**Convent of Mercy Academy “Alpha”**



**FOURTH FORM Unit Plan**

Department: Science

Subject: Physics

Grade: 10

Date: September 2024 - June 2025

Time Allotment: 3 hours & 20 minutes per week

Objectives:

Students should:

1. acquire technical and scientific vocabulary;
2. develop the ability to apply an understanding of the principles and concepts involved in Physics to situations which may or may not be familiar;
3. appreciate the contributions of some of the outstanding regional and international scientists tothe development of Physics;
4. develop critical thinking and problem solving skills; plan, design and perform experiments to test theories and hypotheses;

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| **SEMESTER ONE (CHRISTMAS)-Mechanics** | | | | |
| **TOPICS** | **SUB-TOPICS** | **TIME TAKEN** | **AREAS TO BE COVERED** | **ASSIGNMENTS AND TESTS** |
| **ENERGY** | | | | |
| **Recommended prior knowledge** The word *energy*, with a whole host of meanings and many subtle shades of emphasis, is likely to be part of a learner’s vocabulary. When commencing the course, however, the learner is unlikely to be especially exact in distinguishing between words such as *force*, *energy*, *power,* and *work*. Part of this course must be to help learners use these terms appropriately and accurately when the context is purely scientific and to ensure that they realize that the terms are not simply interchangeable. It might be argued that *energy* is the most basic idea in Physics and that every branch of Physics is the study of a corresponding energy. Again, this idea is found by many learners to be vague, intangible, and inaccessible. It is likely that most learners will have encountered the concept of energy sources and will realize that the maintenance of many aspects of modern life relies on readily available energy sources. The ideas of renewable and non-renewable energy sources and of the benefits and problems associated with the use of fossil fuels are almost certain to be familiar to learners at this stage.  **Context** The concept of energy is hard to grasp, despite it being so crucial to the understanding of Physics. It is an idea that is best taught by using the term correctly and frequently throughout the course; examples of energy transfers could be included in almost any lesson. The section of this unit on renewable and non-renewable energy sources is an area where individual learners can investigate the issues through project work and personal research either through the internet or using periodicals, textbooks or television programmes. The topics on thermal energy transfer, however, are much more easily taught in a conventional way with the usual experiments that show the distinction between transfer by conduction, convection, and radiation.  **Outline** This unit contains ideas that, although superficially familiar to many learners, are unlikely to be properly understood by all. They are, however, ideas that are fundamental to this course and any proper understanding of the subject. They will need constant revisiting and the learners will need to become familiar with them in a thoroughly convincing fashion. In one sense, the whole course is the study of energy, and it is very difficult to teach this unit on its own without reference to other units. The study of energy is never really completed. | | | | |
| Mechanics | 1. Energy | 2 weeks | 1. Introduction to energy 2. Mechanical work and power 3. Energy conversion 4. Energy Efficiency 5. Alternative Energy in the Caribbean | **Research:**  Divide the class into groups with each group being assigned a different form of renewable energy to research and assess its suitability in the Caribbean.  **Test:**  Efficiency of machines |
| **MECHANICS** | | | | |
| **Recommended prior knowledge** The measuring cylinder is not that different from a kitchen measuring jug, and watches and clocks – both digital and analogue – along with rules are likely to be very commonly encountered by the learners even outside the classroom. Learners will need to be familiar with graphs and graphs plotting here and although they are not likely to have talked much in terms of the area under a graph or its gradient, they might have met some of the ideas in other ways. Learners are bound to have some understanding of distance, speed and time and will almost certainly be able to conduct simple calculations in kilometers/hour even if they find meters/second trickier and do not see immediately how it all relates to the equation: *v = x/t*. They will have encountered the term *force* but might well use it interchangeably with terms such as *energy* or *pressure*. They may have encountered the unit newton but may also be measuring forces in other units; this can lead to confusion, but some learners will have previously met the distinction between *mass* and *weight,* and this can help. Learners will have learnt about density, but few will be aware that it is an intrinsic (intensive) property of a substance whereas mass is an extrinsic (extensive) property of an object.  **Context** The ideas covered in this part of the course are conceptually straightforward and few learners will have any difficulty in understanding them. This then is an area where learners might be encouraged to perfect other skills such as graph plotting, mathematical calculation, or the rearrangement of equations. It can also be used to show how an abstract mathematical construction (such as an equation) can be applied in the much more tangible area of kinematics. Again, the ideas dealt with here will be revisited and investigated further in subsequent units.  **Outline** This unit contains ideas that are likely to be very familiar to many learners, although the accompanying mathematics will in some cases prove to be a challenge This is a good topic for introducing new units and for distinguishing between mass and weight. | | | | |
| Mechanics | 1. Hydrostatics | 1 week | 1. Pressure 2. Archimedes’ Principle | **Worksheet:**  Calculation of Pressure and the application of Archimedes Principle  **Practical:**  To investigate personal pressure exerted on the floor. |
| Mechanics | 1. Statics | 2 weeks | 1. Forces, F 2. Turning Forces, T 3. Deformation | **Worksheet:**  Calculation of moments  **Practical:**  Observe situations in which forces are in equilibrium (varied to give different equilibrium situations) |
| Mechanics | 1. Dynamics | 3 weeks | 1. Displacement/distance 2. Velocity/speed 3. Acceleration 4. Displacement-time graphs 5. Velocity-time graphs 6. Aristotle – “laws of motion” 7. Newton’s Law of motion 8. Linear momentum | **Worksheet:**  Constructing and Interpreting v-t and d-t graphs  **Test:**  Statics and dynamics |

