EDUCATIONAL QUALITY AND ASSESSMENT PROGRAMME [EQAP]

SOUTH PACIFIC FORM SEVEN CERTIFICATE [SPFSC]

PHYSICS

SYLLABUS

GENERAL INFORMATION

The Office of the Educational Quality and Assessment Programme (EQAP) is located at:

3 Luke Street, Nabua
Suva
Fiji

Tel: (679) 3315600
Email: eqap@spc.int
Web: www.spc.int / www.eqap.org.fj

Any correspondence regarding this syllabus should be addressed to:

The Director EQAP
Pacific Community (SPC)
Private Mail Bag
Nabua
Fiji

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PREAMBLE AND RATIONALE

This syllabus defines the requirements for the South Pacific Form Seven Certificate Physics examination.

Each of the student outcomes for the course is to be read in conjunction with the Explanatory Notes given for each outcome in this syllabus.

Students also require knowledge and understanding of outcomes from national Year 12 or its equivalent, which are related to the specific outcomes of this syllabus.

This syllabus is derived from a revision of the Educational Quality and Assessment Programme (EQAP) syllabus and the New Zealand National Certificate of Educational Assessment (NCEA) Level 3 Physics Achievement Standards as published by New Zealand Qualifications Authority (NZQA).

The course is designed for students who wish to undertake university studies in Physics and other related fields.

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

- A qualitative treatment allows students to describe, in words 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 (e.g. Years 11 and 12) may also be necessary to answer examination questions based on this syllabus.

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' skills for problem solving in Physics;
- developing students' investigative skills in the determination of complex relationships, patterns and trends in Physics.

The course is also designed to help students develop the attitude and values that are appropriate for scientific investigations, problem solving, critical thinking, collaboration, tolerance, self-sufficiency and good judgement.

GENERAL OBJECTIVES

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

- demonstrate knowledge and understanding of Physical phenomena, concepts, principles and models.
- demonstrate problem solving skills in Physics.
- apply concepts and principles to explain Physical phenomena, systems and devices.
- appreciate the power and limitations of Physical theories and models in Physics.
- carry out practical investigations to determine complex relationships and trends in Physical systems.

CONTENT COMPONENTS

The course content consists of the following strands and sub-strands:

Strand Number	Strand Title	Sub strand	Sub-strand title
1.	Mechanics	1.1	Translational Motion
		1.2	Circular and Rotational Motion
		1.3	Simple Harmonic Motion
		1.4	Practical Investigation
2.	Waves	2.1	Wave Properties
		2.2	Sound Waves
3.	Electricity and Electromagnetism	3.1	DC Circuits and Capacitance
		3.2	Electromagnetic Induction
		3.3	AC Circuits
4.	Atomic and Nuclear Physics	4.1	Atomic Physics
		4.2	Nuclear Physics

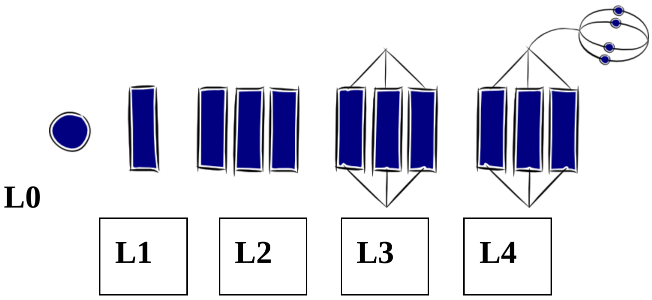
In stating or describing ideas, explaining relationships and solving problems in Physics, students are expected to:

- Apply formulae and/or use graphical, vectorial and phasor methods to find unknown quantities.
- Draw and interpret graphs and diagrams
- Give numerical answers to an appropriate number of significant figures, using SI units of measurements
- Indicate uncertainties in data calculations where necessary

UNPACKING LEARNING OUTCOMES

In this syllabus, Learning Outcomes are stated at three levels of generality: Major Learning Outcomes (MLOs) are stated at the strand level, Key Learning Outcomes (KLOs) are stated at the sub-strand level, and Specific Learning Outcomes (SLOs) are unpacked from the Key Learning Outcomes. Each SLO is a combination of a cognitive skill and a specific content component. Each SLO is given a skill level, level 1 – 4, and this skill level results from the categorisation of the cognitive skill that is embedded in the SLO using the SOLO taxonomy[1].

The SOLO taxonomy provides a simple, reliable and robust model for three levels of understanding – surface deep and conceptual (Biggs and Collis 1982).



At the **prestructural** level (L0) of understanding, the task is inappropriately attacked, and the student has missed the point or needs help to start. The next two levels, unistructural and multistructural are associated with bringing in information (surface understanding). At the **unistructural** level (L1), one aspect of the task is picked up, and student understanding is disconnected and limited. The jump to the multistructural level is quantitative. At the **multistuctural** level (L2), several aspects of the task are known but their relationships to each other and the whole are missed. The progression to relational and extended abstract outcomes is qualitative. At the **relational** level (L3), the aspects are linked and integrated, and contribute to a deeper and more coherent understanding of the whole. At the **extended abstract** level (L4), the new understanding at the relational level is re-thought at another conceptual level, looked at in a new way, and used as the basis for prediction, generalisation, reflection, or creation of new understanding (adapted from Hook and Mills 2011). [http://pamhook.com/solo-taxonomy/…]

The progression from Level 1 to Level 4 is exemplified in the progression from *define* →*describe* → *explain* → *discuss* with each succeeding level indicating a *higher or deeper level of understanding*, as follows:

- **define** – to state a basic definition of a concept [Unistructural or L1]
- **describe** – to give the characteristics of, or give an account of, or provide annotated diagrams. [Multistructural or L2]
- **explain** – to provide a reason for a relationship – an event and its impact, a cause and an effect, as to *how* or *why* something occurs. [Relational or L3]
- **discuss** – this means *linking biological ideas* (descriptions, explanations) to make generalisations to other situations, or predictions of unknown effects or impacts, orevaluations of a known situation with justifications. It may involve relating, comparing, analysing, and justifying. [Extended abstract level or L4]

[1] Structure of Observed Learning Outcomes by Biggs and Collis (1982)

LEARNING OUTCOMES
Strand 1: Mechanics

Major Learning Outcome 1: By the end of this strand, students are able to demonstrate understanding of the Physical phenomena, concepts, principles and relationships involved in mechanics.

Sub-strand 1.1: Translational motion

Key Learning Outcome: By the end of this sub-strand, students are able to demonstrate understanding of physical phenomena, concepts, and principles relating to translational motion.

SLO Nº	Specific Learning Outcomes	Skill Level	SLO Code
1	State Newton's Second Law of motion.	1	Phy1.1.1.1
2	Calculate the magnitude/size of a force on an object in a given situation using Newton's Second Law.	2	Phy1.1.2.1
3	Define centre of mass of a system.	1	Phy1.1.1.2
4	Calculate the centre of mass of a system.	2	Phy1.1.2.2
5	Calculate the unknown parameters using the centre of mass.	2	Phy1.1.2.3
6	Define momentum.	1	Phy1.1.1.3
7	Determine the momentum of a moving object with reference to its centre of mass.	2	Phy1.1.2.4
8	Define impulse as the product of force and time.	1	Phy1.1.1.4
9	Calculate the impulse on an object.	2	Phy1.1.2.5
10	State the relationship between momentum and velocity.	1	Phy1.1.1.5
11	State the law of conservation of momentum.	1	Phy1.1.1.6
12	Show that objects with bigger mass will have larger momentum and vice versa in a given situation.	2	Phy1.1.2.6
13	Determine the speed of a moving object given its momentum and mass.	2	Phy1.1.2.7
14	Describe qualitatively the collision of a moving object with a stationary object (but can move during collision).	2	Phy1.1.2.8
15	Describe qualitatively the collision of a moving object with an immovable object (fixed object).	2	Phy1.1.2.9
16	Describe qualitatively the collision of a moving object with an object moving in the opposite direction.	2	Phy1.1.2.10
17	Describe qualitatively the collision of a moving object with an object moving in the same direction.	2	Phy1.1.2.11
18	Explain why momentum is conserved in collision in terms of Newton's Third Law of motion.	3	Phy1.1.3.1
19	Analyse the change in momentum during collisions.	3	Phy1.1.3.2
20	Solve problems that apply the principle of conservation of momentum during collision of a moving object with a stationary object (in one dimension).	3	Phy1.1.3.3

21	Solve problems that apply the principle of conservation of momentum during collision of a moving object with a stationary object (two dimensions).	3	Phy1.1.3.4
22	Solve problems that apply the principle of conservation of momentum during collision of a moving object with an immovable object (both one and two dimension).	3	Phy1.1.3.5
23	Solve problems that apply the principle of conservation of momentum during collision of a moving object with another object moving in the opposite direction.	3	Phy1.1.3.6
24	Solve problems that apply the principle of conservation of momentum during collision of a moving object with another object moving in the same direction.	3	Phy1.1.3.7
25	Solve problems that apply the principle of conservation of momentum during collision of two moving objects travelling at a given angle.	3	Phy1.1.3.8
26	Define elastic collision.	1	Phy1.1.1.7
27	Define inelastic collision.	1	Phy1.1.1.8
28	Calculate the kinetic energy of an object before/after collision.	2	Phy1.1.2.12
29	Assess collisions in different situations to identify if a collision is elastic or inelastic.	4	Phy1.1.4.1
30	Discuss the implications of high speed vehicular collisions and suggest practical measures for safety.	4	Phy1.1.4.2
31	Describe the inertia of an object (e.g. vehicle as its tendency to remain in uniform motion or at rest using Newton's First Law of motion).	2	Phy1.1.2.13
32	Discuss reasons why Newton's First Law of Motion is not apparent in a given practical situation.	3	Phy1.1.3.9
33	Give reasons for the introduction of low speed zones in busy areas with respect to the concepts of impulse and momentum.	3	Phy1.1.3.10
34	Give reasons for the introduction of air bags in vehicles with respect to the concepts of impulse and momentum.	3	Phy1.1.3.11
35	Identify two safety features of a motor vehicle.	2	Phy1.1.2.14
36	Assess the effectiveness of some safety features of motor vehicles and suggest ways of improving them.	4	Phy1.1.4.3

The formulas related to the above content are listed under *Mechanics* in the Formulae page in **Appendix 2**.

