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<th>Mark Value %</th>
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</table>
| 1       | Waves Practical Task              | 15           | P8 explains wave motions in terms of energy sources and the oscillations produced  
P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources  
P13 identifies appropriate terminology and reporting styles to communicate information and understanding in physics  
P14 draws valid conclusions from gathered data and information  
P15 implements strategies to work effectively as an individual or as a member of a team | T1W7         |
| 2       | Electricity Investigation          | 15           | P1 outlines the historical development of major principles, concepts and ideas in physics  
P2 applies the processes that are used to test and validate models, theories and laws of science with particular emphasis on first-hand investigations in physics  
P7 describes the effects of energy transfers and energy transformations  
P9 describes the relationship between force and potential energy in fields  
P11 identifies and implements improvements to investigation plans  
P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources  
P13 identifies appropriate terminology and reporting styles to communicate information and understanding in physics  
P14 draws valid conclusions from gathered data and information  
P15 implements strategies to work effectively as an individual or as a member of a team | T2W9         |
| 3       | Moving About Investigation         | 15           | P2 applies the processes that are used to test and validate models, theories and laws of science with particular emphasis on first-hand investigations in physics  
P4 describes applications of physics which affect society or the environment  
P5 describes the scientific principles employed in particular areas of physics research  
P6 describes the forces acting on an object which cause changes in its motion  
P7 describes the effects of energy transfers and energy transformations  
P11 identifies and implements improvements to investigation plans  
P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources  
P13 identifies appropriate terminology and reporting styles to communicate information and understanding in physics  
P14 draws valid conclusions from gathered data and information  
P15 implements strategies to work effectively as an individual or as a member of a team | T3W3         |
| 4       | Cosmic Engine Group Work and Oral Presentation | 15           | P1 outlines the historical development of major principles, concepts and ideas in physics  
P3 assesses the impact of particular technological advances on understanding in physics  
P4 describes applications of physics which affect society or the environment  
P5 describes the scientific principles employed in particular areas of physics research  
P10 describes theories and models in relation to the origins of matter and relates these to the forces involved  
P13 identifies appropriate terminology and reporting styles to communicate information and understanding in physics | T3W7         |
| 5       | Preliminary Exam                  | 40           | P1 outlines the historical development of major principles, concepts and ideas in physics  
P6 describes the forces acting on an object which cause changes in its motion  
P7 describes the effects of energy transfers and energy transformations  
P8 explains wave motions in terms of energy sources and the oscillations produced  
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P13 identifies appropriate terminology and reporting styles to communicate information and understanding in physics  
P14 draws valid conclusions from gathered data and information | Term 3 Exam block |
Subject: 12 Physics

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### Assessment Grids

#### Physics

### Preliminary

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### HSC

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<th>2. Motors and Generators</th>
<th>3. From Ideas to Implementation</th>
<th>4. Option</th>
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Board Mandatory Requirements

- All modules must have the same assessment weighting
- No more than 50% weighting may be allocated to examinations and topic tests
- A minimum of 30% weighting must be allocated to tasks that assess students' abilities to conduct first-hand investigations and communicate information and understandings based on these investigations

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Task 1. Waves Practical Test

Task 2. Electricity Investigation

Task 3. Moving About Investigation

Task 4. Cosmic Engine Group Work and Oral Presentation

Task 5. Preliminary Exam
Course: PHYSICS 2001 - 2002

Units: 2 Unit - HSC

Board Mandatory Requirements

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Task 1. **Space Assignment**

Task 2. **Photocell Open Ended Investigation**

Task 3. **Half Yearly Exams**

Task 4. **Option Open Ended Investigation**

Task 5. **Trial HSC**
PBCF Name: __________________

Preliminary Physics
Assessment Task

Waves Practical Task

Date:
Weighting: 15%

Outcomes Assessed

P8 explains wave motions in terms of energy sources and the oscillations produced

P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources

12.1 perform first-hand investigations by:
   a) carrying out the planned procedure, recognising where and when modifications are needed and analysing the effect of these adjustments
   b) efficiently undertaking the planned procedure to minimise hazards and wastage of resources
   c) disposing of any waste materials produced carefully and safely during the investigation
   d) identifying and using safe work practices during investigations

12.2 gather first-hand information by:
   a) using appropriate data collection techniques, employing appropriate technologies, including data loggers and sensors
   b) measuring, observing and recording results in accessible and recognisable forms, carrying out repeat trials as appropriate

12.4 process information to:
   a) assess the accuracy of any measurements and calculations and the relative importance of the data and information gathered
   b) identify and apply relevant mathematical formulae and concepts
   c) illustrate trends and patterns by organising data through the selection and use of appropriate methods, including computer assisted analysis
   d) evaluate the validity of first-hand and secondary information and data in relation to the area of investigation
   e) assess the reliability of first-hand and secondary information and data by considering information from various sources
   f) assess the accuracy of scientific information presented in mass media by comparison with similar information presented in scientific journals

P13 identifies appropriate terminology and reporting styles to communicate information and understanding in physics

13.1 present information by:
   a) selecting and using appropriate text types or combinations thereof, for oral and written presentations
   b) selecting and using appropriate media to present data and information
   c) selecting and using appropriate methods to acknowledge sources of information
   d) using symbols and formulae to express relationships and using appropriate units for physical quantities
   e) using a variety of pictorial representations to show relationships and presenting information clearly and succinctly
   f) selecting and drawing appropriate graphs to convey information and relationships clearly and accurately
   g) identifying situations where use of a curve of best fit is appropriate to present graphical information

P14 draws valid conclusions from gathered data and information

14.1 analyse information to:
   a) identify trends, patterns and relationships as well as contradictions in data and information
   b) justify inferences and conclusions
   c) identify and explain how data supports or refutes an hypothesis, a prediction or a proposed solution to a problem
   d) predict outcomes and generate plausible explanations related to the observations
   e) make and justify generalisations
   f) use models, including mathematical ones, to explain phenomena and/or make predictions
   g) use cause and effect relationships to explain phenomena
   h) identify examples of the interconnectedness of ideas or scientific principles

14.3 use available evidence to:
   a) design and produce creative solutions to problems
   b) propose ideas that demonstrate coherence and logical progression and include correct use of scientific principles and ideas
   c) apply critical thinking in the consideration of predictions, hypotheses and the results of investigations
   d) formulate cause and effect relationships

P15 implements strategies to work effectively as an individual or as a member of a team
Content

In this assessment task, you will attempt five practical stations.

1. You are given 15 minutes to complete each station
2. Movement time is not counted as part of the 15 minutes.
3. All instructions, information and formula are given at the station.
4. All responses are to be made on this answer sheet in the space provided.
5. You will need a blue pen, pencil (2B or greater), eraser, calculator and ruler.
6. All diagrams are to be done in pencil.
7. All writing (excluding diagrams) is to be done in pen.
8.

Station 1
**Station 1**

**Outcomes Assessed:**

P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources

12.1 perform first-hand investigations by:
   a) carrying out the planned procedure, recognising where and when modifications are needed and analysing the effect of these adjustments
   d) identifying and using safe work practices during investigations

12.2 gather first-hand information by:
   a) using appropriate data collection techniques, employing appropriate technologies, including data loggers and sensors
   b) measuring, observing and recording results in accessible and recognisable forms, carrying out repeat trials as appropriate

P14 draws valid conclusions from gathered data and information

14.1 analyse information to:
   f) use models, including mathematical ones, to explain phenomena and/or make predictions

At this station you will measure the angle of refraction of a light beam through a glass slab and the refractive index of the glass slab.

