

South Pacific Board For Educational Assessment



SOUTH PACIFIC FORM SEVEN CERTIFICATE

PHYSICS

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SOUTH PACIFIC FORM SEVEN CERTIFICATE

PHYSICS

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PHYSICS

Preamble

This prescription provides the specifications for assessment for the South Pacific Form Seven Certificate Physics.

The prescription is derived from the requirements of New Zealand University Entrance, Bursaries and Scholarship physics prescription as administered by the New Zealand Qualifications Authority (NZQA).

Students may also require knowledge and understanding of outcomes from the PSSC or its equivalent, which are related to the specific outcomes of this prescription.

Students will complete a course of study which contains a balance of qualitative and quantitative reasoning.

- A qualitative treatment allows students to describe, verbally and graphically, physical situations which are not amenable to algebraic treatment at this level. Even when an algebraic treatment is possible, qualitative understanding should precede it.
- A quantitative treatment allows students to analyse physical situations mathematically. Students will be expected to use experimental uncertainty, correct use of significant figures and units of measurement. The formulae listed in the appendix prescribe the required depth of mathematical treatment. Formulae introduced earlier secondary levels (eg Forms 5 and 6) may also be necessary to answer examination questions based on this prescription.

Aims

The course of study is designed to stimulate student interest in, and enjoyment of, physics by using a wide variety of strategies and contexts. This will be achieved by:

- developing in students an appreciation of the nature of physics and its relevance to the everyday life of people;
- developing students' knowledge and understanding of concepts, principles and models in physics;
- developing students' investigative skills and attitudes in the determination of relationships, patterns and trends in physics.

Objectives

On completing the course of study, students should be able to:

- demonstrate knowledge and understanding of physical phenomena, concepts, principles and models
- apply concepts and principles to explain physical phenomena, systems and devices

- appreciate the power and limitations of physical theories and models in physics
- analyse developments in physics and physics-based applications and their influence on society
- carry out practical investigations to determine relationships, patterns and trends in physical systems
- carry out research activities to identify and explain applications of physical concepts and principles.

CONTENT AREAS

The course content consists of the following six sections:

- A. Mechanics
- B. Waves
- C. Electricity and Electromagnetism
- D. Atomic and Nuclear Physics
- E. Practical Investigation
- F. Research Report

OUTCOMES

SECTION A: MECHANICS

Outcome :

Students will demonstrate knowledge and understanding, by explanation and solving problems, of the physical phenomena, concepts, principles and relationships involved in translational motion, rotational motion and simple harmonic motion.

In demonstrating knowledge and understanding, students will be expected to:

- apply formulae and graphical, vectorial and phasor methods to find unknowns;
- give numerical answers to an appropriate number of significant figures, using SI units of measurement;
- describe, explain and apply physics ideas;
- use free-body force diagrams to find the resultant force
- use the reference circle to analyse simple harmonic motion.

Explanatory Notes

1. Explanation and problem solving of **translational motion** will involve:

- conservation of momentum with reference to the motion of the centre of mass of a system, when the motion of the particles is in one dimension;
- the relationship between rate of change of momentum and the force in one and two dimensions; impulse;
- the following relationships:

$$F\Delta t = m\Delta v$$

$$p = mv$$

$$\Delta p = Ft$$

$$W = Fd$$

$$v^2 = v_i^2 + 2ad \quad F = ma$$

$$d = \frac{(v_i + v)t}{2}$$

$$d = v_i t + \frac{1}{2}at^2$$

$$v = v_i + at$$

2. Explanation and problem solving of **rotational motion** will involve:

- rotational motion with constant angular acceleration and constant angular speed (radian measurement);
- Newton's law of Gravitation; force on a satellite in a circular orbit;
- velocity and acceleration of , and resultant force on, objects orbiting under the influenced of two or more forces (eg conical pendulums, banked corners);
- torque, rotational inertia, and the relationship between torque and angular acceleration;
- angular momentum and its conservation;
- rotational kinetic energy; conservation of gravitational potential energy and rotational and translational kinetic energy;
- the following relationships:

$$\begin{array}{lll}
 F_g = \frac{GMm}{r^2} & \omega = \frac{\Delta\theta}{\Delta t} & \alpha = \frac{\Delta\omega}{\Delta t} \\
 F_c = \frac{mv^2}{r} & \omega = 2\pi f & \tau = I\alpha \\
 a = \frac{v^2}{r} & L = I\omega & L = mvr_{\perp} \\
 v = \frac{2\pi r}{T} & \tau = Fr & E_{k(rot)} = \frac{1}{2}I\omega^2 \\
 f = \frac{1}{T} & d = r\theta & \omega_f^2 = \omega_i^2 + 2\alpha\theta \\
 v = r\omega & \omega_f = \omega_i + \alpha t & \theta = \frac{(\omega_i + \omega_f)t}{2} \\
 a = r\alpha & \theta = \omega_i t + \frac{1}{2}\alpha t^2 &
 \end{array}$$