Sub-strand 1.2: Circular and Rotational Motion

Key Learning Outcome: By the end of this sub-strand, students are able to demonstrate understanding of the Physical phenomena, concepts and principles relating to circular and rotational motion.

SLO Nº	Specific Learning Outcomes	Skill Level	SLO Code
1	Define the radian measure.	1	Phy1.2.1.1
2	Represent the measure of 1 radian in a diagram.	1	Phy1.2.1.2
3	Identify uniform circular motion.	1	Phy1.2.1.3
4	Identify that the centripetal force is always perpendicular to the velocity.	1	Phy1.2.1.4
5	Identify the type of force supplying the centripetal force acting on a body in uniform circular motion.	1	Phy1.2.1.5
6	Convert between radians and revolutions.	2	Phy1.2.2.1
7	Describe the role of gravity on satellite orbiting the earth.	2	Phy1.2.2.2
8	Analyse the forces involved in uniform circular motion for a range of objects, including satellites orbiting the Earth.	3	Phy1.2.3.1
9	Differentiate between concepts/quantities in translational motion and in rotational motion.	2	Phy1.2.2.3
10	Derive equations using the analogy between translational and rotational motion.	3	Phy1.2.3.2
11	Solve problems involving rotational motion with constant angular acceleration and constant angular speed.	3	Phy1.2.3.3
12	Calculate force on a satellite in circular orbit.	2	Phy1.2.2.4
13	Describe the angular momentum of a system in terms of the location and velocities of objects that make up the system.	2	Phy1.2.2.5
14	Solve problems that apply the principle of conservation of momentum for rotational motion.	3	Phy1.2.3.4
15	Describe the rotational inertia of a system in terms of the location and velocities of objects that make up the system.	2	Phy1.2.2.6
16	Explain relationship between velocity, acceleration and resultant force of objects under the influence of 2 or more forces, e.g. conical pendulums.	3	Phy1.2.3.5
17	Explain relationship between velocity, acceleration and resultant force of objects under the influence of 2 or more forces, e.g. banked corners.	3	Phy1.2.3.6
18	Explain the principle utilised by banked corners to allow vehicles to travel around corners safely.	3	Phy1.2.3.7
19	Label the direction of Net force/ Gravitational force/Normal force/Frictional force on a banked curve.	1	Phy1.2.1.6
20	Calculate the horizontal/vertical component of force in a conical pendulum.	2	Phy1.2.2.7
21	Resolve the forces acting in a banking curve.	2	Phy1.2.2.8

22	Resolve the forces acting on a conical pendulum.	2	Phy1.2.2.9
23	Calculate the banking angle for a given situation.	2	Phy1.2.2.10
24	Calculate the maximum velocity for a banked curve in a frictionless case.	2	Phy1.2.2.11
25	Calculate the maximum velocity for a curved road where friction is involved.	2	Phy1.2.2.12
26	Predict, with reasons, what will happen to a vehicle if it travels faster/ slower than speed required to safely travel along a frictionless banked corner.	4	Phy1.2.4.1
27	Calculate angular momentum of a system.	2	Phy1.2.2.13
28	Calculate rotational inertia of a system.	2	Phy1.2.2.14
29	Convert between linear distance and angular displacement of a rotating object.	2	Phy1.2.2.15
30	Convert between linear and angular velocities for a point on a rotating object.	2	Phy1.2.2.16
31	Convert between linear and angular acceleration of a rotating object.	2	Phy1.2.2.17
32	Explain how mass, radius and internal structure can be used to describe the rotational inertia of an object or system.	3	Phy1.2.3.8
33	Relate how rotational inertia affects the motion of an object or system.	3	Phy1.2.3.9
34	Explain the difference in the variables that translational inertia and rotational inertia depend on.	3	Phy1.2.3.10
35	Predict the impact of changing the axis of rotation of an object on its rotational inertia.	4	Phy1.2.4.2
36	Describe the total energy of a rolling object using both translational and rotational energy.	2	Phy1.2.2.18
37	Calculate the total energy of a rolling object using both translational and rotational energy.	2	Phy1.2.2.19
38	Explain how torque works to change rotational kinetic energy of an object or system.	3	Phy1.2.3.11
39	Calculate changes in energy of a system (rotational kinetic energy, translational kinetic energy, potential energy) when provided with angular or linear velocity.	2	Phy1.2.2.20
40	Design an experiment to explore effects of external torques on rotational kinetic energy.	4	Phy1.2.4.3
41	Define angular impulse as the product of torque and time.	1	Phy1.2.1.7
42	Predict the behaviour of colliding bodies in a rotational collision situation by analysing angular impulse and change of angular. momentum.	4	Phy1.2.4.4

The formulas related to the above content are listed under *Mechanics* in the Formulae page in **Appendix 2**.

Sub-strand 1.3: Simple Harmonic Motion

Key Learning Outcome: By the end of this sub-strand, students are able to demonstrate understanding of the Physical phenomena, concepts and principles relating to simple harmonic motion.

	Specific Learning Outcomes	**Skill Level**	**SLO Code**
1	State the SHM equation for displacement.	1	Phy1.3.1.1
2	State the SHM equation for velocity.	1	Phy1.3.1.2
3	State the SHM equation for maximum velocity.	1	Phy1.3.1.3
4	Identify/label positions of minimum displacement/velocity/acceleration.	2	Phy1.3.2.1
5	State the SHM equation for acceleration.	1	Phy1.3.1.4
6	State the SHM equation for maximum acceleration.	1	Phy1.3.1.5
7	Illustrate SHM with a variety of examples.	2	Phy1.3.2.2
8	Calculate the displacement of a particle undergoing simple harmonic motion.	2	Phy1.3.2.3
9	Calculate the velocity of a particle undergoing simple harmonic motion.	2	Phy1.3.2.4
10	Calculate the acceleration of a particle undergoing simple harmonic motion.	2	Phy1.3.2.5
11	Calculate the time or frequency of a particle undergoing simple harmonic motion.	2	Phy1.3.2.6
12	Calculate the angular frequency using the formula ($\omega = 2\pi f$) of a particle undergoing simple harmonic motion.	2	Phy1.3.2.7
13	Calculate the angular frequency using the formula ($\omega = 2\pi/T$) of a particle undergoing simple harmonic motion.	2	Phy1.3.2.8
14	Calculate the angular frequency /spring constant / mass of a spring using the formula $\omega = \sqrt{\frac{k}{m}}$	2	Phy1.3.2.9
15	Calculate the force acting on the mass at different positions in a simple harmonic motion.	2	Phy1.3.2.10
16	Describe oscillations in SHM in terms of amplitude, period and frequency.	2	Phy1.3.2.11
17	Identify positions of maximum displacement, velocity and acceleration in SHM.	2	Phy1.3.2.12
18	Use the equations of motion to solve problems in simple harmonic motion.	3	Phy1.3.3.1
19	Analyse SHM in terms of potential and kinetic energy.	3	Phy1.3.3.2
20	Calculate the kinetic energy in Simple Harmonic motion.	2	Phy1.3.2.13
21	Calculate the potential energy in Simple Harmonic motion.	2	Phy1.3.2.14
22	Calculate the total energy in Simple Harmonic Motion.	2	Phy1.3.2.15
23	Represent Potential Energy, Kinetic Energy and Total Energy graphically.	3	Phy1.3.3.3

24	Interpret algebraic representations of SHM.	3	Phy1.3.3.4
25	Define Underdamped Oscillation.	1	Phy1.3.1.6
26	Define Overdamped Oscillation.	1	Phy1.3.1.7
27	Define critically damped Oscillation.	1	Phy1.3.1.8
28	Interpret graphical representations of SHM.	3	Phy1.3.3.5
29	Describe effects of damping on SHM.	2	Phy1.3.2.16
30	Define forced vibrations.	1	Phy1.3.1.9
31	Describe effects of forced vibrations on SHM.	2	Phy1.3.2.17
32	Describe effects of resonance on SHM.	2	Phy1.3.2.18
33	Determine the maximum speed of an oscillating system.	2	Phy1.3.2.19
34	Discuss the difference between underdamped, overdamped and critically damped oscillations and justify their use in practical applications.	4	Phy1.3.4.1
35	Explain the link between SHM and wave motion	3	Phy1.3.3.6
36	Relate SHM to the reference circle to explain the time period or frequency of the motion	3	Phy1.3.3.7
37	Relate SHM to circular motion to explain the displacement of the motion.	3	Phy1.3.3.8
38	Solve quantitative problems involving SHM	3	Phy1.3.3.9
39	Compare and contrast SHM with uniform circular motion and justify their use in practical applications.	4	Phy1.3.4.2

The formulas related to the above content are listed under *Simple Harmonic Motion* in the Formula page in **Appendix 2**.

Sub-strand 1.4: Practical Investigation

Key Learning Outcome: By the end of this sub-strand, students are able carry out a practical investigation with guidance to determine a complex relationship or trend in a Physical system.

