**  How do we measure the speed of light?  What affect does the motion of a light source have on the speed of light emitted from the source? What are the consequences of this? |
|  | 1. Properties of waves | 1 week | 1. Use the terms phase and phase difference with reference to behavior of waves 2. Distinguish between stationary and progressive waves 3. Explain the properties of stationary waves and perform related calculations 4. Describe practical applications of sound waves in industry 5. Discuss application of sound waves to musical instruments | **Practical:**  Investigation into the variation of the frequency of stationary waves on a string with length, tension and mass per unit length of the string.  **Worksheet:**   * Practise calculations to determine the frequency of the first harmonic. |
| Properties of Waves | 1. Interference | 1 week | 1. Describe experiments to demonstrate diffraction of waves in both narrow and wide gaps 2. Explain the meaning of coherence as applied to waves. 3. Explain the terms superposition and interference of waves 4. State the conditions necessary for two-source interference fringes of waves to be observed 5. Discuss the principles of interference and diffraction 6. Use the approximation 7. Use the expression 8. Use the diffraction grating to determine the wavelength and frequency of light waves. | .  **Practical:**  Use a simple Young’s slit interference experiment for light or microwaves and two speakers for sound.  **Extension:**   * Investigate the historical development of the understanding of the nature of electromagnetic radiation has changed over time. |
|  | ii. Refraction | 0.5 week | 1. Apply the laws of reflection and refraction to behavior of waves 2. Define refractive index in terms of velocity of waves 3. Use Snell’s Law 4. Explain  * Total internal reflection  1. Determine the value of critical angle 2. Discuss practical applications of total internal reflection | **Practical:**  Perform experiments to determine the refractive index of glass  **Supplement:**  *Ask students to conduct research on how light is transmitted along an optical fibre. Students could investigate the effect of fibre thickness on reduction of light intensity of a specific frequency or the effect of the light frequency on loss in intensity for the identical fibre*  **Worksheet:**   * Practise calculations involving the critical angle and the refractive indices of the materials either side of the boundary. * Practise calculations using Snell’s law |
| Physics of the ear and eye | 1. Physics of the ear | 1 week | 1. Discuss the response of the ear to incoming sound and waves. 2. State the orders of magnitude of the threshold of hearing and the intensity at which discomfort is experienced. 3. Use the equation intensity level in 4. Discuss the subjective qualities of the terms ‘noise’ and ‘loudness’ 5. Solve problems using the lens formula | **Practical:**  **Worksheet:**  Calculations using formulae |
|  | Physics of the eye | 1 week | 1. Discuss how the eye forms images of objects at different distances 2. Explain the terms  * Depth of focus * Accommodation * Long sight * Short sight * Astigmatism * Cataracts  1. Discuss how the defects of the eye can be corrected. 2. Discuss the formation of focused images in the simple camera and magnifying glass | **Supplement:**  *Ask students to construct a model of the eye that demonstrates its operation and common defects. A simple laser pointer could be used as the light source*  **Practical:** |