3. Explanation and problem solving of **simple harmonic motion** will involve:

- motion with a restoring force proportional to displacement from an equilibrium position, eg mass-spring, pendulums, buoys;
- displacement, velocity, acceleration, time and frequency of a particle undergoing simple harmonic motion;
- use of equations of motion for cases when the displacement at time zero is either maximum or zero (equilibrium position);
- use of the reference circle when the timing starts at any position;
- conservation of energy;
- damped and forced oscillations; resonance;
- the following relationships:

$$\begin{array}{lll}
 T = 2\pi\sqrt{\frac{l}{g}} & T = 2\pi\sqrt{\frac{m}{k}} & y = A \sin \omega t \\
 F = kx & v = A\omega \cos \omega t & y = A \cos \omega t \\
 E_p = \frac{1}{2}kx^2 & v = -A\omega \sin \omega t & a = -A\omega^2 \sin \omega t \\
 F = -ky & a = -\omega^2 y & a = -A\omega^2 \cos \omega t
 \end{array}$$

SECTION B: WAVES

Outcome

Students will demonstrate knowledge and understanding, by explanation and solving problems, of the physical phenomena, concepts, principles and relationships involved in wave motion.

In demonstrating knowledge and understanding students will be expected to:

- apply formulae and graphical methods to find unknowns;
- give numerical answers to an appropriate number of significant figures, using SI units of measurement;
- describe, explain and apply physics ideas;
- construct and interpret graphs to describe standing waves.

Explanatory Notes:

Explanation and problem solving of wave motion will involve:

- velocity, frequency, period, wavelength, amplitude and phase of transverse and longitudinal waves (eg electromagnetic, seismic, sound, water, waves in springs and strings)
- graphical treatment of the superposition of the two travelling waves; standing waves (nodes and antinodes); beats;
- diffraction; double source interference of electromagnetic waves and sound;
- multiple source interference of electromagnetic waves; diffraction grating;
- standing waves in strings and pipes; harmonics and overtones; resonance;
- Doppler effect for a stationary observer;
- the following relationships:

$$d \sin \theta = n\lambda$$

$$n\lambda = \frac{dx}{L}$$

$$f_b = |f_1 - f_2|$$

$$f_1 = f \frac{v_w}{v_w \pm v_s}$$

$$v = f\lambda$$

$$f = \frac{1}{T}$$

$$d \sin \theta = (n - \frac{1}{2})\lambda$$

$$d = \frac{1}{N}$$

SECTION C: ELECTRICITY AND ELECTROMAGNETISM

Outcome

Students will demonstrate knowledge and understanding, by explanation and solving problems, of DC circuits, Capacitance, Electromagnetic induction and Alternating Current (AC) circuits.

In demonstrating knowledge and understanding students will be expected to:

- apply formulae, graphical, vectorial and phasor methods to find unknowns;
- give numerical answers to an appropriate number of significant figures, using SI units of measurement;
- describe, explain and apply physics ideas.

Explanatory Notes:

1. Explanation and problem solving of **DC circuits and capacitance** will involve:

- work done on a charged particle moving in a uniform electric field; the volt;
- Ohm's and Kirchoff's laws in the calculation of voltages and currents in one- and two-loop circuits, which may include DC voltage sources and resistors including internal resistance;
- capacitance; the parallel plate capacitor; permittivity; dielectrics;
- capacitors in series and parallel; energy stored in a capacitor;
- the charge/discharge characteristics of capacitors in DC capacitor-resistor circuits;
- voltage/time and current/time graphs for a capacitor; time constant;
- the following relationships:

$$\Delta E = Vq$$

$$P = VI$$

$$V = Ed$$

$$Q = VC$$

$$E = \frac{1}{2}QV$$

$$\sum V = 0$$

$$\sum I = 0$$

$$V = \varepsilon - IR$$

$$\tau = RC$$

$$C = \frac{\varepsilon_o \varepsilon_r A}{d}$$

$$C = \frac{\varepsilon_o A}{d}$$

$$C_{TOT} = C_1 + C_2 + \dots$$

$$\frac{1}{C_{TOT}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \dots$$

$$\frac{1}{R_{TOT}} = \frac{1}{R_1} + \frac{1}{R_2} \dots \quad R_{TOT} = R_1 + R_2 + \dots$$

2. Explanation and problem solving of **electromagnetic induction** will involve:

- magnetic flux and the relationship between rate of change of flux and the voltage induced across a conductor;
- induced voltage in a coil with a constant angular velocity in uniform magnetic field;
- mutual inductance; output voltage and power losses in a transformer;
- self-inductance; the inductor and energy stored in an inductor;