Learning Outcomes:

SLO N^{O}	Specific Learning Outcomes	Skill Level	SLO Code
1.	State the aim/purpose of the investigation.	1	Phy1.4.1.1
2.	State question/hypothesis to be answered by the investigation.	1	Phy1.4.1.2
3.	State the rationale of the investigation.	1	Phy1.4.1.3
4.	State background information related to the investigation.	1	Phy1.4.1.4
5.	Identify/State the dependent and/or independent variable in an investigation.	1	Phy1.4.1.5
6	List the equipment/materials required for the investigation.	2	Phy1.4.2.1
8.	Describe the test for each variable.	2	Phy1.4.2.2
9.	Describe the method used in the investigation.	2	Phy1.4.2.3

10.	Use correct units and uncertainties.	2	Phy1.4.2.4
11.	Collect and process data in data tables	2	Phy1.4.2.5
12.	Draw and label graphs	3	Phy1.4.3.1
13.	Explain why the method to be used is selected.	3	Phy1.4.3.2
14.	Maintain a logbook of all work carried out in the investigation.	3	Phy1.4.3.3
	Calculate relevant quantities from given data and graphs to highlight relationship between variables.	2	Phy1.4.2.6
15.	Interpret processed data to show trends, relationships and patterns.	3	Phy1.4.3.4
16.	Draw conclusion that is relevant to the data and linked back to the purpose and hypothesis or aim of the investigation.	3	Phy1.4.3.5
17.	Analyse data by re-expressing data to determine relationship between variables, and determining the value, unit and significance of slope.	3	Phy1.4.3.6
18.	Write and explain the equation derived from the analysis.	3	Phy1.4.3.7
19.	Identify sources of errors and explain how to minimise these errors.	3	Phy1.4.3.8
20.	Provide a theoretical explanation about the expected results from the investigation.	3	Phy1.4.3.9
21.	List bibliography/ references / acknowledgements.	2	Phy1.4.2.7
22.	Evaluate findings in terms of reliability and validity of results and suggest improvements.	4	Phy1.4.4.1
23.	Evaluate findings in terms of limitations and difficulties encountered in the investigation and suggest solutions for improvement.	4	Phy1.4.4.2
24.	Predict and explain everyday phenomena using equations and graphs derived from the data obtained from the investigation.	4	Phy1.4.4.3
25.	Modify or affirm existing scientific conceptions through experimentation and using other evidence.	4	Phy1.4.4.4

The list of investigations suitable for assessment purposes are listed in **Appendix 2**

Strand 2: Waves

Major Learning Outcome: By the end of this strand, students are able to demonstrate understanding of physical phenomena, concepts, principles and relationships related to waves.

Sub-strand 2.1: Wave Properties

Key Learning Outcome: By the end of this sub-strand, students are able to demonstrate understanding by describing, explaining the physical phenomena, concepts, principles and properties of waves.

SLO Nº	Specific Learning Outcomes	Skill Level	Skill Code
1.	Define wave characteristics (wavelength, amplitude, speed).	1	Phy2.1.1.1
2.	List variables that affect wave speed.	2	Phy2.1.2.1
3.	Solve wave problems involving speed, distance and time.	2	Phy2.1.2.2
4	Explain the difference between wave motion and particle motion.	3	Phy2.1.3.1
5	List different types of waves.	2	Phy2.1.2.3
6	State example of transportation of energy in waveform.	1	Phy2.1.1.2
7	Define diffraction.	1	Phy2.1.1.3
8	Describe the changes in the behaviour of waves undergoing diffraction.	2	Phy2.1.2.4
9	Explain how diffraction is affected by the wavelength of a wave.	3	Phy2.1.3.2
10	Distinguish between the effects of reflection, refraction and diffraction of waves.	3	Phy2.1.3.3
11	Give examples of the applications or uses of diffraction in nature.	2	Phy2.1.2.5
12	Describe the setup for a double-slit diffraction pattern.	2	Phy2.1.2.6
13	Define monochromatic light.	1	Phy2.1.1.4
14	Identify the reason for using monochromatic light in Young's double slit experiment.	1	Phy2.1.1.5
15	Draw the interference pattern in Young's double slit experiment.	2	Phy2.1.2.7
16	Explain how the interference pattern from a double slit diffraction setup is formed.	3	Phy2.1.3.4
17	Use Young's interference equations to calculate the location of nth constructive interference.	3	Phy2.1.3.5
18	Use Young's interference equations to calculate the location of nth destructive interference.	3	Phy2.1.3.6
19	Use Young's interference equations to calculate unknown quantities in a given set-up.	3	Phy2.1.3.7
20	Predict with reasons, how changes in any of the variables in Young's experiment will affect the interference pattern.	4	Phy2.1.4.1

Sub-strand 2.2: Sound Waves

Key Learning Outcome: By the end of this sub-strand, students are able to demonstrate understanding by describing, explaining and solving problems related to properties of sound waves.

SLO No	Specific Learning Outcomes	Skill Level	SLO Code
1	Define a standing wave.	1	Phy2.2.1.1
2	Identify the wavelength of a standing wave in a diagram.	1	Phy2.2.1.2
3	Identify the amplitude of a standing wave in a diagram.	1	Phy2.2.1.3
4	Label the nodes and antinodes of a standing wave.	2	Phy2.2.2.1
5	Calculate the wavelength of a standing wave.	2	Phy2.2.2.2
6	Draw wave patterns for open pipe/ closed pipe/ strings.	2	Phy2.2.2.3
7	Draw standing wave patterns for different instruments.	2	Phy2.2.2.4
8	Calculate the frequency/time of a standing wave in a diagram.	2	Phy2.2.2.5
9	Explain the harmonic series for a given string musical instrument.	3	Phy2.2.3.1
10	Define Resonant Frequency.	1	Phy2.2.1.4
11	Calculate resonant frequency.	2	Phy2.2.2.6
12	Describe how beats are generated in waves.	2	Phy2.2.2.7
13	Calculate the beat frequency in waves.	1	Phy2.2.1.5
14	Calculate the frequency of a wave in a given context.	1	Phy2.2.1.6
15	Determine an unknown using the wave speed formula.	1	Phy2.2.1.7
16	Determine the speed of wave in a given context.	1	Phy2.2.1.8
17	Identify that loudness depends on the amplitude (height) and frequency of sound waves.	1	Phy2.2.1.9
18	Identify that pitch depends on frequency and amplitude of a sound wave.	1	Phy2.2.1.10
19	Identify that timbre or the particular quality of a sound depends on the complexity of a sound wave.	1	Phy2.2.1.11
20	Explain differences in effects of sound waves in terms of loudness, pitch and timbre	3	Phy2.2.3.2
21	Interpret textual information and diagrams in order to solve problems using the wave equation.	3	Phy2.2.3.3
22	Predict with reasons, how changes in the medium of wave travel will affect the properties of the wave.	4	Phy2.2.4.1
23	Define Doppler Effect.	1	Phy2.2.1.12
24	Describe examples of the Doppler Effect for both sound and light.	2	Phy2.2.2.8

25	Explain how the Doppler Effect changes the way sound is perceived when the source of sound is moving.	3	Phy2.2.3.4
26	Explain the difference in actual and apparent frequencies of sound waves when the source of sound is moving away (receding) from observer.	3	Phy2.2.3.5
27	Explain the difference in actual and apparent frequencies of sound waves when the source of sound is moving towards (approaching) observer.	3	Phy2.2.3.6
28	Calculate the apparent frequency of a wave when the source is receding/approaching a stationary observer.	2	Phy2.2.2.9
29	Calculate the apparent frequency of a wave when an observer is receding/approaching the stationary source.	2	Phy2.2.2.10
30	Explain the effects of differences in speeds of sound and light using real life examples/situations.	3	Phy2.2.3.7
31	Describe the characteristics of a standing wave in terms of frequency, wavelength, amplitude, period, speed.	2	Phy2.2.2.11

The formulas related to the above content are listed under *Waves* in the Formula page in **Appendix 2.**

Strand 3: Electricity and Electromagnetism

Major Learning Outcome: By the end of this strand, students are able to demonstrate understanding, by explaining and solving problems related to the Physical phenomena, concepts, principles and relationships involved in electricity and electromagnetism.

Sub-strand 3.1: DC Circuits and Capacitance

Key Learning outcome: By the end of this sub-strand, students are able to demonstrate understanding of the Physical phenomena, concepts and principles relating to DC circuits and capacitance.

SLO No	Specific Learning Outcomes	Skill Level	SLO Code
1	State Ohm's Law.	1	Phy3.1.1.1
2	State Kirchhoff's current Law / Junction Rule.	1	Phy3.1.1.2
3.	State Kirchhoff's voltage law/ Loop rule.	1	Phy3.1.1.3
4.	Write Kirchhoff's current rule in a given circuit.	1	Phy3.1.1.4
5.	Write Kirchhoff's voltage rule in a given circuit.	1	Phy3.1.1.5
6.	Calculate current using Ohm's and or Kirchhoff's Law.	2	Phy3.1.2.1
7.	Calculate voltage using Ohm's and or Kirchhoff's Law.	2	Phy3.1.2.2
8.	Calculate resistance using Ohm's and or Kirchhoff's Law.	2	Phy3.1.2.3
9.	Define internal resistance.	1	Phy3.1.1.6
10.	Calculate internal and effective resistance in a circuit.	2	Phy3.1.2.4
11.	Define capacitance.	1	Phy3.1.1.7

