No. 109/1

MARKER CODE		Student Personal Identification Number

South Pacific Form Seven Certificate

PHYSICS

2021

QUESTION and ANSWER BOOKLET

Time allowed: Three hours

(An extra 10 minutes is allowed for reading this paper.)

INSTRUCTIONS

Write your **Student Personal Identification Number (SPIN)** in the space provided on the top right-hand corner of this page.

Answer **ALL QUESTIONS**. Write your answers in the spaces provided in this booklet.

If you need more space for answers, ask the Supervisor for extra paper. Write your SPIN on all extra sheets used and clearly number the questions. Attach the extra sheets at the appropriate places in this booklet.

Major Learning Outcomes (Achievement Standards)	Skill Level & Number of Questions				Weight/ Time
	Level 1 *Uni-structural*	Level 2 *Multi-structural*	Level 3 *Relational*	Level 4 *Extended Abstract*	
Strand 1: Mechanics Demonstrate understanding of the physical phenomena, concepts, principles and relationships involved in mechanics.	7	7	3	-	30% 78min
Strand 2: Waves Demonstrate understanding of the physical phenomena, concepts, principles and relationships related to waves.	5	1	1	1	14% 36min
Strand 3: Electricity and Electromagnetism Demonstrate understanding by explaining and solving problems related to the physical phenomena, concepts, principles and relationships involved in electricity and electromagnetism.	3	1	2	-	11% 28min
Strand 4: Atomic and Nuclear Physics Demonstrate understanding of the physical phenomena, concepts, principles and relationships involved in atomic and nuclear physics.	4	2	1	1	15% 38min
TOTAL	**19**	**11**	**7**	**2**	**70% 180 min**

Check that this booklet contains pages 2–19 in the correct order and that none of these pages are blank.

HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

STRAND 1: MECHANICS

Assessor's use only

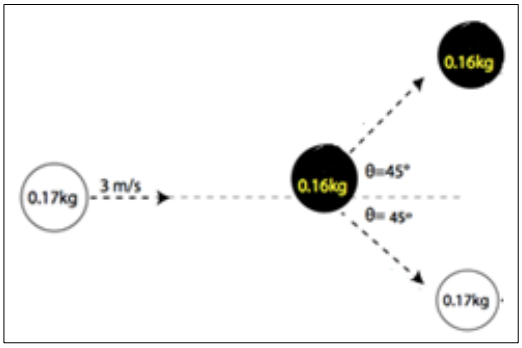
1.1	TRANSLATIONAL MOTION	
1.1a	**Circle the letter that represents the BEST answer**. **Impulse** is best defined as the product of _____. A. force and time B. mass and time C. force and velocity D. mass and velocity	**Unistructural** 1 0 NR
1.1b	As a ball rolls downhill, it gains momentum. State the relationship between momentum and velocity. _____ _____ _____	**Unistructural** 1 0 NR
1.1c	A 0.65 kg soccer ball is moving to the right at a velocity of 10 ms^{-1}. John kicks the ball so that it has a final velocity of 15 ms^{-1} in the same direction. Calculate the impulse on the soccer ball. _____ _____ _____ _____ _____	**Multistructural** 2 1 0 NR
1.1d	Two trolleys, A and B, are placed on a frictionless runway some distance apart. Trolley A is loaded with extra masses to make it heavier than trolley B. Trolley A is given a push so that it moves forward with a uniform velocity and collides with Trolley B which is at rest. Describe qualitatively the above collision, assuming a perfectly elastic collision. _____ _____ _____ _____ _____	**Multistructural** 2 1 0 NR

Assessor's use only

1.1e Define **inelastic collision**.

Unistructural	
1	
0	
NR	

1.1f

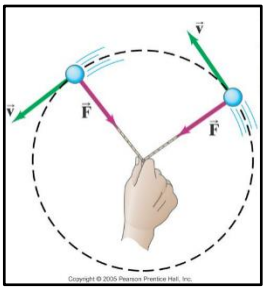
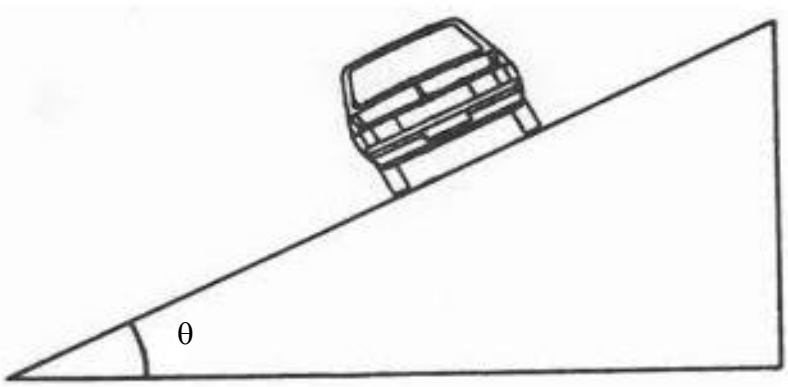


Peter strikes a white ball of mass 0.17 kg, giving it a velocity of 3 ms^{-1} in the direction shown above. When the white ball strikes the black ball, of mass 0.16 kg, which was previously at rest, the two balls deflect at right angles to each other.