- factors which affect the size and direction of the induced voltage of an inductor;
- voltage/time and current/time graphs for an inductor; time constant;
- the following relationships:

$$\phi = BA \qquad \varepsilon = BAN\omega \sin \omega t \qquad E = \frac{1}{2} LI^2$$

$$\varepsilon = -\frac{\Delta\phi}{\Delta t} \qquad \varepsilon = -L \frac{\Delta I}{\Delta T} \qquad \tau = \frac{L}{R}$$

$$\frac{N_p}{N_s} = \frac{V_p}{V_s} \qquad V = Blv$$

3. Explanation and problem solving of **AC circuits** will involve:

- the comparison of the energy dissipation in a resistor carrying direct current and alternating current; root-mean-square values;
- description of full wave rectification and smoothing in DC power supplies;
- reactance and impedance, and their frequency dependence in a series circuit;
- voltage and current and their phase relationship in inductor-resistor and capacitor-resistor series circuit;
- the energy changes, phase relationships and resonant condition for an inductor-capacitor-resistor series circuit;
- the following relationships:

$$V = V_{max} \sin \omega t \qquad I = I_{max} \sin \omega t \qquad z = \sqrt{R^2 + (x_L - x_C)^2}$$

$$I_{max} = \sqrt{2} I_{rms} \qquad V_{max} = \sqrt{2} V_{rms} \qquad f_o = \frac{1}{2\pi\sqrt{LC}}$$

$$X_C = \frac{1}{\omega C} \qquad X_L = \omega L \qquad V = IZ$$

SECTION D: ATOMIC AND NUCLEAR PHYSICS

Outcome

Students will demonstrate knowledge and understanding, by explanation and solving problems, of atomic and nuclear physics.

In demonstrating knowledge and understanding students will be expected to:

- apply formula and graphical methods to find unknowns;
- give numerical answers to an appropriate number of significant figures, using SI units of measurement;
- describe, explain and apply physics ideas;
- draw and interpret energy level diagrams;
- balance equations for nuclear reactions.

Explanatory Notes:

Explanation and problem solving of atomic and nuclear physics will involve:

- the Bohr model of the hydrogen atom;
- the photon; the quantisation of energy; discrete atomic energy levels; electron transition between energy levels; ionisation;
- atomic line spectra (infrared, visible and ultraviolet); Rydberg formula for the hydrogen atom; Lyman, Balmer, Paschen series;
- the photoelectric effect; the electron volt; work function;
- description of the particle/wave duality of light;
- nuclear binding energy and mass deficit;
- conservation of linear momentum, charge, nucleon number and mass-energy for nuclear reactions (fission; fusion; alpha; beta and gamma decay)
- impact of nuclear physics on society;
- the following relationships:

$$\begin{array}{cccc} E = hf & hf = \phi + E_k & E = mc^2 & f = \frac{1}{T} \\ \\ E_n = -\frac{hcR}{n^2} & \Delta E = |E_1 - E_2| & \frac{1}{\lambda} = R\left(\frac{1}{S^2} - \frac{1}{L^2}\right) & v = \lambda f \end{array}$$

SECTION E: PRACTICAL INVESTIGATION

Outcome

Carry out a practical investigation with guidance to determine relationships, patterns and trends in physical systems

In carrying out the practical investigation, students will be expected to:

- present a feasible plan;
- collect, record and organise relevant data;
- indicate knowledge of uncertainties;
- process and analyse data to identify a trend, relationship or pattern;
- provide critical evaluation and/or discussion;
- present a report with valid conclusions that are justified and supported by evidence;

Explanatory Notes:

1. An investigation is an activity covering the complete process from planning to reporting and will involve students in the collection of primary data to provide a relationship, pattern or trend.
2. The investigation will be conducted with teacher guidance. This means the teacher is supporting the student throughout the investigation but the whole process is student driven. Teacher's support gives general direction only such as broad questions, resource suggestions or possible new directions.
3. Students should be provided with the opportunity to undertake preliminary research into the nature of the practical investigation and some form of tracking or checking before developing their plan into a method.
4. The report will include:
 - an introduction describing the nature of the practical investigation and the aspect(s) investigated.
 - a plan, including a purpose and final method used;
 - recorded observations, measurements and data;
 - processed data showing a trend, relationship or pattern;
 - a conclusion analysing processed data in terms of the purpose of the investigation;
 - a discussion of the physical concepts or principles involved in the investigation;
 - an evaluation considering the validity of the investigation such as
 - reliability of the data
 - sources of error
 - the limitation of the investigation
 - bias
 - an acknowledgement list of the references consulted.
5. Evidence of student performance can be taken from any part of the report, including the log book.
6. The processes of investigation are not necessarily sequential. The process may begin at any point and will tend to move backwards and forwards. Students should be

reflecting on their decisions, actions, and findings and should be modifying their plan and actions as they proceed.

7. Log books must be kept by all students and must contain all rough data and notes. Log books are a working record of all the work students do, and are used for authenticity. Log books should be regularly checked by the teacher.
8. Students are expected to have done some formative work before attempting the practical investigation. The practical investigation is to be completed individually over a period of time. A typical time period would include 10-12 hours of classroom time. Students would be expected to do work at home.

SECTION F: RESEARCH REPORT

Outcome

Research and present a report which identifies and explains applications of physical concepts and principles.