**Materials at this station**

Power supply
Ray box kit
Glass slab
Protractor

**Method**

1. Assemble the ray box using a single slit.
2. Arrange the light source and glass slab as follows:

   ![Diagram of light ray and glass slab]

   Incoming light ray  \[ \text{Angle is 45°} \]
   Glass slab

3. Place your answer sheet underneath the glass slab.
4. Trace the outline of the incoming light ray and glass slab onto the answer sheet.
5. Trace the path of the refracted light ray onto the sheet.
6. Measure the angle of refraction from the sheet.
7. Repeat steps 2 to 6 for the angles 30° and 60°. Record your results in a suitable way.
8. Use the formula \( n_2 = \frac{\sin \Theta_1}{\sin \Theta_2} \) to calculate the refractive index for each angle.
9. Calculate the average refractive index.
**Station 2**

**Outcomes Assessed:**

P8 explains wave motions in terms of energy sources and the oscillations produced

P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources

12.1 perform first-hand investigations by:
   a) carrying out the planned procedure, recognising where and when modifications are needed and analysing the effect of these adjustments

12.4 process information to:
   a) assess the accuracy of any measurements and calculations and the relative importance of the data and information gathered
   c) illustrate trends and patterns by organising data through the selection and use of appropriate methods, including computer assisted analysis

P13 identifies appropriate terminology and reporting styles to communicate information and understanding in physics

13.1 present information by:
   d) using symbols and formulae to express relationships and using appropriate units for physical quantities
   e) using a variety of pictorial representations to show relationships and presenting information clearly and succinctly
   f) selecting and drawing appropriate graphs to convey information and relationships clearly and accurately
   g) identifying situations where use of a curve of best fit is appropriate to present graphical information

P14 draws valid conclusions from gathered data and information

14.1 analyse information to:
   a) identify trends, patterns and relationships as well as contradictions in data and information

At this station you will measure and superimpose two waves.

**Materials at this station**

Rope attached to a retort stand

**Method**

1. Generate a pulse by quickly lifting the end of the rope 5 cm up and back down to the original position.
2. Estimate the length and amplitude of the pulse just as it hits the retort stand. Write this down.
3. Draw the wave on the graph paper. Label this “wave 1”
4. Repeat step 1.
5. Estimate the length and amplitude of the pulse just as it leaves the retort stand. Write this down.
6. Draw the wave on the graph paper on the same axes as the first wave. Label this “wave 2”
7. Add the two waves. Label this “resultant”.
**Station 3**

**Outcomes Assessed:**

P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources

12.1 perform first-hand investigations by:
   d) identifying and using safe work practices during investigations

12.2 gather first-hand information by:
   b) measuring, observing and recording results in accessible and recognisable forms, carrying out repeat trials as appropriate

12.4 process information to:
   b) identify and apply relevant mathematical formulae and concepts

P13 identifies appropriate terminology and reporting styles to communicate information and understanding in physics

13.1 present information by:
   c) using a variety of pictorial representations to show relationships and presenting information clearly and succinctly

P14 draws valid conclusions from gathered data and information

14.1 analyse information to:
   a) identify trends, patterns and relationships as well as contradictions in data and information

At this station you will construct diagrams of rays reflecting and refracting from objects.

**Materials at this station**

Ray box kit
Power supply
Protractor

**Method**

1. Arrange the light box and mirrors so that they follow the patterns below:

   ![Diagram 1](image1)
   ![Diagram 2](image2)
   ![Diagram 3](image3)

2. Trace the path of light and the mirrors onto the space provided in the answer sheet.
3. Measure the incident and reflected angle from the normal. Record this in a suitable way.
4. Repeat steps 2 – 3 for TWO other different angles.
Station 4

Outcomes Assessed:
P8 explains wave motions in terms of energy sources and the oscillations produced
P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources
  12.1 perform first-hand investigations by:
    a) carrying out the planned procedure, recognising where and when modifications are needed and analysing the effect of these adjustments
P13 identifies appropriate terminology and reporting styles to communicate information and understanding in physics
  13.1 present information by:
    d) using symbols and formulae to express relationships and using appropriate units for physical quantities
    e) using a variety of pictorial representations to show relationships and presenting information clearly and succinctly
P14 draws valid conclusions from gathered data and information
  14.1 analyse information to:
    a) identify trends, patterns and relationships as well as contradictions in data and information
    f) use models, including mathematical ones, to explain phenomena and/or make predictions

At this station you will determine the frequency of three tuning forks.

Materials at this station
Plastic measuring cylinder
Tuning fork
Eye dropper
ruler

Method
1. Partly fill the measuring cylinder with water.
2. Strike the tuning fork labelled “A” on the table and hold it over the mouth of the measuring cylinder.
3. Listen for a hum
4. Adjust the height of water in the measuring cylinder until the hum is the loudest.
5. Record the distance from the top of the measuring cylinder to the water level.
6. Repeat steps 1-5 for the tuning forks labelled “B” and “C”. Record your results in a suitable way.
7. The wavelength of the tuning is four times the distance measured in step 5. Use the equation \( v = f \lambda \) to determine the frequencies of the three tuning forks given that the speed of sound in air is 330 m/s.
**Station 5**

**Outcomes Assessed:**

P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources

12.2 gather first-hand information by:
- b) measuring, observing and recording results in accessible and recognisable forms, carrying out repeat trials as appropriate

12.4 process information to:
- a) assess the accuracy of any measurements and calculations and the relative importance of the data and information gathered
- b) identify and apply relevant mathematical formulae and concepts
- c) illustrate trends and patterns by organising data through the selection and use of appropriate methods, including computer assisted analysis

P13 identifies appropriate terminology and reporting styles to communicate information and understanding in physics

13.1 present information by:
- f) selecting and drawing appropriate graphs to convey information and relationships clearly and accurately
- g) identifying situations where use of a curve of best fit is appropriate to present graphical information

P14 draws valid conclusions from gathered data and information

14.1 analyse information to:
- e) make and justify generalisations
- f) use models, including mathematical ones, to explain phenomena and/or make predictions
- g) use cause and effect relationships to explain phenomena

14.3 use available evidence to:
- c) apply critical thinking in the consideration of predictions, hypotheses and the results of investigations
- d) formulate cause and effect relationships

P15 implements strategies to work effectively as an individual or as a member of a team

At this station you will investigate the results of an unknown experiment.

**Materials at this station**

Image of results of an investigation. Each ruler in the image is one metre.

**Method**

1. Suggest an aim for this investigation. Explain why you have made this suggestion.
2. Using the formula \( \text{Area} = \pi r^2 \), calculate the area of each globe using a scale of 1:1.
3. Draw a graph of area of globe against distance.
4. Describe the graph that you have produced.
Outcomes Assessed

P8 explains wave motions in terms of energy sources and the oscillations produced
P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources
P13 identifies appropriate terminology and reporting styles to communicate information and understanding in physics
P14 draws valid conclusions from gathered data and information
P15 implements strategies to work effectively as an individual or as a member of a team