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| **SEMESTER ONE (EASTER)** | | | | |
| **TOPICS** | **SUB-TOPICS** | **TIME TAKEN** | **AREAS TO BE COVERED** | **ASSIGNMENTS AND TESTS** |
| **THERMAL PHYSICS** | | | | |
| **Recommended prior knowledge** Many physics teachers do not like the term *heat*, preferring to refer to *heating* as a process rather than to *heat* as a form of energy. The terms *thermal energy* and *internal energy* are used commonly in the syllabus. It would be clumsy, however, to avoid the historical terms *latent heat* and *specific heat capacity* both of which appear in the syllabus. Although heating is in many ways as intangible and abstract as electricity, it is a concept with which most learners are more comfortable. The idea of temperature is one that learners ought to have encountered by the time they embark on this course although they might use it interchangeably with the term *heat*. Likewise, liquid-in-glass thermometers should be familiar, as should digital thermometers of various sorts. Not all learners will realize that heat is a form of energy and the historically separate unit *the calorie* only re-emphasizes this perceived distinction. Similarly, it is important to use the temperature unit *the degree Celsius* rather than *the degree centigrade* or *the degree*. Learners should have encountered the term *molecule* and should be aware of the microscopic structure of matter. This unit includes *evaporation,* Evaporation is sometimes considered to be a fourth heat transfer mechanism.  **Context** Although the concept of energy is hard to grasp, learners seem much more comfortable with the specific example of *thermal energy* and *heating*. This is probably because of the learners’ familiarity with heating. This acquaintance will have been developed from using domestic heating systems, cooking with oil or water and simple things such as adjusting the temperature of the water in a bath or from a shower. It shows the importance of practical experience in general and the pedagogic importance of practical lessons in this subject. Consequently, this unit, or at least most of it, can comfortably be taught towards the beginning of the course.  **Outline** This unit contains ideas that are very familiar to many learners, but their understanding is unlikely to be thorough. The relationship between macroscopic phenomena and molecular behavior will probably be new to many but it is one of the foundations of all physics and the topics from this unit are excellent vehicles for introducing this relationship. | | | | |
| Thermal Physics | 1. Nature of heat 2. Temperature, T | 1 week | 1. Caloric and kinetic theories of heat (Rumford cannon-boring experiments). 2. Joule’s experiment 3. Net thermal energy transfer 4. Thermometric Properties 5. Thermometer calibration 6. Temperature and kinetic energy | **Research:**  Rumford cannon-boring experiment  **Test:**  Thermal Physics and Temperature |
| 1. Phases of Matter | 1 week | 1. Intermolecular forces of solid, liquid and gases 2. Kinetic theory |  |
| 1. Expansion | 0.5 week | 1. Effects of Thermal expansion | **Research:**  Applications of thermal expansion e.g., creaking roofs, carbonated beverages, opening jars |
| 1. Gas Laws | 2 weeks | 1. Establishment of the Kelvin temperature scale 2. Conversion between Kelvin and Celsius 3. Gas laws 4. Gas and the Kinetic theory | **Worksheet:**  Conversion Practice  Application of Kinetic Theory  Gas Calculations |
| Thermal measurements | 1. Specific heat capacity | 2 weeks | 1. Specific heat capacity vs. heat capacity 2. Calculations of specific heat capacity | **Practical:**  To determine the specific heat capacity of water |
|  | 1. Specific Latent heat, l | 2 weeks | 1. Phase change 2. Calculations for specific latent heat of fusion and vaporization 3. Evaporation and boiling | **Worksheet:**  Calculations on specific latent heat  **Test:**  Thermal Physics and Measurements |
|  | 1. Transfer of thermal energy | 0.5 week | 1. Conduction, convection, and radiation 2. Factors affecting absorption and emission. 3. Absorbers and emitters 4. Applications (e.g., greenhouse effect. Solar heater, Vacuum Flask) | **Research:**  In the Caribbean Islands, note where air conditioning units are typically placed in rooms. In cold countries where will heaters be in a room? Explain the choices from Principles of Physics |