12.	Draw the symbol of a capacitor.	1	Phy3.1.1.8
13.	Describe the function of a capacitor in a circuit.	2	Phy3.1.2.5
14.	Explain parallel plate capacitors and their capacitances.	3	Phy3.1.3.1
15.	Describe a role of a dielectric in a capacitor.	2	Phy3.1.2.6
16.	Discuss the process of increasing the capacitance of a dielectric capacitor.	3	Phy3.1.3.2
17.	Determine capacitance given charge and voltage.	2	Phy3.1.2.7
18.	Determine the capacitance of a dielectric capacitor.	2	Phy3.1.2.8
19.	Calculate parameters using the formula $C = \frac{k\varepsilon_0 A}{d}$	3	Phy3.1.3.3
20.	Write expressions for total capacitance in series and in parallel arrangements.	2	Phy3.1.2.9
21.	Identify series and parallel parts in the combination of connection of capacitors.	2	Phy3.1.2.10
22.	Calculate the effective capacitance in series given individual capacitances.	2	Phy3.1.2.11
23.	Calculate the effective capacitance in parallel given individual capacitances.	2	Phy3.1.2.12
24.	List some uses of capacitors.	2	Phy3.1.2.13
25.	Formulate the appropriate equation for the energy stored in a capacitor.	2	Phy3.1.2.14
26.	Calculate the energy stored in a capacitor.	2	Phy3.1.2.15
27.	Describe the importance of the time constant, τ.	2	Phy3.1.2.16
28.	Calculate the time constant for a given resistance and capacitance.	2	Phy3.1.2.17
29.	Explain why batteries in a flashlight gradually lose power and the light dims over time.	3	Phy3.1.3.4
30.	Draw voltage-time graph for given data for a capacitor.	3	Phy3.1.3.5
31.	Draw current-time graph for given data for a capacitor.	3	Phy3.1.3.6
32.	Describe what happens to a graph of the voltage across a capacitor over time as it charges/discharges.	2	Phy3.1.2.18
33.	Describe what happens to a graph of the current across a capacitor over time as it charges/discharges.	2	Phy3.1.2.19
34.	Interpret voltage/time graphs for a capacitor.	3	Phy3.1.3.7
35.	Interpret current/time graphs for a capacitor.	3	Phy3.1.3.8
36.	Identify the time constant using Current/Voltage graphs.	2	Phy3.1.2.20
37.	Discuss how a timing circuit works and suggest improvements to existing applications.	4	Phy3.1.4.1
38.	State the function of a stroboscope.	1	Phy3.1.1.11
39.	Calculate the necessary speed of a strobe flash needed to freeze the movement of an object over a particular length.	3	Phy3.1.3.9

The formulas related to the above content are listed under *DC Circuits and Capacitance* in the Formula page **in Appendix 2**.

Sub-strand 3.2: Electromagnetic Induction

Key Learning outcome: By the end of this sub-strand, students are able to demonstrate understanding of the Physical phenomena, concepts and principles relating to electromagnetic induction.

SLO No	Specific Learning Outcomes	Skill Level	SLO Code
1	Define Magnetism	**1**	Phy3.2.1.1
2	State the cause of magnetism	1	Phy3.2.1.2
3	Define magnetic field/ magnetic flux	1	Phy3.2.1.3
4	Draw characteristic magnetic field lines for simple magnets (bar magnets, horse shoe magnets)	1	Phy3.2.1.4
5	Draw characteristic magnetic field lines for current carrying wires/ solenoids	1	Phy3.2.1.5
6	Draw characteristic magnetic field lines of the earth.	1	Phy3.2.1.6
7	Distinguish between geographic north and magnetic north	2	Phy3.2.2.1
8	Calculate the flux of a uniform magnetic field through a loop of arbitrary orientation.	2	Phy3.2.2.2
9	Describe the relationship between the rate of change of flux and the voltage induced across a conductor	2	Phy3.2.2.3
10	Describe methods to produce an electromotive force (emf) with a magnetic field or magnet and a loop of wire.	2	Phy3.2.2.4
11	Calculate emf, current, and magnetic fields using Faraday's Law.	3	Phy3.2.3.1
12	Explain the physical results of Lenz's Law	3	Phy3.2.3.2
13	Calculate the induced voltage in a coil with a constant angular velocity in a uniform magnetic field	2	Phy3.2.2.6
14	Calculate emf, and force due to the motion of an object in a magnetic field.	2	Phy3.2.2.7
15	Calculate magnetic field, and torque due to the motion of an object in a magnetic field.	3	Phy3.2.3.3
16	State the role of a transformer	1	Phy3.2.1.7
17	Explain how a transformer works.	3	Phy3.2.3.4
18	Calculate voltage, current, and/or number of turns given the other quantities.	2	Phy3.2.2.8
19	Define inductance	1	Phy3.2.1.8
20	Draw the symbol of an inductor	1	Phy3.2.1.9
21	List the factors that affect the size and direction of the induced voltage of an inductor	2	Phy3.2.2.9
22	Calculate the inductance of an inductor.	2	Phy3.2.2.10
23	Calculate the energy stored in an inductor.	2	Phy3.2.2.11
24	Calculate the emf generated in an inductor.	2	Phy3.2.2.12

25	Discuss the factors that affect inductance (coil material, number of turns, coil length and coil area) in relation to real examples	4	Phy3.2.4.1
26	Discuss how various modern safety features impact the set up and use of electric circuits.	4	Phy3.2.4.2
27	Develop a model using the principles of electromagnetic induction with correct technicalities.	4	Phy3.2.4.3
28	Select appropriate materials for model development	2	Phy3.2.2.13
29	Outline the procedure for model development	2	Phy3.2.2.14
30	Work collaboratively and productively to develop model	3	Phy3.2.3.5
31	Presents accurate information confidently	3	Phy3.2.3.6
32	Combines presentation with ICT skills	3	Phy3.2.3.7
33	Relates the principles of electromagnetic induction to the working of the model	3	Phy3.2.3.8

The formulas related to the above content are listed under *Electromagnetic Induction* in the Formula page in **Appendix 2.**

Sub-strand 3.3: AC Circuits

Key Learning outcome: By the end of this sub-strand, students are able to demonstrate understanding of the Physical phenomena, concepts and principles relating to AC circuits.

SLO No.	Specific Learning Outcomes	Skill Level	SLO Code
1.	Define the RMS voltage/current.	1	Phy3.3.1.1
2.	State the effect of capacitance on current in an AC circuit.	1	Phy3.3.1.2
3.	State the effect of inductance on current flow in an AC circuit.	1	Phy3.3.1.3
4.	Sketch voltage and current versus time in simple resistive circuits.	2	Phy3.3.2.1
5.	Sketch voltage and current versus time in simple capacitive circuit.	2	Phy3.3.2.2
6.	Sketch voltage and current versus time in simple inductive circuits.	2	Phy3.3.2.3
7.	Calculate inductive and capacitive reactance.	2	Phy3.3.2.4
8.	Calculate current and/or voltage in simple inductive, capacitive, and resistive circuits.	2	Phy3.3.2.5
9.	Calculate the impedance in a RLC series circuit.	2	Phy3.3.2.6
10.	Calculate the phase angle, resonant frequency, power, power factor in a RLC series circuit.	2	Phy3.3.2.7
11.	Calculate the voltage, and/or current in a RLC series circuit.	2	Phy3.3.2.8
12.	Draw the circuit diagram for an RLC series circuit.	2	Phy3.3.2.9
13.	Explain the significance of the resonant frequency.	3	Phy3.3.3.1
14.	Determine maximum voltage output of a circuit.	2	Phy3.3.2.10
15.	Calculate angular frequency for an AC circuit.	2	Phy3.3.2.11

16.	Calculate the reactance of a capacitor.	2	Phy3.3.2.12
17.	Determine current of resonance.	2	Phy3.3.2.13
18.	Describe the max value of current when the circuit is at resonance.	2	Phy3.3.2.14
19.	Calculate rms voltage/current produced in a given situation.	2	Phy3.3.2.15
20.	Calculate the peak (maximum) voltage/current.	2	Phy3.3.2.16
21.	Illustrate peak and RMS voltages graphically.	3	Phy3.3.3.2
22.	Apply formulae, graphical, vectorial and phasor methods to find unknowns.	3	Phy3.3.3.3
23.	Explain how low or high frequencies can be filtered out using capacitors/ inductors.	3	Phy3.3.3.4
24.	Discuss with reason what could be added to the AC circuit to make the current and voltage of the supply run in phase.	4	Phy3.3.4.1
25.	Design a system to act as low/ high frequency filter in a specific application involving AC circuits	4	Phy3.3.4.2

The formulas related to the above content are listed under *AC Circuits* in the Formula page in **Appendix 2**.

Strand 4: Atomic and Nuclear Physics

Major Learning Outcome: By the end of this strand, students are able to demonstrate understanding of the Physical phenomena, concepts, principles and relationships involved in Atomic and Nuclear Physics.

Sub-strand 4.1: Atomic Physics

Key Learning Outcome: By the end of this sub-strand, students are able to demonstrate understanding, by describing, explaining and solving problems related to the Physical phenomena, concepts, principles and relationships involved in atomic and nuclear Physics.