<table>
<thead>
<tr>
<th>Band</th>
<th>Criteria</th>
<th>Mark Range</th>
</tr>
</thead>
</table>
| Excellent  | • Evaluates the significance of data obtained in terms of its validity and reliability.  
             • Manipulate formulae to obtain new equations.  
             • Discusses the reasons for a modification to a planned procedure.  
             • Assesses the accuracy of measurements and data obtained by comparison to common experience.  
             • Analyse data to obtain trends and patterns that may not be evident on casual analysis.  
             • Repeat trials of measurements to obtain valid and reliable results.  
             • Apply mathematical and statistical procedures to obtain parameters for trends such as gradient, mean, etc.  
             • Modifies steps in a planned procedure to more efficiently or safely carry out the procedure. | 25-30 |
| Substantial| • Determines relationships between observations quantitatively and makes predictions.  
             • Performs calculations on measurements.  
             • Identifies steps in a planned procedure that are not suitable or safe.  
             • Numerically correlate trends and patterns using methods such as line of best fit, curve fitting, etc.  
             • Correctly plot a graph and fully label it (title, axes, units, points, LOBF)  
             • Draw a LOBF correctly on a scatter graph.  
             • Manipulates measurements to obtain secondary data. | 19-24 |
| Good       | • Correctly apply a formula to a given situation.  
             • Determines relationships between observations qualitatively.  
             • Use pictorial representations such as flow charts, Venn diagrams, etc. to display information.  
             • Obtain the correct formula for a given situation.  
             • Recognises trends or patterns in observations.  
             • Identify a trend in a scatter graph.  
             • Identify trends and patterns in data sets.  
             • Distinguishes different features of wave motion and applies these to oscillations. | 13-18 |
| Satisfactory| • Uses safe work practices during investigations.  
             • Employs appropriate data collection techniques, including data loggers and sensors.  
             • Measures, observes and records results in accessible and recognizable forms.  
             • Draw accurately labelled diagrams concisely and neatly.  
             • Identify a suitable graph to use in a given situation.  
             • Identify situations where a formula may be required.  
             • Recalls that waves are a form of energy and outlines the basic principles of wave motion.  
             • Obtains measurements correctly without random or systematic errors. | 7-12 |
| Elementary  | • Follows a planned procedure.  
             • Identifies safe work practices during investigations.  
             • Identifies appropriate data collection techniques, including data loggers and sensors.  
             • Measures, observes and records results.  
             • States observations in a problem  
             • Use symbols and formulae to express relationships and using appropriate units for physical quantities. | 0-6 |

Total mark = __________________________
PBCF

Preliminary Physics
Assessment Task

Electricity Investigation

Due Date (By): T2W9
Weighting: 15%

Outcomes Assessed
This task covers and assesses the syllabus outcome (Module 8.3, section 5):

“Students plan, choose equipment or resources for, and perform a first hand investigation to lift a specified weight by designing an electromagnet.”

P2 applies the processes that are used to test and validate models, theories and laws of science with particular emphasis on first-hand investigations in physics
P11 identifies and implements improvements to investigation plans
11.2 plan first-hand investigations to:
a) demonstrate the use of the terms ‘dependent’ and ‘independent’ to describe variables involved in the investigation.
b) design investigations that allow valid and reliable data and information to be collected
c) describe and trial procedures to undertake investigations and explain why a procedure, or a sequence of procedures or the repetition of procedures is appropriate
11.3 choose equipment or resources by:
a) identifying and/or setting up the most appropriate equipment or combination of equipment needed to undertake the investigation
P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources
12.1 perform first-hand investigations by:
a) carrying out the planned procedure, recognising where and when modifications are needed and analysing the effect of these adjustments

Content

The strength of an electromagnet depends on a number of variables. It is expected that your investigation will focus on the relationship between the strength of your electromagnet (measured by how many paper clips it can lift) and two of these variables. The graphs so derived should enable you to choose correct values for these variables in order to lift the specified weight.

This assessment task consists of three parts:

1. Submission of proposed investigation
2. Trialling of procedure(s)
3. Attempted lifting of specified weight.

1. You are to submit your investigation plan. This will consist of
   a) Title
   b) Aim
   c) Equipment / Apparatus
   d) Procedure
   e) Table of Results
   f) Discussion – In separate paragraphs you are to respond to the requirements of 11.2a,b,d

2. Prior to this your investigation plan will be returned. You will be provided with the materials to construct an electromagnet. As your procedures should be applicable to any (laboratory appropriate!) electromagnet there should be no difficulty in substituting for the electromagnet referred to in your investigation plan.

3. You will then carry out your investigation plan, complete the results section and resubmit with the electromagnet you constructed.
   Immediately following this you will be required to respond to the requirements of 12.1a

   Your investigation plan and electromagnet will be returned and you will be told the weight to lift. It is important that you get as close to this figure as possible, using your results from part 2. Information regarding the exact experimental set up to be provided by the examiner/s for this section will not be disclosed prior to this time.
### Outomes Assessed

P2 applies the processes that are used to test and validate models, theories and laws of science with particular emphasis on first-hand investigations in physics

P11 identifies and implements improvements to investigation plans

P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Mark Range</th>
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</thead>
<tbody>
<tr>
<td>a) Evaluates an experimental method in terms of the validity and reliability of the data to be collected.</td>
<td>13-15</td>
</tr>
<tr>
<td>a) Analyses an experimental method to ensure that the design of the equipment allows valid and reliable data to be collected.</td>
<td>10-12</td>
</tr>
<tr>
<td>b) Describes and trials procedures to undertake an investigation and explains why a procedure is appropriate.</td>
<td></td>
</tr>
<tr>
<td>c) Carrying out the planned procedure, recognising where and when modifications are needed and analysing the effects of these adjustments.</td>
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</tr>
<tr>
<td>d) Chooses an experimental set up which applies the results of the prior experimental procedure to lift a weight to a high degree of accuracy.</td>
<td></td>
</tr>
<tr>
<td>a) Examines an experimental method to ensure the collection of valid and reliable data.</td>
<td>6-9</td>
</tr>
<tr>
<td>b) Describes a procedure to undertake an investigation and states why it is suitable.</td>
<td></td>
</tr>
<tr>
<td>c) Carrying out the planned procedure, recognising where and when modifications are needed and describing the effects of these adjustments.</td>
<td></td>
</tr>
<tr>
<td>d) Chooses an experimental set up which applies the results of the prior experimental procedure to lift a weight to a reasonable degree of accuracy.</td>
<td></td>
</tr>
<tr>
<td>e) Correctly distinguishes between dependent and independent variables in an experimental investigation.</td>
<td></td>
</tr>
<tr>
<td>f) Identifying and/or setting up the most appropriate equipment or combination of equipment needed to undertake the investigation.</td>
<td></td>
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<tr>
<td>a) Recognises the need for valid and reliable data to be collected.</td>
<td>3-5</td>
</tr>
<tr>
<td>b) Outlines a basic experimental procedure to carry out an investigation.</td>
<td></td>
</tr>
<tr>
<td>c) Carrying out the planned procedure, recognising where and when modifications are needed and stating the effects of these adjustments.</td>
<td></td>
</tr>
<tr>
<td>d) Chooses an experimental set up which applies the results of the prior experimental procedure to lift a weight to a low degree of accuracy.</td>
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</tr>
<tr>
<td>e) Defines/uses the terms “dependent” and “independent” as they apply to experimental investigations.</td>
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<tr>
<td>f) Correctly sets up equipment to carry out an experimental investigation.</td>
<td></td>
</tr>
<tr>
<td>a) Substantially fails to achieve one or more of the above outcomes.</td>
<td>0-2</td>
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</tbody>
</table>

**Total mark = _________________**
Outcomes Assessed

This task covers and assesses the syllabus outcome (Module 8.4, section 5, dot point 1 (column 3)):

“Students identify data sources, plan, choose equipment or resources for, and gather and process first-hand data and/or secondary information and analyse information about the potential danger presented by loose objects in a vehicle.”