In preparing the research report students will be expected to:

- collect relevant information
- identify the physical concept(s) or principle(s)
- present a report of the research

Explanatory Notes:

1. In research, the student collects and interprets information from mainly secondary sources. Some use of primary sources is acceptable.
2. An appropriate device or natural phenomenon is selected from which physical concepts or principles from the Form 7 course of study are identified. Teachers may need to assist students in the selection of an appropriate research activity.
3. An application refers to the causal feature of the device or natural phenomenon which are underpinned by interacting physical concepts and/or principles.
4. The report must include an explanation of how the identified physical concepts or principles contribute to the feature of the application; and will be presented as a written document.
5. Students are expected to have completed some formative work before attempting the research activity. It is expected that students would spend 3-4 hours of class time on their research activity. Additionally, students would be expected to work at home.

Assessment

Students will be assessed by:

- a three-hour written external examination 80%
- an internally assessed practical investigation 15%
- an internally assessed research report 5%

Assessment may involve the use of skills and knowledge from PSSC physics when relevant to the development of the South Pacific Form Seven Certificate physics.

The Written Examination

The written examination will test a range of knowledge, understanding and skills consistent with the aims and objectives of this prescription.

Real life situations will be used wherever possible. Requisite information about the context used will be supplied.

Students will be required to answer questions on each of the four sections specified for the external examination. Questions may require mathematical, graphical or diagrammatic answers or descriptive responses. Any mathematical analysis will be limited to the use of the formulae listed in the relevant sections and in the appendix. All formulae listed will be supplied in the examination paper.

The approximate weighting for each section of the written paper will be as follows:

| | |
|----------------------------------|-----|
| Mechanics | 35% |
| Waves | 20% |
| Electricity and Electromagnetism | 30% |
| Atomic and Nuclear Physics | 15% |

Internal Assessment

1. Practical Investigation

The practical investigation carried out by students in schools will meet the objectives stated in this prescription.

The practical investigation is to be assessed by teachers in schools. Teachers will assess the following aspects of investigative skills. The expected mark weighting for each aspect is shown in brackets. An overall mark out of 15 will be generated.

- planning and design (5%)
- information gathering (2%)
- processing and analysing (5%)
- interpreting and reporting (3%)

2. Research Report

The research report is included to allow a measure of flexibility in the course of study. It can provide further study of a selected area of a physics-based application.

The research report is to be assessed by the teachers in schools. Teachers will assess the following aspects. The mark weighting for each aspect is shown in brackets. An overall mark out of 5 will be generated.

Select a device or a natural phenomenon and

- gather relevant information
- identify the physical concept(s) or principle(s) involved
- present a written explanation of the application of the physics concept(s) or principle(s) involved (5%)

General Notes:

Coursework requirements, the assessment tasks and weightings given to each task should be clearly explained to students at the beginning of the year's course. Results should be clearly recorded so that accurate information on each student's written and practical work is readily available. At the start of the year students should be given a copy of the assessment statement to be used.

It is expected that students will complete relevant and formative topic tests and practical activities for course completion.

The assessment statement, copies of all assessment tasks and assessment schedules used as well as all internal assessment work necessary for a sample of students must be available for verification on request until 30 November of the year of the examination.

The internally assessed mark for each student shall be forwarded to the South Pacific Board for Educational Assessment by the liaison teacher or the principal, by the date specified by the Director, on the mark capture sheet provided by SPBEA. The principal or liaison teacher will certify that the prescription requirements have been fulfilled.

APPENDICES

APPENDIX 1: FORMULAE

These formulae are those that may be required for the examination.

Translation Motion

$$\begin{array}{lll}
 F\Delta t = m\Delta v & v^2 = v_i^2 + 2ad & F = ma \\
 p = mv & d = \frac{(v_i + v)t}{2} & \\
 \Delta p = Ft & d = v_i t + \frac{1}{2}at^2 & \\
 W = Fd & v = v_i + at &
 \end{array}$$

Rotational Motion

$$\begin{array}{lll}
 F_g = \frac{GMm}{r^2} & \omega = \frac{\Delta\theta}{\Delta t} & \alpha = \frac{\Delta\omega}{\Delta t} \\
 F_c = \frac{mv^2}{r} & \omega = 2\pi f & \tau = I\alpha \\
 a = \frac{v^2}{r} & L = I\omega & L = mvr_{\perp} \\
 v = \frac{2\pi r}{T} & \tau = Fr & E_{k(rot)} = \frac{1}{2}I\omega^2 \\
 f = \frac{1}{T} & d = r\theta & \omega_f^2 = \omega_i^2 + 2\alpha\theta \\
 v = r\omega & \omega_f = \omega_i + \alpha t & \theta = \frac{(\omega_i + \omega_f)t}{2} \\
 a = r\alpha & \theta = \omega_i t + \frac{1}{2}\alpha t^2 &
 \end{array}$$

Simple Harmonic Motion

$$\begin{array}{lll}
 T = 2\pi\sqrt{\frac{l}{g}} & T = 2\pi\sqrt{\frac{m}{k}} & y = A \sin \omega t \\
 F = kx & v = A\omega \cos \omega t & y = A \cos \omega t \\
 E_p = \frac{1}{2}kx^2 & v = -A\omega \sin \omega t & a = -A\omega^2 \sin \omega t \\
 F = -ky & a = -\omega^2 y & a = -A\omega^2 \cos \omega t
 \end{array}$$