SLO No	Specific Learning Outcomes	Skill Score	SLO Code
1.	Describe the basic structure of the atom, the sub-structure of all matter.	2	Phy4.1.2.1
2.	Explain Bohr's theory of the hydrogen atom.	3	Phy4.1.3.1
3.	Explain Bohr's planetary model of the atom.	3	Phy4.1.3.2
4.	State one postulate or one limitation of Bohr's theory.	1	Phy4.1.1.1
5.	Discuss the postulates and limitations of Bohr's theory.	4	Phy4.1.4.1
6.	Define quantum number.	1	Phy4.1.1.2
7.	Explain the ionization of radiation in an atom.	3	Phy4.1.3.3
8.	Define Photoelectric Effect.	1	Phy4.1.1.3
9.	Describe a typical photoelectric effect experiment.	2	Phy4.1.2.2
10.	Define photons.	1	Phy4.1.1.4
11.	Define Photoelectrons.	1	Phy4.1.1.5
12.	Illustrate the photoelectric effect using diagram.	2	Phy4.1.2.3
13.	Calculate the work function of a material given the threshold frequency or vice versa.	2	Phy4.1.2.4
14.	Determine the maximum kinetic energy of photoelectrons ejected by photons of a particular energy or wavelength.	3	Phy4.1.3.4
15.	Explain Max Planck's contribution to the development of quantum mechanics.	3	Phy4.1.3.5
16.	Explain why atomic spectra indicate quantization.	3	Phy4.1.3.6
17.	Explain the term particle-wave duality means, and why it is applied to EM radiation.	3	Phy4.1.3.7
18.	Relate the linear momentum of a photon to its energy or wavelength, and apply linear momentum conservation to simple processes involving the emission, absorption, or reflection of photons.	3	Phy4.1.3.8
19.	Convert energy from electron volts to joules or vice versa	1	Phy4.1.1.6
20.	Explain the relationship between the energy of a photon in joules or electron volts and its wavelength or frequency.	3	Phy4.1.3.9
21.	Calculate the amount of energy given photon frequency or vice versa.	2	Phy4.1.2.5

22.	Calculate the number of photons per second emitted by a monochromatic source of specific wavelength and power.	2	Phy4.1.2.6
23.	Identify the ionisation energy of hydrogen atom is 13.6 eV.	1	Phy4.1.1.7
24.	Illustrate energy state using the energy-level diagram to show Lyman, Balmer and Paschen and Bracket spectral lines.	3	Phy4.1.3.10
25.	Draw and interpret energy level diagrams.	3	Phy4.1.3.11
26.	Use Rydberg's formula to calculate the wavelength of emitted photons.	2	Phy4.1.2.7
27.	Calculate wavelengths for given frequencies in a spectrum.	2	Phy4.1.2.8
28.	Identify the spectral region of emitted photons from a hydrogen atom.	1	Phy4.1.1.8

Sub-strand 4.2: Nuclear Physics

Key Learning Outcome: By the end of this sub-strand, students are able to demonstrate understanding of nuclear physics by describing, explaining and solving problems related to the physical phenomena, concepts, principles and relationships in nuclear physics.

SLO No	Specific Learning Outcomes	Skill Score	SLO Code
1	Identify a characteristic of alpha radiation.	1	Phy4.2.1.1
2	Identify characteristic of beta radiation.	1	Phy4.2.1.2
3	Identify characteristic of gamma radiation.	1	Phy4.2.1.3
4	Explain the process and results of nuclear radiation.	3	Phy4.2.3.1
5	Name a type of nuclear radiations – alpha, beta, gamma emission	1	Phy4.2.1.4
6	Explain the types of radiation—alpha emission, beta emission, and gamma emission.	3	Phy4.2.3.2
7	Calculate mass deficit of a nucleus.	2	Phy4.2.2.1
8	Define nuclear fusion.	1	Phy4.2.1.5
9	Define nuclear fission.	1	Phy4.2.1.6
10	Define half-life.	1	Phy4.2.1.7
11	Define radioactive dating.	1	Phy4.2.1.8
12	Calculate age of old objects by radioactive dating.	2	Phy4.2.2.2
13	Balance equations for nuclear reactions.	2	Phy4.2.2.3
14	Calculate energy released in the formation of specific isotopes.	2	Phy4.2.2.4
15	Discuss how fission fuel reacts and describe what it produces.	4	Phy4.2.4.1
16	Distinguish between controlled and uncontrolled chain reactions.	3	Phy4.2.3.4
17	Discuss processes to achieve practical fusion energy generation and suggest safety measures that are necessary to minimise danger.	4	Phy4.2.4.2

The formulas related to the above content are listed under *Atomic and Nuclear Physics* in the Formula page in **Appendix 2**.

ASSESSMENT

Students will be assessed by:

- a three-hour written external examination 70%
- two internally assessed tasks 30%

Assessment may involve the use of skills and knowledge from Year 11 and 12 Physics when relevant to the development of the South Pacific Form Seven Certificate Physics.

Assessment Blueprint

The assessment blueprint for Physics is given below. The weighting for each strand and skill level is to be noted as these will be adhered to for assessment.

	STRAND	**Assessment Type**	**SKILL LEVEL/ SCORE**				
			1	**2**	**3**	**4**	**Weight**
1	**MECHANICS**	EA					**31**
		IA	1	2	2	1	**15**
2	**WAVES**	EA					**15**
3	**ELECTRICITY & MAGNETISM**	EA					**11**
		IA		2	1	2	**15**
4	**ATOMIC & NUCLEAR PHYSICS**	EA					**13**
	Total number of items		**20**	**15**	**10**	**5**	**50**
	Total score		**20**	**30**	**30**	**20**	**100**

External Assessment

The written examination will be **a three-hour written paper** and will test a range of knowledge, understanding and skills consistent with the aims, objectives and outcomes of this syllabus.

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 section. 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	30%
Waves	15%
Electricity and Electromagnetism	10%
Atomic and Nuclear Physics	15%
Total	**70%**

Internal Assessment

The practical investigation carried out by students in schools will meet the outcomes stated in this syllabus. There are two internal assessment tasks, each of which focuses on specific aspects of practical investigations. The tasks are to be assessed by teachers in schools. The first task focuses on the entire procedure of carrying out a practical investigation. This includes planning, design and methodology; data collection; data processing and analysis; and discussion and evaluation of results. The specific aspects of investigative skills to be assessed are outlined in Appendix 2.

Task 1: Practical Investigation (15%)

- The investigation must be carried out independently.
- Students are to plan, design, carry out and report on an investigation into a Physics phenomenon or relationship, based on **Strand 1 – Mechanics.**
- Students must maintain a logbook that should be submitted together with the completed report.
- The investigation must
    - ✓ have a clear purpose
    - ✓ be based on a clear methodology or procedure
    - ✓ be suitably equipped so that results are valid and reliable
    - ✓ produce quantitative data (including appropriate number of significant figures and uncertainties)
    - ✓ include appropriate data processing, data analysis and discussion and evaluation of the results
    - ✓ lead to a report to be submitted to the teacher for scoring.
- A list of suggested topics in Mechanics is provided in the **Advisory Section** (page 41), although students are not restricted to these topics.
- Teachers are strongly advised to assist students in their planning for the investigation and support them with their resources and time allocations in the laboratory.
- Teachers are also strongly advised to ensure that there is a variety of investigations that students chose to carry out, instead of majority of groups carrying out one investigation only.
- The learning outcomes that are addressed in this task are outlined under **Sub-strand 1.4**.
- Teachers are urged to draw students' attention to the expectations outline in these learning outcomes which they must address in this IA Task 1.

- Student responses will be scored using the criteria specified in the Assessment Schedule for Task 1, which can be found in **page 26 onwards**.

Task 2: Model development: Application of theoretical knowledge (15%)

- Students will be assessed on learning outcomes from **Sub-strand 3.2. Electromagnetic Induction in Strand 3 (Electricity and Magnetism).**
- **This task targets research skills, practical skills, presentation skills, innovation and creativity and will be carried out in small groups under laboratory conditions.**
- The task will be assessed on the criteria specified in the Scoring Rubric for Task 2, which can be found in **page 29 onwards.**
- The details related to the task are provided below.

Model Development Guidelines:

1. Teacher Guidelines:

This task is new in this 2020 version of the SPFSC Physics syllabus, so it is important they you familiarise yourself well with the task expectations, the related SLOs and the scoring rubric. The task targets research skills, practical skills, presentation skills, innovation and creativity and will be carried out in small groups under laboratory conditions. Teachers are advised to provide students with the guidance that they need but must avoid carrying out the task for the students. Students are to be guided in the choice of the model that they intend to develop, the sourcing of necessary materials and equipment, the use of laboratory equipment, the creation of videos, and putting together electronic equipment for presentations. Students are to work in groups of twos or threes, with a gender mix, and the teacher is to keep a record of this grouping.

Teachers are to ensure that groups are distributed across the different model topics. In other words, it must not be the case that majority of groups work on one model topic. Teachers are to also ensure that there is no borrowing of resources, but that each group is to go out of its way to secure the materials and equipment that it needs to create its model. This is important as innovation and creativity is critical to this task.

Teachers are to allocate the space for groups to create their models in. The Physics laboratory is the preferred space; however some space in the classroom may also be appropriate.

2. Duration/Conditions:

The preparation for this model may take place over a period of 2 - 3 weeks of in class and out of class time. Students will need about a week to decide on a model and confirm this with the teacher and then source the equipment and materials that they will need. One week for the development of the model, which is to be accompanied by video shooting (using a smart phone) of the model development, then the third week for the presentation to the class. Other teachers in the school may be invited to view the presentations.

3. Student Guidelines for the task:

This task will require you to create a model based on a concept (and procedures) taken from the principles of electromagnetism (substrand 3.2). The list of possible areas of model development are given in 4. below. You are to organise yourself into groups of threes or twos with a mix of gender and let your teacher know of your group members.

Select a topic for model development from the list below. Research widely on how to create the model and the materials and equipment that are necessary for creating the model. Gather your research findings and outline the materials and procedure that your group will use. Allocate roles to your group members including who is to get what equipment and/or materials. It is important that all group members contribute equally in the model development; not just one member getting materials and doing most of the work while the others just hang around and watch.

Create your model in the laboratory or in a space allocated by your teacher. As the development of the model begins, take pictures and short clip videos (on a smart phone) of the different steps and the final successful product. These pictures and videos will form part of your presentation. Prepare your presentation notes and allocate the different portions of the presentation to each group member. Again, it is important that every group member play an active role during the presentation. The presentation will involve the use of presentation slides and a presentation projector so that all students and your teacher can see the development of your model. Learn together how to create presentation slides and create links to videos and pictures, how to transfer pictures and videos from the smart phone to a computer, how to link the computer to a projector, and how to project powerpoint slides during the presentation. It is expected that year 13 students should be competent in these 21st century ICT skills.