P2 applies the processes that are used to test and validate models, theories and laws of science with particular emphasis on first-hand investigations in physics
P4 describes applications of physics which affect society or the environment
P6 describes the forces acting on an object which cause changes in its motion
P7 describes the effects of energy transfers and energy transformations
P11 identifies and implements improvements to investigation plans

11.1 identify data sources to:
b) determine the type of data that needs to be collected and explain the qualitative or quantitative analysis that will be required for this data to be useful
11.2 plan first-hand investigations to:
c) design investigations that allow valid and reliable data and information to be collected
b) carrying out a risk assessment of intended experimental procedures and identifying and addressing potential hazards
P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources
12.1 perform first-hand investigations by:
a) carrying out the planned procedure, recognising where and when modifications are needed and analysing the effect of these adjustments
d) identifying and using safe work practices during investigations

Content

The danger of loose objects in vehicles has many factors. It is expected that your investigation will focus on the relationship between the nature of the loose object and its effect on hypothetical passengers in a vehicle.

This assessment task consists of two parts:

1. The investigation
2. Literature search

1. You are to submit your investigation plan. This will consist of

   a) Title
   b) Aim
   c) Equipment / Apparatus
   d) Procedure - In separate paragraphs you are to respond to the requirements of 11.1b, 11.2c, 11.3b
   e) Results
   f) Discussion – In separate paragraphs you are to respond to the requirements of 12.1a, d
   g) Conclusion.

2. You are to perform a literature search about the dangers of loose objects in vehicles. References should be written in an accepted format.
Moving About Investigation Marking Scale

Outcomes Assessed
P2 applies the processes that are used to test and validate models, theories and laws of science with particular emphasis on first-hand investigations in physics
P4 describes applications of physics which affect society or the environment
P6 describes the forces acting on an object which cause changes in its motion
P7 describes the effects of energy transfers and energy transformations
P11 identifies and implements improvements to investigation plans
P12 discusses the validity and reliability of data gathered from first-hand investigations and secondary sources

<table>
<thead>
<tr>
<th>Band</th>
<th>Criteria</th>
<th>Mark Range</th>
</tr>
</thead>
</table>
| Excellent   | • Uses the concept of null hypothesis or hypothesis testing to validate theories.  
• Gives and explains specific examples of the effect of science on society/environment.  
• Resolves forces on an object individually.  
• Explains the quantitative analysis that is needed to process the data.  
• Analyse an experimental method to ensure that the design of the experiment allows valid and reliable data.  
• Justify an experimental method in terms of the validity and reliability of the data obtained.  
• Evaluates risk management strategies performed in an experimental investigation.  
• Discusses the reasons for a modification to a planned procedure. | 13-15      |
| Substantial | • Identifies and quantifies confounding variables in an experiment. Uses mathematical models to fit data.  
• Describes how energy is transformed.  
• Explains the qualitative analysis that is needed to process the data.  
• Examine the use of variables in an experimental investigation to ensure that data collected is valid/reliable.  
• Classifies risks in an experimental investigation according to danger.  
• Designs appropriate risk management strategies to minimize hazards during an experimental investigation.  
• Modify steps in a planned procedure to more efficiently or safely carry out the procedure. | 10-12      |
| Good        | • Relates the results of an experiment to its aim. Accepts or discards theories on the basis of the results.  
• Identifies areas of society where science has made an impact.  
• States that a force changes an object's direction.  
• Repeat trials or investigations to ensure reliable data.  
• Describe the nature of each risk in an experimental investigation.  
• Uses safe work practices during investigations. | 7-9        |
| Satisfactory| • Maintains all variables except one constant in experiments. Creates suitable controls in experiments  
• Identifies types of energy and states that energy is conserved.  
• Identifies types of data that need to be collected  
• Manipulate equipment so as to minimize systematic errors to obtain valid results  
• Identify risks involved in carrying out an experimental investigation.  
• Identifies steps in a planned procedure that are not suitable or safe.  
• Identifies safe work practices during investigations. | 4-6        |
| Elementary  | • Identifies and describes simple variables and controls in experiments.  
• Follows a planned procedure. | 0-3        |

Total mark = ______________________
PBCF
Preliminary Physics
Assessment Task

**Cosmic Engine Group Work and Oral Presentation**

Due Date: 31st August 2001
Weighting: 15%

**Outcomes Assessed**

This task covers and assesses the syllabus outcomes (Module 8.5, section 4, dot point 1 (column 3)) and (Module 8.5, section 5, dot point 2 (column 3)):

8.5.4.1(3) “present information and use available evidence to discuss the factors affecting the size of the gravitational force.”
8.5.5.2(3) “present information to schematically represent the path of solar winds as they flow around the Earth”

P1 outlines the historical development of major principles, concepts and ideas in physics
P3 assesses the impact of particular technological advances on understanding in physics
P4 describes applications of physics which affect society or the environment
P10 describes theories and models in relation to the origins of matter and relates these to the forces involved
P13 identifies appropriate terminology and reporting styles to communicate information and understanding in physics

13.1 present information by:

a) selecting and using appropriate text types or combinations thereof, for oral and written presentations
b) selecting and using appropriate media to present data and information
c) selecting and using appropriate methods to acknowledge sources of information
d) using symbols and formulae to express relationships and using appropriate units for physical quantities
e) using a variety of pictorial representations to show relationships and presenting information clearly and succinctly

**Content**

The earth protects life in different ways. In this assessment, you and a partner will research and present information on the above two dot points. Both partners will be awarded the same mark. This assessment task consists of two parts:

1. **Speech summary and presentation notes.**
2. **Speech.**

1. You are to submit two pieces of writing. This will consist of
   a) a summary of your speech
   b) presentation notes to be distributed to each student in both classes. All material should be referenced.
2. After the due date of this assessment, you and your partner will present a 10 minute speech on the topic. You may use any reasonable technology – this must be arranged with the teacher beforehand.
**Outcomes Assessed**

P1 outlines the historical development of major principles, concepts and ideas in physics

P3 assesses the impact of particular technological advances on understanding in physics

P4 describes applications of physics which affect society or the environment

P10 describes theories and models in relation to the origins of matter and relates these to the forces involved

P13 identifies appropriate terminology and reporting styles to communicate information and understanding in physics

<table>
<thead>
<tr>
<th>Band</th>
<th>Criteria</th>
<th>Mark Range</th>
</tr>
</thead>
</table>
| Excellent       | • Provides a detailed historical development of many concepts in physics describing how each concept outcompeted others  
• Critically evaluates the impact of particular advances on specific areas of scientific research.  
• Gives and explains specific examples of the effect of science on society / environment.  
• Applies theories of forces to explain how matter is formed.  
• Uses in-text referencing of sources.  
• Utilises the features of a medium to present data and information.                                                | 13-15      |
| Substantial     | • Compares competing theories in the historical development of physics.  
• Justifies why a particular advance aids scientific research, using examples.  
• Outlines some theories about the origins of matter.  
• Uses composite text types correctly.  
• Uses pictorial representations such as flow charts, Venn diagrams, etc. to display information.                  | 10-12      |
| Good            | • Sequences the development of major concepts in physics.  
• Explains other advances and demonstrates why a particular advance is useful in an area of scientific research.  
• Identifies areas of society where science has made an impact.  
• Arranges data and information to suit a medium.  
• Draws accurately labelled diagrams concisely and neatly                                                        | 7-9        |
| Satisfactory    | • Describes major concepts in physics mentioning people that first postulated them.  
• Describes the relevance of the advances to the scientific research.  
• Selects a text type suitable for a piece of writing or oral tasks.  
• Identifies suitable media for a given task.  
• Creates a bibliography using an acceptable format.  
• Uses symbols and formulae to express relationships and uses appropriate units for physical quantities.            | 4-6        |
| Elementary      | • States some of the ideas in physics  
• States some technological advances.                                                                                                                                  | 0-3        |

**Total mark = _________________**
Outcomes Assessed
This task covers and assesses the syllabus outcome Module 9.2, section 2, dot point 3 (column 3):

9.2.2.3(3) “perform a first-hand investigation, gather secondary information and analyse data to describe factors, such as initial and final velocity, maximum height reached, range, time of flight of a projectile, and quantitatively calculate each for a range of situations by using simulations, data loggers and computer analysis.”