Waves

$$\begin{array}{lll}
 d \sin \theta = n\lambda & n\lambda = \frac{dx}{L} & f_b = |f_1 - f_2| \\
 f_1 = f \frac{v_w}{v_w \pm v_s} & v = f\lambda & f = \frac{1}{T} \\
 d \sin \theta = (n - \frac{1}{2})\lambda & d = \frac{1}{N} &
 \end{array}$$

DC circuits and Capacitance

$$\Delta E = Vq$$

$$P = VI$$

$$V = Ed$$

$$Q = VC$$

$$E = \frac{1}{2}QV$$

$$\sum V = 0$$

$$\sum I = 0$$

$$V = \varepsilon - IR$$

$$\tau = RC$$

$$C = \frac{\varepsilon_o \varepsilon_r A}{d}$$

$$C = \frac{\varepsilon_o A}{d}$$

$$C_{TOT} = C_1 + C_2 + \dots$$

$$\frac{1}{C_{TOT}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \dots$$

$$\frac{1}{R_{TOT}} = \frac{1}{R_1} + \frac{1}{R_2} \dots$$

$$R_{TOT} = R_1 + R_2 + \dots$$

Electromagnetic Induction

$$\phi = BA$$

$$\varepsilon = BAN\omega \sin \omega t$$

$$E = \frac{1}{2}LI^2$$

$$\varepsilon = -\frac{\Delta\phi}{\Delta t}$$

$$\varepsilon = -L\frac{\Delta I}{\Delta T}$$

$$\tau = \frac{L}{R}$$

$$\frac{N_p}{N_s} = \frac{V_p}{V_s}$$

$$V = Blv$$

AC Circuits

$$V = V_{max} \sin \omega t$$

$$I = I_{max} \sin \omega t$$

$$z = \sqrt{R^2 + (x_L - x_C)^2}$$

$$I_{max} = \sqrt{2}I_{rms}$$

$$V_{max} = \sqrt{2}V_{rms}$$

$$f_o = \frac{1}{2\pi\sqrt{LC}}$$

$$X_C = \frac{1}{\omega C}$$

$$X_L = \omega L$$

$$V = IZ$$

Atomic and Nuclear Physics

$$E = hf$$

$$hf = \phi + E_k$$

$$E = mc^2$$

$$E_n = -\frac{hcR}{n^2}$$

$$L = \frac{nh}{2\pi}$$

$$\Delta E = |E_1 - E_2|$$

$$\frac{1}{\lambda} = R\left(\frac{1}{S^2} - \frac{1}{L^2}\right)$$

$$f = \frac{1}{T}$$

$$v = \lambda f$$

APPENDIX 2

F7 PHYSICS INTERNAL ASSESSMENT : ASSESSMENT SCHEDULE FOR PRACTICAL INVESTIGATION

| Item | Acceptable | Merit | Excellent |
|---|--|---|--|
| PLANNING AND DESIGN (14 marks) | | | |
| <i>Purpose / Hypothesis / Aim</i> | Statement/prediction/question on a relationship or variable relevant to the investigation. 1 | Statement/prediction/question based on measurable relationship or measurable variables. 2 | Statement/prediction/question making a measurable relationship between two measurable variables that can be investigated. 3 |
| <i>Variable testing / Trialling</i> | Evidence of trialling of at least one variable 1 | Evidence of trialling shows: <ul style="list-style-type: none"> testing to determine the range of the independent variable OR <ul style="list-style-type: none"> testing to determine the best way to measure the effect on the dependent variable 3 | Evidence of trialling shows: <ul style="list-style-type: none"> testing to determine the range of the independent variable AND <ul style="list-style-type: none"> testing to determine the best way to measure the effect on the dependent variable. 5 |
| <i>Method</i> | A feasible method. Relates to the question / statement / prediction but lacks the details needed for repetition of the procedure by someone else ie. <ul style="list-style-type: none"> how the dependent variable will be measured is evident; range given for the independent variable; some procedures stated; some controlled variables are identified. 2 | A valid method. Procedures can be followed to achieve similar results ie: <ul style="list-style-type: none"> how the dependent variable will be measured is clear and appropriate; appropriate range given for the independent variable; most procedures stated; appropriate values of controlled variables are given. 4 | A valid and reliable method. Procedure can be followed to achieve similar and reliable results ie: <ul style="list-style-type: none"> as for achievement with merit; how the dependent variable will be measured is clear and appropriate; appropriate range given for the independent variable; all key procedures stated in detail. 6 |
| INFORMATION GATHERING (10 marks) | | | |
| <i>Background Information (Context)</i> | Limited information relevant to the investigation context, OR Research information but has limited relevance to the investigation context. 1 | Range of information relevant to the investigation context. 3 | Wide range of information relevant to the investigation context. Information is sufficient to enable the results to be explained. 5 |