4. List of topics for model development:

a. Construct a motor using reusable materials like magnets from old radios.
b. Making a tattoo machine from a motor.
c. Making a coconut scraper from a motor.
d. Generating an induced voltage with permanent magnets.
e. Generating an induced voltage with electromagnets.
f. Simple self-induction (when switching a circuit on and off)

The list above is not exhaustive. Teachers and students are encouraged to search the internet for ideas related to the above and other topics that may be found to be relevant. The topic has to be related to substrand 3.2: Electromagnetism. Some extra information is provided in 7. below.

5. The Presentation

During the presentation, students are to showcase the following:

a. How they arrived at the decision on the model to develop.
b. How they obtained their materials and equipment.
c. The procedure that they followed during model development.
d. The product i.e. the working model
e. Relate the working model to the various principles of electromagnetism. This is important - the working model may be good to show, but students' demonstration of understanding of the principles of electromagnetism that underline the model is equally important.

6. The Scoring Rubric

The scoring rubric that will be used to score the model and the presentation is provided in the next section. Teachers are to make the scoring rubric available to students so that they are aware of how their work will be scored.

7. Extra information on models

You may refer to the following sites as starting points. Both teachers and students are encouraged to explore the internet widely for relevant information.

a. https://www.phywe.com/en/physics/age-16-19/electricity/electromagnetic-induction/
b. https://www.youtube.com/watch?v=gpP7c-VN0x8

c. https://www.youtube.com/watch?v=UyqLpbg_HvY

d. https://www.youtube.com/watch?v=d9Y9v6txZ9k

IA Scoring Rubrics

IA Task 1 Scoring Rubric

TASK 1 – Practical Investigation Assessment Criteria (15%)

SLO #	SLO Code	Skill Level	Learning outcome assessed (in brief)	Skill Level 1	Skill Level 2	Skill Level 3	Skill Level 4
1.	Phy1.4.1.1	1	State aim/purpose	Aim/purpose is stated			
2.	Phy1.4.1.2	1	State question/hypothesis	Question/hypothesis is stated			
3.	Phy1.4.1.3	1	State rationale	Rational is stated			
4.	Phy1.4.1.4	1	State background information/introduction	Background information/introduction given			
5.	Phy1.4.1.5	1	State dependent and independent variables	Variables given			
6	Phy1.4.2.1	2	List the equipment/materials required for the investigation	Equipment list is not complete	All equipment are stated		
8.	Phy1.4.2.2	2	Describe variable test	Simple description only	Features of the test are provided fully		
9.	Phy1.4.2.3	2	Describe methodology	Methodology is outlined but not complete	Methodology is outlined and complete		
10.	Phy1.4.2.4	2	Use units and uncertainties	Uses units	Uses units and uncertainties		

11.	Phy1.4.2.5	2	Process data into tables	Tables and/or graphs provided but not complete	Tables and/or graphs provided and complete		
12.	Phy1.4.3.1	3	Draw and label graphs	Graph is drawn but not mostly incomplete or has errors	Graph is drawn with most details correct	Graph is fully correct, with appropriate labels and scale	
13.	Phy1.4.3.2	3	Explain why method was used	One appropriate idea on the method is given	More than one idea on method	Ideas on method linked to benefit/s	
14.	Phy1.4.3.3	3	Maintain a logbook	Log book is simple only	Log book has a number of items	Items in logbook are comprehensive and linked	
15.	Phy1.4.2.6	2	Calculate relevant quantities	One simple quantity calculated	More than one quantity calculated		
16.	Phy1.4.3.4	3	Interpret data to show trends	Data is stated	A number of data pieces are stated in an attempt to link them but trend is not clear or incorrect.	Data trends are correct and complete	
17.	Phy1.4.3.5	3	Draw conclusion in relation to aim/hypothesis	One appropriate statement is made	Two appropriate statements are made but are not linked	Concluding statement shows relational thinking	
18.	Phy1.4.3.6	3	Analysis of data and significance of slope	Data is given but analysis is not relevant	Slope is determined but not its significance	Significance of slope in relationship is expressed	
19.	Phy1.4.3.7	3	Equation derived from analysis	Some attempt to write a derived equation is noted	Derived equation is written but no explanation of terms or equation given	Derived equation is written and explained	
20	Phy1.4.3.8	3	Sources of error explained	Only one source of error identified	Sources of error identified	Sources of error identified and explained	

21	Phy1.4.3.9	3	Provide a theoretical explanation about the expected results from the investigation with evidence.	Provide theoretical explanation only	Provide theoretical explanation with one evidence	Provide theoretical explanation with more than one evidence	
21.	Phy1.4.2.7	2	List bibliography / references	One source is acknowledged	Sources are acknowledged appropriately		
24.	Phy1.4.4.3	4	Predict and explain application of phenomena using data	Concept is stated but not described or related to any prediction or everyday phenomena	Phenomena related to concept is described; no explanation or prediction	Phenomena related to concept explained, but unable to make a prediction using equations and graphs derived from data	Everyday phenomena related to concept is predicted and explained using equations and graphs derived from data

Note that it is expected that students who successfully complete this sub-strand are able to demonstrate all of the above learning outcomes; however only selected learning outcomes will be assessed in Task 1 to contribute to its Internal Assessment weight of 15%. The breakdown will consist of 1xLevel 1, 2xLevel 2, 2xLevel 3 and 1xLevel 4 learning outcomes.

IA Task 2 Model Development Scoring Rubric

TASK 2 – Application of theoretical knowledge (15%)

SLO Code	Skill Level	Learning outcome assessed (in brief)	Skill Level 1	Skill Level 2	Skill Level 3	Skill Level 4
Phy3.2.2.9	2	List factors that affect the size and direction of induced voltage	States one factor only	Lists two or more factors		
Phy3.2.4.1	4	Discuss the factors that affect inductance	Only states one factor	States two or more factors, without linking these to how they affect inductance	States two or more factors, and link them to how they affect inductance	States two or more factors, link them to how they affect inductance and uses appropriate examples
Phy3.2.4.2	4	Discuss how modern safety features impact the set up and use of electric circuits.	Only states one safety feature	States two or more safety features, without linking these to impacts on use of ECs	States two or more factors, and link them to how they impact use of ECs.	States two or more factors, link them to how they impact the use of ECs and uses appropriate examples
Phy3.2.2.13	2	Selects appropriate materials for model development	Some materials are appropriate	All materials are appropriate		
Phy3.2.3.5	3	Work collaboratively and productively to develop model	Tends to work alone	Works collaboratively but on a selective basis	Is a good team worker	
Phy3.2.4.3	4	Develop a model with correct technicalities	Model is not fully developed	Model is fully developed but has some technical issues	Model is fully developed and fully functioning but lack good appearance	Model is fully developed, fully functioning and has good appearance (aesthetic appeal)
Phy3.2.3.6	3	Present accurate information confidently	Reads from text when presenting	Presents with confidence but incorrect at times	Presents accurate information and with confidence	

Phy3.2.3.7	3	Combines presentation with ICT skills	Present using paper and talk only	Uses presentation slides but not linked to pictures and/or videos; or needs assistance with using technology	Uses presentation slides, links to pictures and/or videos, and confident in using technology	
Phy3.2.3.8	3	Relates the principles of electromagnetism to the workings of the model	Only states one principle	States two or more principles without linking directly to where they apply in the model	States two or more principles and links all of them to the working of the model	

Note that it is expected that students who successfully complete this sub-strand are able to demonstrate all of the above learning outcomes; however only selected learning outcomes will be assessed in Task 2 to contribute to its Internal Assessment weight of 15%. The breakdown will consist of 1xLevel 2, 3xLevel 3 and 1xLevel 4 learning outcomes.

APPENDIX

Appendix 1: List of Practical Investigation Topics

1. Investigations will cover the process from gathering primary data to reporting to find a relationship or trend.
2. Teacher guidance in setting the parameters for the investigation and providing background information may be sought, but students are to take the lead in the investigation.
3. Investigations are to be limited to the following concepts:
    1. inverse,
    2. inverse squared,
    3. squared
    4. square root relationships
    5. Centre of mass
    6. Rotational motion and conservation of energy

The following investigations are suitable for assessment purposes. Other investigations can be used but they must be related to the topics covered in this syllabus and comply to note 3 above.

1. To investigate the relationship between period of the motion of a pendulum and the length of the string. ($T = 2\pi\sqrt{\frac{l}{g}}$)
2. To investigate the relationship between period of the motion of a spring and the mass attached to the spring. ($T = 2\pi\sqrt{\frac{m}{k}}$)
3. To investigate the relationship between distance and the time for a trolley to travel down a ramp. ($d = \frac{1}{2}at^2$)
4. Bifilar pendulum (a horizontal rod or ruler that is supported by two vertical threads) how the period of oscillation when a rod is twisted horizontally about its centre point is affected by the distance between the suspension threads. ($T = \left(\frac{2\pi r\sqrt{l}}{\sqrt{3g}}\right)\frac{1}{D}$) where l is the length of the suspension cord; D is the separation between the threads; g is the acceleration due to gravity and r is the length of a rod. This theory assumes the set-up is symmetrical and that the rod is uniform and rotating horizontally about a fixed axis through its centre

5. Bifilar pendulum (a horizontal rod or ruler that is supported by two vertical threads) how the period of oscillation when a rod is twisted horizontally about its centre point is affected by the length of the suspension threads. ($T = \left(\frac{2\pi r\sqrt{l}}{\sqrt{3g}}\right)\frac{1}{D}$)

   where l is the length of the suspension cord; D is the separation between the threads; g is the acceleration due to gravity and r is the length of a rod. This theory assumes the set-up is symmetrical and that the rod is uniform and rotating horizontally about a fixed axis through its centre.