H2 analyses the ways in which models, theories and laws in physics have been tested and validated
H6 explains events in terms of Newton’s Laws, Law of Conservation of Momentum and relativity
H7 explains the effect of energy transfers and transformation
H9 explains the effects of electric, magnetic and gravitational fields
H12 evaluates ways in which accuracy and reliability could be improved in investigations
12.2 gather first-hand information by:
a) using appropriate data collection techniques, employing appropriate technologies, including data loggers and sensors
12.3 gather information from secondary sources by:
a) accessing information from a range of resources, including popular scientific journals, digital technologies and the Internet
H14 assesses the validity of conclusions from gathered data and information
14.1 analyse information to:
f) use models, including mathematical ones, to explain phenomena and/or make predictions

Content
In this assessment task, you will follow a planned procedure to obtain results on projectile motion. You will then analyse these results and results obtained from simulations to describe factors, such as initial and final velocity, maximum height reached, range, time of flight of a projectile. There are two parts to this assessment:

1. Experimental Report of Experiment 4 from the 9.2 Space Student Notes.
2. Solutions to a range of projectile motion questions.
**HSC Physics C1: Space Experiment 4: Measuring Projectile Motion**

**Aim:** To describe factors, such as initial and final velocity, maximum height reached, range, time of flight of a projectile, and quantitatively calculate each for a range of situations.

**Materials**
- Digital camera
- Computer
- Projectile board
- Ball bearing
- (each student to provide a floppy disk)

**Method**
A motion picture of a ball bearing projected using various trajectories is taken whilst the ball is moving against the projectile board background:

(a) ground to ground motion
(b) height to ground motion (from moving start)
(c) ground to height motion

Each movie is taken as a quicktime movie with a frame rate of 15 frames/sec. Your teacher will demonstrate how to analyse the images on the computer using Windows Media Player. These movies are in QuickTime format and will be available from Mr. Neubronner's web site: [http://members.optushome.com.au/galenneubronner/physics/index.htm](http://members.optushome.com.au/galenneubronner/physics/index.htm) in the 9.2 Space section of the page. You may use either the data on this site or data obtained in class.

**Analysis**
1. For each motion, create a table of instantaneous speed in both the horizontal and vertical directions as follows:

<table>
<thead>
<tr>
<th>Interval (1/15 sec)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal distance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical distance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interval (1/15 sec)</th>
<th>0-1</th>
<th>1-2</th>
<th>2-3</th>
<th>3-4</th>
<th>4-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal Speed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical Speed</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

2. Draw a graph of velocity versus time for each motion. Graph both directions on the same graph.
3. Calculate the accelerations acting on the ball from the above graphs.
4. Measure the time of flight, maximum height, range, initial (first frame) and final velocities (last frame) for each motion.
5. Analyse and discuss the motion of the ball in each case.
6. References should be quoted in a suitable manner.

**Part 2 - Solutions to a range of projectile motion questions.**

Do the following questions attached:
   a) Dyett problems 8-16, 27-28
   b) Humphrey's Set 17
   c) Projectile Motion worksheets.

Each question is to be clearly labelled and appropriate diagrams drawn.
### Outcomes Assessed

- **H2** (bands 1-5) analyses the ways in which models, theories and laws in physics have been tested and validated.
- **H6** (bands 3-5) explains events in terms of Newton’s Laws, Law of Conservation of Momentum and relativity.
- **H7** (bands 3-5) explains the effect of energy transfers and transformation.
- **H9** (bands 3-5) explains the effects of electric, magnetic and gravitational fields.
- **H12** evaluates ways in which accuracy and reliability could be improved in investigations.

12.2 gather first-hand information by:
- (bands 2-3) using appropriate data collection techniques, employing appropriate technologies, including data loggers and sensors.

12.3 gather information from secondary sources by:
- (bands 1-4) accessing information from a range of resources, including popular scientific journals, digital technologies and the Internet.

- **H14** assesses the validity of conclusions from gathered data and information.

14.1 analyse information to:
- (bands 1-5) use models, including mathematical ones, to explain phenomena and/or make predictions.

### Band Criteria Mark

<table>
<thead>
<tr>
<th>Band</th>
<th>Criteria</th>
<th>Mark Range</th>
</tr>
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</table>
| Excellent – 5      | - H2 Accepts or discards theories on the basis of the results by analysing the ways in which this investigation tests and validates models, theories and laws.  
                     - H6 Describes quantitatively situations where Newton's Law of Motion, Conservation laws or relativity apply, giving numerical examples where appropriate.  
                     - H7 Describes specific examples of energy transfers and transformations quantitatively.  
                     - H9 Applies the idea of “field” to particles moving within a field quantitatively.  
                     - H14.1f Determines relationships between observations quantitatively and makes predictions. | 33-40      |
| Substantial – 4    | - H2 Relates the results of an experiment to its aim. Uses mathematical models to apply first hand data.  
                     - H6 Describes qualitatively situations where Newton's Law of Motion, Conservation laws or relativity apply, giving examples.  
                     - H7 Describes specific examples of energy transfers and transformations qualitatively.  
                     - H9 Applies the idea of “field” to particles moving within a field qualitatively.  
                     - H12.3a Accesses information from a range of resources, including popular scientific journals, digital technologies and the internet.  
                     - H14.1f Determines relationships between observations qualitatively. | 25-32      |
| Good – 3           | - H2 Explains the impact of variables on the accuracy of experimental results.  
                     - H6 States Newton's Laws of Motion, Conservation laws and basic principles of relativity.  
                     - H7 Outlines the basic principles of energy transfers and transformations.  
                     - H9 Outlines the basic nature of electric, magnetic and gravitational fields.  
                     - H12.2a Employs appropriate data collection techniques, including data loggers and sensors.  
                     - H14.1f Recognises trends or patterns in observations. | 17-24      |
| Satisfactory – 2   | - H2 Describes variables relevant to the accuracy of experimental outcomes.  
                     - H12.2a Identifies appropriate data collection techniques, including data loggers and sensors.  
                     - H12.3a Identifies information from a range of resources, including popular scientific journals, digital technologies and the internet | 9-16       |
| Elementary – 1     | - H2 Identifies and describes simple variables.  
                     - H14.1f States observations in a problem | 0-8        |

Total mark = _________________
Photocell Open Ended Investigation

Due Date: T2W8 - 2002
Weighting: 25%

Outcomes Assessed

This task covers and assesses the syllabus outcomes (Module 9.3, section 3, dot point 2 (column 3)), (Module 9.3, section 5, dot point 2 (column 2)), (Module 9.4, section 2, dot point 2 (column 3)) and (Module 9.4, section 2, dot point 4 (column 3)):

9.3.3.2(3) “perform first-hand investigations to produce direct current using voltaic cells.”
9.3.5.2(2) “gather, process and analyse information to identify some of the energy transfers and transformations involving the conversion of electrical energy into more useful forms in the home and industry”.
9.4.2.2(3) “perform a first-hand investigation to demonstrate the photoelectric effect”.
9.4.2.4(3) “identify data sources gather, process and present information to summarise the use of the photoelectric effect in breathalysers, solar cells and photocells.”