| Item | Acceptable | Merit | Excellent |
|---|---|---|---|
| <i>Experimental Data</i> | Some quantitative data collected which is appropriate (or relevant) to the aim/purpose/hypothesis. 1 | Quantitative data collected and based on the manipulation of one variable over a range appropriate to the aim / purpose / hypothesis. Raw data can be accessed for processing. 3 | Sufficient quantitative data collected to enable a valid, reliable conclusion to be made. Data lies within typical limits of accuracy of method and equipment. 5 |
| PROCESSING (7 marks) | | | |
| <i>Tables/Graphs and Statistical Analysis</i> | Self-contained tables or graphs as appropriate for the data collected. <ul style="list-style-type: none"> graphing conventions followed; some minor errors may be evident. 2 | Systematic and accurate processing of data. Analysis not completed to the point where the trend or relationship can be determined. (minor errors acceptable) 5 | Data is processed to enable relevant trend/relationship/pattern (linear or non-linear) to be accurately determined. All graphical/table conventions are accurately applied (minor errors acceptable) 7 |
| <i>Calculations (If relevant)</i> | Some attempt to complete relevant calculations (ignore minor errors) 1 | Relevant calculations completed accurately. Correct units given. (ignore minor errors in calculations) 3 | Relevant calculations completed accurately. Units, significant figures and errors indicated appropriately. The trend/relationship is stated as a mathematical statement. (ignore minor errors in calculation) 5 |
| INTERPRETING (13 marks) | | | |
| <i>Discussion</i> | Description of the results and or conclusion 1 | Links background information or the results to the context of the investigation. 3 | Explanation of the relationship between background information, experimental results and the context of the investigation. 5 |

| Item | Acceptable | Merit | Excellent |
|------------------------------|---|--|---|
| <i>Conclusion</i> | Conclusion drawn from data. 1 | Conclusion drawn from data and linked to the purpose/hypothesis/aim. 2 | Valid conclusion drawn from data and linked to the purpose/hypothesis/aim. 3 |
| <i>Evaluation</i> | Describes errors or problems relevant to the purpose/hypothesis/aim. 1 | Explains errors or problems in terms of validity and reliability. 3 | Critically evaluates the method in terms of accuracy, reliability and validity of the findings, sources of error and limitations of the investigation. Justifies the improvements/modifications for further research. 5 |
| REPORTING (6 marks) | | | |
| <i>Format / Presentation</i> | Report is organised in an appropriate format. 1 | Report is complete and references listed. 2 | Report is complete and full list of references in the approved format is given. 3 |
| <i>Communication</i> | Can be read but spelling and grammatical errors significantly affect overall understanding. 1 | Report sectioned and complete in own words, had errors of spelling, grammar, units, or repetition without affecting understanding. 2 | Report clear, concise and well organised in all sections. No repetition or irrelevant information – very few minor errors. 3 |

- Notes:
- 1) Failure to reach acceptable level gains zero mark.
 - 2) Assessment judgement is to the best performance standard. No marks other than those given in each section of the assessment schedule should be awarded.

(Total : 50 marks / 55 marks if Calculations included)

APPENDIX 3

F7 PHYSICS INTERNAL ASSESSMENT : RESEARCH REPORT GENERIC ASSESSMENT SCHEDULE

| Research Report | LEVEL OF ACHIEVEMENT | | |
|--|---|--|---|
| | MINIMAL* | MERIT | EXCELLENT |
| Background Information (Content) | Evidence of one resource consulted/used 1 | Evidence of more than one resource consulted/used 2 | Evidence of more than one resource consulted/used and referenced accurately 3 |
| Relationships Identified and Explained | The relevant concepts/principles and the device/natural phenomenon described accurately but not linked. (both described but not linked). 5 | The relevant concepts/principles and the device/natural phenomenon described and linked accurately. (both described and linked) 10 | Uses physics to fully explain the cause and effect of the device/natural phenomenon. Discussion includes variations which may change the nature and/or intensity in the device or natural phenomenon. 15 |
| Presentation | <ul style="list-style-type: none"> poorly organised written report supplemented with at least one illustration. 1 | <ul style="list-style-type: none"> A well organised format Neatness and legibility Written report supplemented with at least one text referenced illustration. 2 | <ul style="list-style-type: none"> Clearly presented, well organised, and in a logical format. Originality of expression Illustrations that fully integrated in the text. 3 |

(* Note: Any level of achievement lower than minimal receives zero marks)

SOUTH PACIFIC FORM SEVEN CERTIFICATE

Internal Assessment Summary Form

PHYSICS

Country: _____ School: _____

| Task | Brief Description | Start Date | End Date | Weighting |
|----------------------------|-------------------|------------|----------|------------|
| 1. Practical Investigation | | | | 15% |
| 2. Research Report | | | | 5% |
| Total | | | | 20% |

Note:

1. Be specific about dates, not just Week 3 Term 1, etc.
2. Ensure that the topics for Practical Investigation and Research Report are within the prescription.
3. Assessment schedules are provided in the prescription and must be used for the 2 tasks.