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| **SEMESTER TWO (SUMMER) –WAVES AND OPTICS** | | | | |
| **Recommended prior knowledge** Both sound and light are phenomena that all learners will be aware of and will have realized that they can be understood and investigated as branches of science. Learners might be aware that waves can be used to transfer energy from one location to another and may have been given basic definitions of wave motion. It is less likely that they will have encountered the distinction between oscillations of matter being used to transfer energy as a wave and the actual movement of matter with energy; this might be highlighted at this stage. Learners may be aware of simple sound phenomena and will probably know words such as *pitch* and *loudness*.  They will have seen demonstrations that show the need for a medium to transmit sound and might know that sound travels differently in different media, that is it has different speeds and different attenuation rates in different media. They are also likely to be aware that whilst the speed of sound is large, it is very substantially less than that of light; that lightning arrives before thunder is a widely known example of this. Similarly, a learner might be aware that sound spreads out in a way that light does not, although the precise nature of diffraction is unlikely to be understood. Learners will have heard of infra-red radiation (and perhaps also ultraviolet radiation, although this is not separately mentioned in the syllabus) but will not necessarily follow what is meant by the phrase *invisible light* which is often applied to this component of the electromagnetic spectrum. Likewise, ultrasound might have been described *as sound which we cannot hear*.  **Context** Within the Physics course, *waves, sound, and light* are natural partners and can be dealt with early in the course; there are few challenging concepts although some learners will find the idea of frequency more challenging than others. It is also likely that there will be those who cannot invariably rearrange *v = f* λ and obtain the correct answer. Inevitably, the study of infra-red radiation will link with the study of the transfer of thermal energy, and it might help if the electromagnetic spectrum could be studied before thermal transfer. Otherwise, the term *radiation* (used in many ways in physics and frequently confused in the media) can easily lead to misunderstanding. Waves are often represented in diagrammatic forms and this unit can be used to emphasize the importance of clear and appropriate diagrams in explaining the subject, both generally and when answering examination questions.  **Outline** This unit contains ideas that relate to the common experiences of many learners, and it can be used to show that everyday phenomena can be more thoroughly understood when a scientific explanation is offered. | | | | |
| **TOPICS** | **SUB-TOPICS** |  | **AREAS TO BE COVERED** | **ASSIGNMENTS AND TESTS** |
| Wave Motion | 1. Types of waves | 0.5 week | 1. Types of waves 2. Wave properties 3. Transverse vs. longitudinal | **Research:**  Explain why ants survive in an operating microwave oven. |
| Sound | 1. Production and Propagation | 0.5 week | 1. Sound Production 2. ‘pitch’ and ‘loudness’ |  |
|  | 1. Speed of Sound | 0.5 week | 1. Speed of sound 2. Reflection, refraction, diffraction and interference of sound waves 3. Ultrasound |  |
| Electromagnetic waves | 1. Characteristics of EM Waves | 0.5 week | 1. Properties of EM waves 2. Distinguish amongst the types of EM waves 3. Source of each waves |  |
| Light Waves | 1. Wave particle duality | 0.5 week | 1. Rival theories of light 2. Young’s double slit experiment | **Research:**  Identify modern technology that operates on the principle that light behaves as a particle. Observe pictures with a traditional film camera and a digital camera and compare the differences between them including how each forms an image. |
|  | 1. Rays of light | 0.5 week | 1. Explanation of the rare observation of the diffraction of light 2. Light travels in a straight line | **Test:**  EM waves, wave particle duality, light rays |
|  | 1. Reflection | 0.5 week | 1. Laws of reflection 2. Images in a plane mirror |  |
|  | 1. Refraction | 0.5 week | 1. Real life applications of refraction of light e.g. mirages 2. Refraction of light rays 3. Prisms 4. Snell’s law | **Research:**  Discuss how raindrops and prisms have similar effect with light in forming rainbows and spectrum respectively using diagrams. |
|  | 1. Critical angle and total reflection | 1 week | 1. Explain ‘critical angle’ and ‘total internal reflection.’ 2. Critical angle vs. total internal reflection 3. Diagrams of total internal reflection |  |
| Lenses | 1. Action of lenses | 1 week | 1. Converging and diverging lenses 2. Definition of terms: *principal axes*, *principal focus, focal length, focal plane, magnification* |  |
|  | 1. Image formation | 1 week | 1. Real vs. virtual images 2. Equations for magnification 3. Lens formula and scale diagrams |  |

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