H3 assesses the impact of particular advances in physics on the development of technologies
H5 identifies possible future directions of physics research
H9 explains the effects of electric, magnetic and gravitational fields
H10 describes the nature of electromagnetic radiation and matter in terms of the particles
H11 justifies the appropriateness of a particular investigation plan

11.1 identify data sources to:
a) analyse complex problems to determine appropriate ways in which each aspect may be researched
d) identify and use correct units for data that will be collected
c) recommend the use of an appropriate technology or strategy for data collection or information gathering that will assist efficient future analysis

H12 evaluates ways in which accuracy and reliability could be improved in investigations

12.1 perform first-hand investigations by:
a) carrying out the planned procedure, recognising where and when modifications are needed and analysing the effect of these adjustments
d) identifying and using safe work practices during investigations

12.3 gather information from secondary sources by:
a) accessing information from a range of resources, including popular scientific journals, digital technologies and the Internet
c) extracting information from numerical data in graphs and tables as well as written and spoken material in all its forms
d) summarising and collating information from a range of resources
e) identifying practising male and female Australian scientists, and the areas in which they are currently working and in formation about their research

12.4 process information to:
a) assess the accuracy of any measurements and calculations and the relative importance of the data and information gathered
b) identify and apply appropriate mathematical formulae and concepts
f) assess the accuracy of scientific information presented in mass media by comparison with similar information presented in scientific journals

H13 uses terminology and reporting styles appropriately and successfully to communicate information and understanding

13.1 present information by:
b) selecting and using appropriate media to present data and information
c) selecting and using appropriate methods to acknowledge sources of information
d) using symbols and formulae to express relationships and using appropriate units for physical quantities

H14 assesses the validity of conclusions from gathered data and information

14.1 analyse information to:
c) identify and explain how data supports or refutes a hypothesis, a prediction or a proposed solution to a problem
g) use cause and effect relationships to explain phenomena
h) identify examples of the interconnectedness of ideas or scientific principles

14.2 solve problems by:
b) describing and selecting from different strategies, those which could be used to solve a problem
**Content**

In this assessment task, you will investigate the efficiency of one type of photocell in terms of its ability to produce direct current and an investigation into how the photocell utilises the photoelectric effect according to the equation $E = hf - \Phi$.

**Format**

The assessment is to be presented in two parts:

1. **Log Book**
   This section details an account of your investigation. Your research, thoughts, resources, contacts list and other details are to be recorded in this section.

2. **Report**
   This is to be in the standard report format (refer to the handout “Experimental Report Writing in HSC Science”). A bibliography of all referenced work is to be included.

   The background of the report should deal with dot points 9.3.5.2(2) and 9.4.2.4(2) in depth.

   While there is no word limit on this task, it is anticipated that you would spend approximately 30 – 40 hours TOTAL on the research, design, evaluation and reporting in this task.
Outcomes Assessed

H1 (bands 1-5) evaluates how major advances in scientific understanding and technology have changed the direction or nature of scientific thinking
H2 (bands 1-5) analyses the ways in which models, theories and laws in physics have been tested and validated
H3 (bands 1-5) assesses the impact of particular advances in physics on the development of technologies
H5 (bands 1-5) identifies possible future directions of physics research
H7 (bands 2-5) explains the effect of energy transfers and transformation
H8 (bands 2-5) analyses wave interactions and explains the effects of those interactions
H9 (bands 2-5) explains the effects of electric, magnetic and gravitational fields
H10 (bands 1-5) describes the nature of electromagnetic radiation and matter in terms of the particles
H11 (bands 1-5) justifies the appropriateness of a particular investigation plan
H12 (bands 1-5) evaluates ways in which accuracy and reliability could be improved in investigations
H13 (bands 1-5) uses terminology and reporting styles appropriately and successfully to communicate information and understanding
H14 (bands 1-5) assesses the validity of conclusions from gathered data and information

<table>
<thead>
<tr>
<th>Band</th>
<th>Criteria</th>
<th>Mark Range</th>
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</table>
| Excellent | • H1 Provides a detailed historical development of many concepts in physics describing how each concept influenced scientist and modified /revolutionised existing theories.  
• H2 Accepts or discards theories on the basis of the results by analysing the ways in which this investigation tests and validates models, theories and laws.  
• H3 Critically evaluates the usefulness of particular advances in specific areas of scientific research.  
• H5 Evaluates the potential of future technology in social, technical and environmental terms.  
• H7 Relates the effect if energy transfers and transformation to conservation laws.  
• H8 Quantitatively analyses wave interactions to examine the nature of such interactions  
• H9 Analyses the factors that affect a field.  
• H10 Describes reality in terms of wave-particle duality quantitatively.  
• H11.1a Critically analyses the effectiveness of the overall solution in terms of the original problem.  
• H11.1e Evaluates the best technology to gather a particular item of data.  
• H12.1a Evaluates a modification to a planned procedure to deduce if the changes have been effective.  
• H12.3a Accesses information from a range of resources, including popular scientific journals, digital technologies and the internet  
• H12.3c Evaluates the validity of numerical data from graphs and tables as well as written and spoken materials.  
• H12.4a Evaluates the significance of data obtained in terms of its validity and reliability.  
• H12.4b Creates new equations and relationships.  
• H12.4f Assesses scientific information presented in mass media and in scientific journals in terms of accuracy.  
• H13.1b Utilise the features of a medium to present data and information.  
• H14.1c Examines data in terms of its support or refutation of a theory.  
• H14.1g Deduces the cause and effect in a given situation. | 41-50 |
<table>
<thead>
<tr>
<th>Band</th>
<th>Criteria</th>
<th>Mark Range</th>
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</thead>
</table>
| Substantial | • H1 Compares competing theories in the historical development of physics and how these theories changed scientists’ ideas about their existing theories.  
• H2 Relates the results of an experiment to its aim. Uses mathematical models to apply first hand data.  
• H3 Justifies why a particular advance aids in scientific research using examples.  
• H5 Predicts future science or technology on the basis of prior history using examples.  
• H7 Describes specific examples of energy transfers and transformations quantitatively.  
• H8 Quantitatively examines wave interactions in specific situations.  
• H9 Applies the idea of “field” to particles moving within a field quantitatively.  
• H10 Describes reality in terms of wave-particle duality qualitatively.  
• H11.1a Integrates the solution of each component of a complex problem into a meaningful relationship or single entity.  
• H11.1e Analyses the effectiveness of each type of technology in collecting or gathering information.  
• H12.1a Discusses the reasons for a modification to a planned procedure.  
• H12.1d Uses safe work practices during investigations.  
• H12.3c Assesses the reliability of information from secondary sources.  
• H12.3e Cites Australian research in secondary sources.  
• H12.4a Assesses the accuracy of measurements and data obtained by comparison to common experience.  
• H12.4b Manipulate formulae to obtain new equations.  
• H12.4f Discuss the reliability of scientific information presented in mass media and in scientific journals.  
• H12.4c Use in-text referencing of sources.  
• H12.4e Recognises trends or patterns in observations. | 31-40 |