ADVISORY SECTION

1. Suggested Texts

(a) Possible Student Texts

The following texts are New Zealand based:

- i) Physics Alive by R Campbell
- ii) ESA Revision Guide by P. Howison (Tonga, Vanuatu)
- iii) Senior School Physics by I. Jacobs (Teacher resource in Vanuatu)
- iv) Advanced Senior Physics by N. Barber and R. Osborne
- v) Year 13 Physics: Course Manual by Chris Rutter (Tonga)
- vi) Physics-Year 13 by Trevor Castle, New Zealand Pathfinder Series (Vanuatu)

(b) Teacher References

(see **Appendix 5** on page 28)

2. Suggested Teaching Programme

This is an example of a teaching programme (timeline) showing the time that needs to be spent on different learning outcomes on which teachers can base their schemes of work.

The programme allows for spare weeks for term holidays, time out, revision, exams etc.

With countries/schools in the region having a variety of term times, teachers will need to plan their own programmes using this programme as a guide. It is important that time is incorporated into the programme for students to carry out the work necessary for the two internal assessment tasks.

(see **Appendix 6**, page 29, for sample programme)

3. Notes for Measurements and Graphs

- (a) Students are required to give all answers with the appropriate significant figures.

Working with significant figures:

- (i) When quantities are added or subtracted, the answer should be rounded to the least number of decimal places of the quantities given.
- (ii) When quantities are multiplied or divided, the answer should be rounded to the least number of significant figures of the quantities given.

- (b) Uncertainties in data calculations
- (i) Limit of reading for equipment:
The accepted limit of reading used for the South Pacific Form Seven Certificate is the smallest unit of measurement on the measuring device.
 - (ii) The Half-range rule will be applied when a measurement is repeated for increased accuracy.
- (c) Uncertainties in mathematical calculations.
- (i) When measurements are added or subtracted, the absolute uncertainty values are added.
 - (ii) When measurements are multiplied or divided, the percentage uncertainty values are added.
- (d) Error bars, best-fit lines and error lines
- (i) Students will be expected to draw error bars on graphs using both absolute uncertainty values and percentage uncertainty values supplied with the data.
 - (ii) Students will be expected to be able to draw best-fit lines for linear trends and the correlation error line (maximum or minimum possible slope).
- (e) Graphing conventions.
- All graphs must include the following:
- appropriate title which identifies variables
 - axes are labelled with both the name of the quantity and unit (in brackets)
 - the independent variable is on the horizontal axis
 - there is an appropriate scale using equal intervals
 - data is clearly and accurately plotted.

4. Teacher Guide Notes for the Practical Investigation

Teacher Guidelines:

The following guidelines are supplied to enable teachers to carry out valid and consistent assessment for the Practical Investigation.

Context/setting:

Students may choose any practical investigation or from a list given by the teacher. Teachers are expected to discuss choice of topic with the students and advise them on the appropriateness of their selection.

Conditions:

Done individually over a period of time. A typical time period would include 10 – 12 hours of classroom time. Students will be expected to do work at home. A log must be kept, detailing all work, and sighted by the teacher at negotiated times.

Resource requirements:

If students are working on individual topics then schools will need a way that students can obtain resources, gear, samples etc.

Additional Information:

Teachers should note that students are expected to have done some formative work before attempting something of this magnitude.

Students will need to submit a log book detailing their investigation. Logs are a working record of all a student does to complete the investigation. Log books should not be typed and students are encouraged to put into their log any notes, research and photocopies they collect. Logs are to be checked by the teacher at regular intervals throughout the investigation to assist authenticity.

The plan includes the aim/purpose, introduction/background and the method. Students must hand in their preliminary plan for the teacher to decide if the plan is feasible or workable (the final marking of the plan will be done at the end of the investigation when the log book and report are handed in for assessment).

5. Teacher Guide Notes for the Research Report

Teacher Guidelines

The following guidelines are supplied to enable teachers to carry out valid and consistent assessment of the Research Report.

Context/setting:

Students may choose any research topic or from a list given by the teacher. Teachers are expected to discuss choice of topic with the students and advise them on the appropriateness of their selection. The topic must be based on physics, concepts and principles from this prescription and have a real life content such as a device or natural phenomenon.

Conditions:

Done individually over a period of time. A typical time period would include 3 – 4 hours of classroom time. Students will be expected to do work at home. A log must be kept, detailing all work, sighted by the teacher at negotiated times.

Resource requirements:

If students are working on individual topics then schools will need a way that students can access suitable references.

Additional information:

Teachers should note that students are expected to have done some formative work before attempting something of this magnitude.

Students will need to submit a log book detailing their investigation. Logs are a working record of all a student does to complete the investigation. Log books should not be typed and students are encouraged to put into their log any notes, research and photocopies they collect. Logs are to be checked by the teacher at regular intervals throughout the investigation to assist authenticity.