6. To investigate how the period, T of the cantilever is affected by the mass, m on the cantilever.

   The theoretical formula for the period of oscillation of a cantilever is $T = 2\pi\sqrt{\frac{ml}{3EI}}$. In the formula, the product EI is called the flexural rigidity and is a measure of how well the cantilever withstands stresses. This will need to be measured by the teacher for the particular cantilever for assessment.

7. To find the relationship between the mass of a stack of paper of muffin cups and the terminal velocity it reaches when it is dropped.

   The theory states that $v^2 = \frac{g}{k}m$ where g is the acceleration due to gravity, m is the mass of the cups, v the terminal velocity and k is the drag coefficient.

8. To investigate the centre of mass of various irregular objects and a system of masses and how the centre of mass varies with change of radius.

9. To investigate the basic concepts of rotational motion such as torque and moment of inertia and to validate the conservation of energy law.

Appendix 2: Formula Sheet

Mechanics

Translational Motion

1. $v_f = v_i + at$
2. $d = v_i t + \frac{1}{2}at^2$
3. $v_f^2 = v_i^2 + 2ad$
4. $d = \left(\frac{v_i + v_f}{2}\right)t$
5. $F = ma$
6. $E_k = \frac{1}{2}mv^2$
7. $E_p = mgh$
8. $W = Fd$
9. $E_p = \frac{1}{2}kx^2$
10. $P = \frac{W}{t}$
11. $p = mv$
12. $F_w = mg$

Circular and Rotaional Motion

13. $v = \frac{2\pi r}{T}$
14. $a = \frac{v^2}{r}$

Mechanics (continued)

15. $F = \frac{mv^2}{r}$
16. $a = \frac{4\pi^2 r}{T^2}$
17. $v = \sqrt{rg\tan\theta}$
18. $F_g = \frac{GMm}{r^2}$
19. $v = \sqrt{\frac{GM}{r}}$
20. $v = \sqrt{\frac{2GM}{r}}$
21. $\theta = \frac{d}{r}$
22. $\omega = \frac{\Delta\theta}{\Delta t}$
23. $\alpha = \frac{\Delta\omega}{\Delta t}$
24. $a = r\alpha$
25. $\omega_f = \omega_i + \alpha t$
26. $\theta = \omega_i t + \frac{1}{2}\alpha t^2$

Mechanics (continued)

27. $\omega_f^2 = \omega_i^2 + 2\alpha\theta$
28. $\theta = \left(\frac{\omega_f + \omega_i}{2}\right)t$
29. $\tau = Fr$
30. $\tau = I\alpha$
31. $L = I\omega$
32. $L = mvr$
33. $E_{kr} = \frac{1}{2}I\omega^2$
34. $T = \frac{1}{f}$, $f = \frac{1}{T}$
35. $\omega = 2\pi f$, $\omega = \frac{2\pi}{T}$
36. $E_k = \frac{GMm}{2r}$
37. $U = -\frac{GMm}{r}$
38. $g = \frac{GM}{r^2}$

Simple Harmonic Motion

1. $v_{max} = \omega A$
2. $v = \omega\sqrt{A^2 - x^2}$
3. $a_{max} = -\omega^2 A = \frac{k}{m}A$
4. $a = -\omega^2 y$
5. $y = A\sin\omega t$
6. $v = \omega A\cos\omega t$
7. $a = -\omega^2 A\sin\omega t$
8. $F = kx$
9. $T = 2\pi\sqrt{\frac{m}{k}}$, $f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$
10. $T = 2\pi\sqrt{\frac{l}{g}}$, $f = \frac{1}{2\pi}\sqrt{\frac{g}{l}}$
11. $E = \frac{1}{2}kA^2$
12. $E = \frac{1}{2}m\omega^2 A^2$
13. $v = f\lambda$

Waves

1. $f' = \left(\frac{v \pm v_0}{v \mp v_s}\right)f$
2. d=1/N

Waves (continued)

3. $\omega = 2\pi f$
4. $k = \frac{2\pi}{\lambda}$
5. Path Difference $= n \times \lambda$
6. $d\sin\theta = n\lambda$
7. $n\lambda = \frac{dx}{L}$

Electricity and Electromagnetism

DC circuits and capacitance

1. $E = \frac{F}{q}$
2. $E = \frac{k_e Q}{d^2}$
3. $W = Vq$
4. $V = \frac{kQ}{r}$
5. $V = Ed$
6. $C = \frac{Q}{\Delta V}$

Electricity and Electromagnetism (continued)

7. $C = \dfrac{\varepsilon_r \varepsilon_0 A}{d}$
8. $C_p = C_1 + C_2 + \ldots$
9. $\dfrac{1}{C_s} = \dfrac{1}{C_1} + \dfrac{1}{C_2} + \ldots$
10. $\tau = RC$
11. $U = \dfrac{1}{2}QV$ $= \dfrac{1}{2}CV^2$ $= \dfrac{Q^2}{2C}$
12. $I = \dfrac{\Delta Q}{\Delta t}$
13. $V = IR$
14. $\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \ldots$
15. $R_s = R_1 + R_2 + \ldots$
16. $E = \rho J$

Electricity and Electromagnetism (continued)

17. $P = VI = I^2R = \dfrac{v^2}{R}$

Electromagnetic Induction

1. $F = Bvq$
2. $v = \dfrac{E}{B}$
3. $F = BIl\sin\theta$
4. $\tau = BANI\cos\theta$
5. $F = \dfrac{kI_1I_2\, l}{r}$
6. $B = \dfrac{\mu_0 I}{2\pi r} = \dfrac{kI}{r}$
7. $r = \dfrac{mv}{Bq}$

Electricity and Electromagnetism (continued)

Alternating Current Circuits

1. $V = Bvl\sin\theta$
2. $\phi_B = BA\cos\theta$
3. $\varepsilon = -L\dfrac{dI}{dt}$
4. $E_L = \dfrac{1}{2}LI^2$
5. $V = \dfrac{-\Delta\phi}{\Delta t}$
6. $V_{rms} = \dfrac{V_{max}}{\sqrt{2}}$
7. $I_{rms} = \dfrac{I_{max}}{\sqrt{2}} = \dfrac{V_{rms}}{R_T}$
8. $V = BAN\omega\sin\omega t$

Electromagnetic Induction and Alternating Current Theory (continued)

9. $V = \dfrac{-M\Delta I}{\Delta t}$
10. $V = -L\dfrac{\Delta I}{\Delta t}$
11. $V_C = I\chi_C$
12. $\chi_C = \dfrac{1}{2\pi fC} = \dfrac{1}{\omega C}$
13. $Z = \dfrac{V_s}{I}$
14. $V_L = I\chi_L$
15. $\chi_L = 2\pi fL = \omega L$
16. $Z = \sqrt{R^2 + (\chi_L - \chi_C)^2}$
17. $P_f = \cos\phi = \dfrac{R}{Z}$
18. $f_o = \dfrac{1}{2\pi\sqrt{LC}}$
19. $\tan\phi = \dfrac{\chi_L - \chi_c}{R}$

Atomic and Nuclear Physics

1. $E = hf$
2. $E_k = eV$
3. $E_k = hf - \phi$
4. $\dfrac{1}{\lambda} = R\left(\dfrac{1}{n_f^{\,2}} - \dfrac{1}{n_i^{\,2}}\right)$
5. $c = f\lambda$
6. $E_n = \dfrac{-hcR}{n^2}$ $= \dfrac{-13.6\,eV}{n^2}$
7. $\lambda = \dfrac{h}{mv}$
8. $L = \dfrac{nh}{2\pi}$
9. $v = \dfrac{nh}{2\pi mr}$

Appendix 3: IA Programme Proposal Template

FULL IA PROGRAM

_

Page 1: COVER PAGE

xxxxxx SEC SCHOOL **SPFSC 2020** **Xxxxx (subject): FULL IA PROGRAM** Name:

Page 2: INSERT IA SUMMARY FORM HERE

(To be completed, signed by both the teacher and the School Principal of his/her Nominee/school stamped/scan/insert)

Pages 3-6:

1 **Task title: Task 1:__________________________**

The title should be brief and include a reference to the particular syllabus topic or skill which is being assessed by the task.

Example: *"Research Topic – Investigation of a Social Issue."*

2 **Learning Outcomes: List the Specific Learning Outcomes (SLOs) to be assessed by the task**

These are found in the syllabus and need to be identified before the tasks are constructed.

Example: *Describe a feature of ….*

(Copy and paste directly from the aligned Syllabus: it must show strand, sub strand and SLOs)

3. **Assessment/Task:**

Describe the task as a form of assessment to measure student achievements of the above learning outcomes at different stages of the lesson/task implementation.

(Think of what are the best types of assessment for the above LOs so that your students can demonstrate they have achieved the learning outcomes. Also include how you will pre-assess their knowledge at the beginning of the lesson and how you will continuously assess them throughout the strand/topic to monitor their learning progress. The summative assessments are the final IA tasks.)

e.g. Diagnostic: *(can be oral questions/short tests/ surveys/questionnaires to find out what students already know before the lesson)*

Formative: 1. This is the formative use of the summative assessment such as the drafts submitted, self-assessment, peer assessment, teacher assessment of the drafts and specific feedback provided to improve the task. 2. For CATs – this can be similar items prepared by teachers using the SLOs and given to students for practice. After scoring, the feedback needs to be given to improve learning. If majority students not doing well then re-teach using another strategy, assess and monitor learning.

Summative: (these are the final IA tasks or the CATs to measure how much the students have learnt/achieved after the learning period)

4 Resources: List materials required for completing the task (for learning & demonstrating the achievement for the SLOs.

This must specify any material items such as books, documents, maps, stimulus material, equipment required by the task, including use of technology.