| Good | • H1 Sequences the development of major concepts in physics noting contributions made to theories.  
• H2 Explains the impact of variables on the accuracy of experimental results.  
• H3 Compares other advances and demonstrates why a particular advance is useful in an area of scientific research.  
• H5 Describes how different lines of scientific research may converge to create new avenues.  
• H7 Describes specific examples of energy transfers and transformations qualitatively.  
• H8 Describes how waves interact qualitatively.  
• H9 Applies the idea of “field” to particles moving within a field qualitatively.  
• H10 Quantitatively applies the wave model of electromagnetic radiation and the particle theory of matter in explaining phenomena.  
• H11.1a Classifies each component of the problem according to its level of difficulty and constructs solutions to each.  
• H11.1e Compares the use of different types of technologies to collect or gather information.  
• H12.1a Modifies steps in a planned procedure to more efficiently or safely carry out the procedure.  
• H12.1d Identifies safe work practices during investigations.  
• H12.3a Identifies information from a range of resources, including popular scientific journals, digital technologies and the internet.  
• H12.3c Applies information from numerical data in graphs and tables as well as from written and spoken material in all its forms.  
• H12.3e Identifies Australian scientists, the areas in which they are working and information about their research.  
• H12.4a Performs calculations on measurements.  
• H12.4b Correctly apply a formula to a given situation.  
• H12.4f Compare scientific information presented in mass media and in scientific journals  
• H13.1b Arrange data and information to suit a medium.  
• H14.1h States observations of similar principles that come from different areas of science.  
• H14.2b Selects an appropriate strategy to solve a problem. | 21-30 |
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<thead>
<tr>
<th>Band</th>
<th>Criteria</th>
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<tbody>
<tr>
<td>Satisfactory</td>
<td>• H1 Describes major concepts in physics mentioning people that first postulated them.</td>
<td>11-20</td>
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<tr>
<td></td>
<td>• H2 Describes variables relevant to the accuracy of experimental outcomes.</td>
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<td></td>
<td>• H3 Explains the relevance of the advances to the scientific research.</td>
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<td>• H5 Suggests new avenues of research on the basis of current science.</td>
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<td>• H7 Outlines the basic principles of energy transfers and transformations</td>
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<td>• H8 States the properties and characteristics of waves.</td>
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<td>• H9 Outlines the basic nature of electric, magnetic and gravitational fields.</td>
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<td>• H10 Applies the wave model of electromagnetic radiation and the particle theory of matter in explaining phenomena.</td>
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<td></td>
<td>• H11.1a Breaks large problem into smaller, discrete problems.</td>
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<td>• H11.1e Apply appropriate technologies to collect or gather information.</td>
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<td>• H12.1a Identifies steps in a planned procedure that are not suitable or safe.</td>
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<td>• H12.3c Interpolates and extrapolates information from numerical data in graphs and tables as well as from written and spoken material in all its forms.</td>
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<td>• H12.4a Manipulates measurements to obtain secondary data.</td>
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<td>• H12.4b Obtain the correct formula for a given situation.</td>
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<td></td>
<td>• H12.4f Summarise the scientific information presented in mass media and in scientific journals.</td>
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<td>• H13.1c Create a bibliography using an acceptable format.</td>
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<td></td>
<td>• H14.1c Identifies data in problems.</td>
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<td>• H14.1g States observations in a problem.</td>
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<td>• H14.2b Identifies a problem and its components.</td>
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<tr>
<td>Elementary</td>
<td>• H1 States some of the ideas in physics</td>
<td>0-10</td>
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<td></td>
<td>• H2 Identifies and describes simple variables.</td>
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<td>• H3 States some technological advances made through science.</td>
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<td>• H5 State some current scientific research and the trends they indicate.</td>
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<td>• H10 Defines the nature of electromagnetic radiation using a wave model and for matter using a particle model.</td>
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<td>• H11.1a Identifies large problem and describes it concisely.</td>
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<td>• H11.1d Use correct units for physical quantities.</td>
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<td>• H11.1e Identify types of data to be collected.</td>
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<td>• H12.1a Follows a planned procedure</td>
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<td>• H12.3c Identifies and extracts information from numerical data in graphs and tables as well as from written and spoken material in all its forms.</td>
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<td>• H12.3d Summarises and collates information from a range of sources.</td>
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<td>• H12.4a Obtains measurements correctly without random or systematic errors.</td>
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<td>• H12.4b Identify situations where a formula may be required.</td>
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<td>• H12.4f Gather scientific information presented in mass media and in scientific journals.</td>
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<td>• H13.1b Identify suitable media for a given task.</td>
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</table>

Total mark = ____________________
Outcomes Assessed

This task covers and assesses the syllabus outcomes in an entire section of the elective module you have chosen:

- Medical Physics Section 2
- Astrophysics Section 3
- From Quanta to Quarks Section 1
- The Age of Silicon Section 4

H1 evaluates how major advances in scientific understanding and technology have changed the direction or nature of scientific thinking
H2 analyses the ways in which models, theories and laws in physics have been tested and validated
H7 explains the effect of energy transfers and transformation
H8 analyses wave interactions and explains the effects of those interactions
H9 explains the effects of electric, magnetic and gravitational fields
H11 justifies the appropriateness of a particular investigation plan

11.1 identify data sources to:
   e) recommend the use of an appropriate technology or strategy for data collection or information gathering that will assist efficient future analysis
11.2 plan first-hand investigations to:
   b) identify variables that needed to be kept constant, develop strategies to ensure that these variables are kept constant, and demonstrate the use of a control
   c) design investigations that allow valid and reliable data and information to be collected
11.3 choose equipment or resources by:
   b) carrying out a risk assessment of intended experimental procedures and identifying and addressing potential hazards
H12 evaluates ways in which accuracy and reliability could be improved in investigations

12.1 perform first-hand investigations by:
   a) carrying out the planned procedure, recognising where and when modifications are needed and analysing the effect of these adjustments
   d) identifying and using safe work practices during investigations
12.2 gather first-hand information by:
   b) measuring, observing and recording results in accessible and recognisable forms, carrying out repeat trials as appropriate
12.3 gather information from secondary sources by:
   a) accessing information from a range of resources, including popular scientific journals, digital technologies and the Internet
   c) extracting information from numerical data in graphs and tables as well as written and spoken material in all its forms
12.4 process information to:
   a) assess the accuracy of any measurements and calculations and the relative importance of the data and information gathered
   b) identify and apply appropriate mathematical formulae and concepts
   f) assess the accuracy of scientific information presented in mass media by comparison with similar information presented in scientific journals
H13 uses terminology and reporting styles appropriately and successfully to communicate information and understanding

13.1 present information by:
   c) selecting and using appropriate methods to acknowledge sources of information
H14 assesses the validity of conclusions from gathered data and information

14.1 analyse information to:
   c) identify and explain how data supports or refutes a hypothesis, a prediction or a proposed solution to a problem
14.3 use available evidence to:
   c) apply critical thinking in the consideration of predictions, hypotheses and the results of investigations
Content
In this assessment task, you will do all the column 3 activities from your chosen option topic to present as an investigation. The column 2 activities from the same section are to be presented as background for your experimental report.

Format
The assessment is to be presented in two parts:

1. Log Book
This section details an account of your investigation. Your research, thoughts, resources, contacts list and other details are to be recorded in this section.

2. Report
This is to be in the standard report format (refer to the handout “Experimental Report Writing in HSC Science”). A bibliography of all referenced work is to be included.