The report focuses on:

- identification of a natural phenomenon or physical device
- identification of the physical concepts / principles involved in the phenomenon / device
- explanation of how the physics interacts to produce the cause / effect of the phenomenon / device

6. Some suggested topics for:

(a) Practical Investigation

- (i) Find the moment of inertia of an object (that can rotate) by rolling the object down a slope.
- (ii) To investigate the variation in refractive index as a function of the concentration of sugar in a water solution.
- (iii) How the period of oscillation when a rod is twisted horizontally about its centre point is affected by both the distance between the suspension threads and the length of the suspension threads.
- (iv) To investigate the relationship between period of the motion of a pendulum and the length of the string.
- (v) Use the tucker-timer to investigate the relationship between linear acceleration and displacement.
- (vi) Movement of particles along a beach.
- (vii) Use of physics principles, when explaining the results of an investigation into the relationships between the thickness of the legs of the quadrupeds and the quadrupeds' weight.
- (viii) The relationship between resistor length and its resistance.
- (ix) The relationship between the natural vibration frequency of a piece of wire and its length.
- (x) To determine the power law governing the period of a bifdar pendulum.

(b) Research Report

- (i) Ultrasound imaging
- (ii) Earthquakes
- (iii) Tropical cyclones
- (iv) The bicycle
- (v) The camera
- (vi) The loudspeaker
- (vii) The telephone
- (viii) The telescope
- (ix) Photoelectric cell
- (x) A multimeter etc.
- (xi) Dynamo
- (xii) Engine ignition
- (xiii) Engine propellers
- (xiv) A tsunami
- (xv) Fluorescent tube
- (xvi) the yoyo or other toys
- (xvii) Sailboat sails.

APPENDIX 5

Some Useful Teacher References

NOTE: This is a very subjective list. Borrow these from other teachers or the library and see what you think before investing in any of the following resources.

Teacher Reference Texts (University level)

- **University Physics**
Authors: Young & Freedman
Publisher: Addison Wesley
ISBN: 0-2-1-331132-1
(soft cover ISBN)
- **Physics**
Author: Paul A. Tipler
Publisher: WH Freedman & Co.
ISBN: 1572596155 (soft cover)

Conceptual Thinking Books (both are published in USA so don't fit the prescription exactly)

- **Conceptual Physics**
Author: Paul G. Hewitt
Publisher: Addison Wesley
ISBN: 0-321-00971-1 (hard cover)
- **Thinking Physics**
(Multichoice questions with detailed answers)
Author: Lewis Carol Epstein
Publisher: Insight Press

Contextual Physics Books (both are overseas series, UK and Australia respectively, so again don't fit the prescription exactly)

- **Supported Learning in Physics Project Books (8 different books + teacher's guide)**
Authors: Various
Publisher: Heineman
ISBN: 0-435-68838-3, 0-435-68845-6
0-435-68843-x, 0-435-68841-3
0-435-68846-4, 0-435-68844-8
0-435-68842-1, 0-435-68840-5
0-435-68839-1
- **PHYSICS CONTEXT PROBLEMS**
(2 books: Units 1 & 2, Units 3 & 4)
Author: Charles Taylor
Publisher: Thomas Nelson
ISBN: 0-17-008721-2 and 0-17-008844-8

Websites

(A detailed list of a few excellent sites follows this page)

Discussion Groups

(Discuss/ask questions through an email discussion list, particularly good if you are the only physics teacher at your school)

- <http://nzip.rsnz/es/email.htm>
This is an NZIP site so is relevant to NZ teachers.
- <http://www.keithtipton.com/physhare/>
This site has an archive section so that you can look up past questions

Miscellaneous

(Just a mixture of other interesting physics related resources)

- **Neat Zippy Ideas Vol IV**
A mixture of contributions from a number of physics teachers, compiled by Derek Chirnside. Available from NZIP Education Sectioni. (Samples include in this booklet)
- **Flying circus of Physics (with answers)**
An old book but still interesting
Author: Jearl Walker
Publisher: John Wiley & Sons
ISBN: 0-471-02984-x(soft cover)
- **E = mc² A biography of the world's most famous equation**
Author: David Bodanis
Publisher: Macmillan
ISBN: 0-333-78033-7 (hard cover)
- **The way things work**
Author: David Macaulay
Publisher: Houghton Mifflin Company
ISBN: 0-395-42857-2 (hard cover)
- **The Helix (junior science magazine)**
Available from the Royal Society
- **BP Technology File**
ISBN: 0-473-04434-X

APPENDIX 6

Suggested Teaching Programme for 2004 Form 7 Physics

| Week | Term One | Term 2 | Term 3 |
|------|---------------------------------|----------------------------------|---|
| 1 | A. School Administration | Waves | Electricity and Electromagnetism (continued) |
| 2 | Graphing and Uncertainties | | ↓ |
| 3 | Graphing and Uncertainties | | Atomic Physics |
| 4 | Mechanics | | ↓ |
| 5 | | Mid Year Exams | |
| 6 | | Electricity and Electromagnetism | ↓ |
| 7 | | | Final School Exams |
| 8 | | | Revision |
| 9 | | | Study |
| 10 | | | UB Exams start around this date |
| 11 | | | |
| 12 | | | |
| 13 | Research Report (start) | Practical Investigation | |
| 14 | | | |