5 Guidelines for the teacher on advance preparation requirements

a) **time required** by the student for task completion (monitoring progress)
b) recommended dates/date range for task completion
c) organization of room and hardware to facilitate task completion (learning assessment).

(After the task has been completed and scored, teachers will need an IA score capture sheet to record the performance of all students in the class.)

6 Guidelines for the teacher on task completion and task control

This must specify:

- the role of the teacher during the period of task completion
- instructions that are to be given by the teacher to the students
- actions that are required of the teacher during task completion

7 Preparation by the students beforehand

If students are required to prepare in advance of the task date, preparatory notes must indicate the requirements. For example, students may need to collect support materials for a task that is supervised in a classroom.

8 Task outline for the student

This outline is a brief description of the task that the student is to complete. It is a general description without specific detail.

Example: *Your task is to focus on an important social issue. After investigating that issue, you need to process information collected and suggest possible courses of action that authorities could take.*

9 Task detail for the student

This must provide a detailed description of the task in the sequence that the student would be expected to follow during task completion. This must clearly state:

- what the student is expected to do
- what the student is expected to record and present for assessment.

10. Feedback & Support

Allocate time for:

i. Student's self-assessment and correction
ii. Peer assessment, feedback, and time for improvement
iii. Teacher assessment, feedback, and time for time improvement

(NB: State how this will be carried out)

11. Final submission & scoring

State when the final task is due and how it will be assessed. State how the school (HOD/SPFSC Coordinator) will monitor the scoring of the tasks.

12 Scoring Rubric

Copy and paste directly from the aligned Syllabus the relevant scoring rubrics

13 Assessment score capture sheet for the task

This will be provided by EQAP

(Repeat 1-13 for other tasks)

Appendix 4: IA Summary Form

SOUTH PACIFIC FORM SEVEN CERTIFICATE
INTERNAL ASSESSMENT SUMMARY FORM
PHYSICS

Country: ______________________ School: __________________________________

Task	Brief Description	Assessment date	Weighting
1. Practical Investigation			15%
2. Model Development			15%
Notes:			
		Total	30%

Note:

1. Be specific about dates, not just Week 3 Term 1, etc.
2. Ensure that the topic for the Practical Investigation relates to the syllabus.
3. Assessment schedules are provided in **Appendix 3 and 4**, and <u>must</u> be used for the assessment of the investigation.
4. If more than two investigations were carried out use the area labelled notes to describe the extra investigations and dates of assessment.
5. **Score Capture Forms will be sent to schools from EQAP and student results for IA Tasks 1 and 2 are to be entered directly on to those Score Capture Sheets**

Teacher's Name and Signature: ………………………………………………………..

Principal's Name and Signature: ……………………………..………………………

Advisory Section

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. These are not directly prescribed in this syllabus but are expected to be part of the teaching and learning experiences for students.

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 score for each student shall be forwarded to the Educational Quality and Assessment Programme by the liaison teacher or the principal, by the date specified by the Director, on the score capture sheet provided by EQAP. The principal or liaison teacher will certify that the syllabus requirements have been fulfilled.

Recommended Texts and Resources

1. Suggested Texts

(a) Possible Student Texts

The following texts are appropriate for this syllabus:

i) Physics Alive by R Campbell
ii) ESA Y13 Revision Guide by P. Bendall and P. Howison
iii) Senior School Physics by I. Jacobs
iv) Advanced Senior Physics by N. Barber and R. Osborne (no longer in print)
v) Year 13 Physics: Course Manual by Chris Rutter
vi) Physics-Year 13 by Trevor Castle, New Zealand Pathfinder Series

(b) Other texts

i) ESA Y13 Physics AME workbook by P Bendall
ii) ESA Y13 Physics Learning workbook by P Bendall
iii) Study Pass Reference notes – Y13 Physics www.studypass.co.nz

(c) Teacher resources

Conceptual Physics by Paul G Hewitt published by Pearson is an excellent resource textbook for teachers.

Websites:
NZ Institute of Physics www.nzip.org.nz
Institute of Physics www.iop.org
New Zealand Qualifications Authority (includes exemplar work similar to the standard expected by this syllabus) www.nzqa.govt.nz/Physics
NZ Ministry of Education www.tki.org.nz
NZ Curriculum Guides http://seniorsecondary.tki.org.nz/
NZ Assessment (NCEA)
http://www.tki.org.nz/e/community/ncea/ **Online Teaching applets**

- phet.colorado.edu
- https://www.sparknotes.com/psychology/psych101/sensation/section3/
- https://science.howstuffworks.com/science-videos.htm

Notes for Measurements and Graphs

(a) Students are required to give 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 can be applied when a measurement is repeated for increased accuracy. Alternative methods are acceptable but should be documented to ensure overall consistency.

(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 absolute uncertainty values.
(ii) Students will be expected to be able to draw best-fit lines for linear trends and an error line.

(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 SI 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.

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 internal assessment tasks.

Teaching Programme – SPFSC Physics

Week	Learning Outcomes	Syllabus Reference	Assessment
Term I/ Week			
1.	Explain Physical phenomena, concepts and principles relating to translational motion	1.1	
2.	Solve problems relating to translational motion	1.1	
3.	Explain Physical phenomena, concepts and principles relating to circular and rotational motion	1.2	
4.	Explain Physical phenomena, concepts and principles relating to circular and rotational motion	1.2	
5.	Solve problems relating to circular and rotational motion	1.2	
6.	Solve problems relating to circular and rotational motion	1.2	
7.	Explain Physical phenomena, concepts and principles relating to simple harmonic motion	1.3	
8.	Explain Physical phenomena, concepts and principles relating to simple harmonic motion	1.3	
9.	Solve problems relating to simple harmonic motion	1.3	
10.	Practical activities on Mechanics	1.1-1.3	
11.	Practical Investigation	1.4	IA Task 1
12.	Practical Investigation	1.4	
13.	Revision/ formative assessment/ term test		
Term II/ Week			
1	Explain Physical phenomena, concepts and principles relating to sound waves	2.1	
2	Solve problems relating to sound waves	2.1	
3	Explain Physical phenomena, concepts and principles relating to light waves	2.2	

4	Solve problems relating to light waves	2.2	
5	Explain Physical phenomena, concepts and principles relating to DC circuits and capacitance	3.1	
6	Explain Physical phenomena, concepts and principles relating to DC circuits and capacitance	3.1	
7	Solve problems relating to DC circuits and capacitance	3.1	
8	Explain Physical phenomena, concepts and principles relating to electromagnetic induction	3.2	IA Task 2 starts
9	Solve problems relating to electromagnetic induction	3.2	
10	Explain physical phenomena, concepts and principles relating to AC circuits	3.3	
11	Explain physical phenomena, concepts and principles relating to AC circuits	3.3	IA Task 2 ends
12	Practical activities on Waves and Electricity & Electromagnetism	2.1-3.3	
13	Revision/ formative assessment/ term test/ Common Assessment task	3.3	
Term III/ Week			
1	Solve problems relating to AC circuits	3.3	
2	Solve problems relating to AC circuits	3.3	
3	Explain Physical phenomena, concepts and principles relating to Atomic Physics	4.1	
4	Solve problems relating to Atomic Physics	4.1	
5	Solve problems relating to Nuclear Physics	4.2	
6	Practical activities on Atomic and Nuclear Physics Physics	2.1-3.3	
7-8	Revision and Study Week		
9-10	SPFSC Physics Final Examination		

The following formulae may be of use to you:

$F = ma$

$F = kx$

$E_p = ½kx^2$

$F = -ky$

$F\Delta t = m\Delta v$

$p = mv$

$\Delta p = Ft$

$W = Fd$

$v^2 = v_i^2 + 2ad$

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

$d = v_i t + ½at^2$

$v = v_i + at$

$F_g = \frac{GMm}{r^2}$

$F_c = \frac{mv^2}{r}$

$a = \frac{v^2}{r}$

$v = \frac{2\pi r}{T}$

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

$a = r\alpha$

$v = r\omega$

$\omega = \frac{\Delta\theta}{\Delta t}$

$\alpha = \frac{\Delta\omega}{\Delta t}$

$\omega = 2\pi f$

$\tau = I\alpha$

$L = I\omega$

$\tau = Fr$

$L = mvr_\perp$

$d = r\theta$

$\omega_f = \omega_i + \alpha t$

$\omega_f^2 = \omega_i^2 + 2\alpha\theta$

$\theta = \frac{(\omega_i + \omega_f)t}{2}$

$\theta = \omega_i t + ½\alpha t^2$

$E_{k(rot)} = ½I\omega^2$

$a = -\omega^2 y$

$P = VI$

$\phi = BA$

$\Delta E = Vq$

$Q = VC$

$\sum I = 0$

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

$C_{TOT} = C_1 + C_2 + ...$

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

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

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

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

$Z = \sqrt{R^2 + (X_L - X_C)^2}$

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

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

$X_L = \omega L$

$V = IZ$

$T = 2\pi\sqrt{\frac{l}{g}}$

$T = 2\pi\sqrt{\frac{m}{k}}$

$y = A\cos\omega t$

$v = -A\omega\sin\omega t$

$a = -A\omega^2\cos\omega t$

$y = A\sin\omega t$

$v = A\omega\cos\omega t$

$a = -A\omega^2\sin\omega t$

$E = ½QV$

$V = \varepsilon - IR$

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

$V = Ed$

$R_{TOT} = R_1 + R_2 + ...$

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

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

$\sum V = 0$

$\tau = RC$

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

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

$V = Blv$

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

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

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

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

$d\sin\theta = (n - ½)\lambda$

$d\sin\theta = n\lambda$

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

$f_b = |f_1 - f_2|$

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

$v = f\lambda$

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

$E = hf$

$hf = \phi + E_k$

$E = mc^2$

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

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

$\Delta E = |E_1 - E_2|$

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