While there is no word limit on this task, it is anticipated that you would spend approximately 15 – 20 hours TOTAL on the research, design, evaluation and reporting in this task.
Option Open Ended Investigation Marking Scale

Name: ____________________

**Outcomes Assessed**

| H1 | (bands 1-5) evaluates how major advances in scientific understanding and technology have changed the direction or nature of scientific thinking |
| H2 | (bands 1-5) analyses the ways in which models, theories and laws in physics have been tested and validated |
| H3 | (bands 1-5) assesses the impact of particular advances in physics on the development of technologies |
| H5 | (bands 1-5) identifies possible future directions of physics research |
| H7 | (bands 2-5) explains the effect of energy transfers and transformation |
| H8 | (bands 2-5) analyses wave interactions and explains the effects of those interactions |
| H9 | (bands 2-5) explains the effects of electric, magnetic and gravitational fields |
| H10 | (bands 1-5) describes the nature of electromagnetic radiation and matter in terms of the particles |
| H11 | (bands 1-5) justifies the appropriateness of a particular investigation plan |
| H12 | (bands 1-5) evaluates ways in which accuracy and reliability could be improved in investigations |
| H13 | (bands 1-5) uses terminology and reporting styles appropriately and successfully to communicate information and understanding |
| H14 | (bands 1-5) assesses the validity of conclusions from gathered data and information |

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<th><strong>Band</strong></th>
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| Excellent | • H1 Provides a detailed historical development of many concepts in physics describing how each concept influenced scientist and modified revolutionised existing theories.  
• H2 Accepts or discards theories on the basis of the results by analysing the ways in which this investigation tests and validates models, theories and laws.  
• H7 Relates the effect if energy transfers and transformation to conservation laws.  
• H8 Quantitatively analyses wave interactions to examine the nature of such interactions  
• H9 Analyses the factors that affect a field.  
• H11.1e Evaluates the best technology to gather a particular item of data.  
• H11.2e Evaluate different experimental methods to produce the most valid and reliable data.  
• H11.3b Evaluates risk management strategies performed in an experimental investigation.  
• H12.1a Evaluates a modification to a planned procedure to deduce if the changes have been effective.  
• H12.2b Repeat trials of measurements to obtain valid and reliable results.  
• H12.3a Accesses information from a range of resources, including popular scientific journals, digital technologies and the internet  
• H12.3c Evaluates the validity of numerical data from graphs and tables as well as written and spoken materials.  
• H12.4a Evaluates the significance of data obtained in terms of its validity and reliability.  
• H12.4b Creates new equations and relationships.  
• H12.4f Assesses scientific information presented in mass media and in scientific journals in terms of accuracy.  
• H14.1c Examines data in terms of its support or refutation of a theory.  
• H14.3c Critically analyse the predictions of an hypothesis in terms of results. | 25-30 |
| Substantial | • H1 Compares competing theories in the historical development of physics and how these theories changed scientists' ideas about their existing theories.  
• H2 Relates the results of an experiment to its aim. Uses mathematical models to apply first hand data.  
• H7 Describes specific examples of energy transfers and transformations quantitatively.  
• H8 Quantitatively examines wave interactions in specific situations.  
• H9 Applies the idea of “field” to particles moving within a field quantitatively.  
• H11.1e Analyses the effectiveness of each type of technology in collecting or gathering information.  
• H11.2b Construct conditions where only one variable can change in an experimental investigation.  
• H11.2c Analyse an experimental method to ensure that the design of the experiment allows valid and reliable data.  
• H11.3b Designs appropriate risk management strategies to minimize hazards during an experimental investigation.  
• H12.1a Discusses the reasons for a modification to a planned procedure.  
• H12.1d Uses safe work practices during investigations.  
• H12.3c Assesses the reliability of information from secondary sources.  
• H12.4a Assesses the accuracy of measurements and data obtained by comparison to common experience.  
• H12.4b Manipulate formulae to obtain new equations.  
• H12.4f Discuss the reliability of scientific information presented in mass media and in scientific journals.  
• H14.1c Distinguishes between data that support a theory and data that is irrelevant.  
• H14.3c Predict the results of an hypothesis in a novel situation | 18-24 |
<table>
<thead>
<tr>
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<th>Criteria</th>
<th>Mark Range</th>
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<tbody>
<tr>
<td><strong>Good</strong></td>
<td>• H1 Sequences the development of major concepts in physics noting contributions made to theories.</td>
<td>12-17</td>
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<tr>
<td></td>
<td>• H2 Explains the impact of variables on the accuracy of experimental results.</td>
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<td>• H7 Describes specific examples of energy transfers and transformations qualitatively.</td>
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<td>• H11.1e Compares the use of different types of technologies to collect or gather information.</td>
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<td>• H11.2b Describes conditions necessary in an experimental investigation to keep variables constant.</td>
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<td>• H11.2c Examine the use of variables in an experimental investigation to ensure that data collected is valid/reliable.</td>
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<td>• H11.3b Classifies risks in an experimental investigation according to danger.</td>
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<td>• H12.1a Modifies steps in a planned procedure to more efficiently or safely carry out the procedure.</td>
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<td>• H12.1d Identifies safe work practices during investigations.</td>
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<td>• H12.2b Measures, observes and records results in accessible and recognizable forms.</td>
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<td>• H12.3a Identifies information from a range of resources, including popular scientific journals, digital technologies and the internet.</td>
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<td>• H12.3c Applies information from numerical data in graphs and tables as well as from written and spoken material in all its forms</td>
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<td>• H12.4a Performs calculations on measurements.</td>
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<td>• H12.4b Correctly apply a formula to a given situation.</td>
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<td>• H12.4f Compare scientific information presented in mass media and in scientific journals</td>
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<td>• H13.1c Use in-text referencing of sources.</td>
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<td>• H14.3c Determines if there are any logical flaws between the results, hypothesis and predictions of an investigation.</td>
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<tr>
<td><strong>Satisfactory</strong></td>
<td>• H1 Describes major concepts in physics mentioning people that first postulated them.</td>
<td>6-11</td>
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<td></td>
<td>• H2 Describes variables relevant to the accuracy of experimental outcomes.</td>
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<td>• H9 Outlines the basic nature of electric, magnetic and gravitational fields.</td>
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<td>• H11.1e Apply appropriate technologies to collect or gather information.</td>
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<td>• H11.2b Identify controls in an experimental investigation.</td>
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<td>• H11.2c Repeat trials or investigations to ensure reliable data.</td>
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<td>• H11.3b Describe the nature of each risk in an experimental investigation.</td>
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<td>• H12.1a Identifies steps in a planned procedure that are not suitable or safe.</td>
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<td>• H12.2b Measures, observes and records results.</td>
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<td></td>
<td>• H12.3c Interpolates and extrapolates information from numerical data in graphs and tables as well as from written and spoken material in all its forms</td>
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<td>• H12.4a Manipulates measurements to obtain secondary data.</td>
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<td>• H12.4b Obtain the correct formula for a given situation.</td>
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<td>• H12.4f Summarise the scientific information presented in mass media and in scientific journals.</td>
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<td>• H14.1c Identifies data in problems.</td>
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<td>• H14.3c Describes the relationship between the results, hypothesis and predictions of an investigation.</td>
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<tr>
<td><strong>Elementary</strong></td>
<td>• H1 States some of the ideas in physics</td>
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<td>• H2 Identifies and describes simple variables and controls in experiments.</td>
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<td>• H11.1e Identify types of data to be collected.</td>
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<td>• H11.2c Manipulate equipment so as to minimize systematic errors to obtain valid results.</td>
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<td>• H11.3b Identify risks involved in carrying out an experimental investigation.</td>
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<td>• H12.1a Follows a planned procedure</td>
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<td>• H12.3c Identifies and extracts information from numerical data in graphs and tables as well as from written and spoken material in all its forms</td>
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<td>• H12.3d Summarises and collates information from a range of sources.</td>
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<td>• H12.4a Obtains measurements correctly without random or systematic errors.</td>
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<td>• H12.4b Identify situations where a formula may be required.</td>
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<td>• H12.4f Gather scientific information presented in mass media and in scientific journals.</td>
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<td>• H13.1c Create a bibliography using an acceptable format.</td>
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<tr>
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<td>• H14.3c Outlines the results, hypothesis and predictions of an investigation.</td>
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**Total mark = **