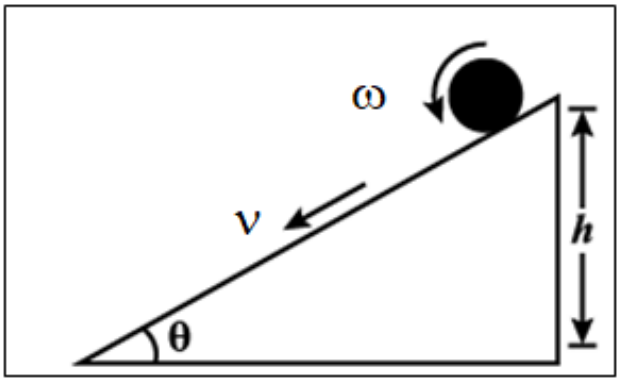
Determine the speed of the white ball and the black ball after the collision.

Relational	
3	
2	
1	
0	
NR	

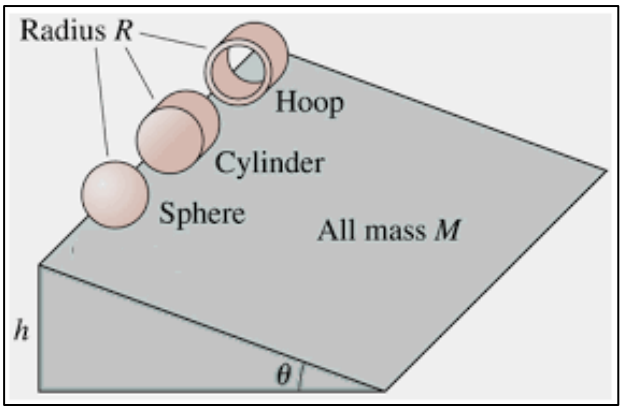
Assessor's use only

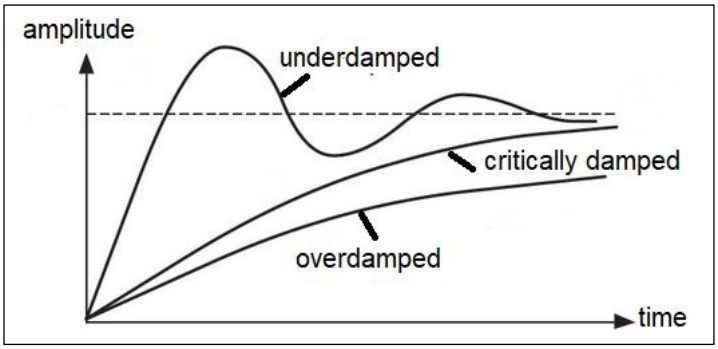
1.2	**CIRCULAR AND ROTATIONAL MOTION**	
1.2a	Consider a mass attached to the end of a string and whirled around in a horizontal circle as shown in the diagram on the right. Identify the type of force supplying the centripetal force acting on the mass. _____ _____ _____ 	**Unistructural** 1 | 0 | NR
	Use the information given below to answer questions 1.2b and 1.2c. Given below is a diagram of a car traveling around a bend of radius 20 m with a 25° banking.	
1.2b	On the diagram, draw all the forces acting on the car as it travels along the banked curve, assuming that there is no frictional force between the car and the road. Indicate the forces by means of arrows. 	**Multistructural** 2 | 1 | 0 | NR

Assessor's use only

1.2c	If the car and its driver have a combined mass of 1200 kg, calculate the car's maximum speed without slipping off the road.	**Multistructural** 2 1 0 NR
1.2d	An 8 kg ball rolls from rest down a slope without slipping and onto a horizontal surface. If the rotational inertia of the ball is 1.02 kgm^2 and its angular speed and linear velocity at the end of the slope are 26.4 $rads^{-1}$ and 10.54 ms^{-1} respectively, calculate the total energy gained by the ball. 	**Multistructural** 2 1 0 NR

Assessor's use only

1.2e	A child rides a bike in a circle of radius 8.6 m at a speed of 5 ms^{-1}. Calculate the angular velocity of the bike. _____ _____ _____ _____ _____ _____ _____ _____	**Multistructural** 2 | 1 | 0 | NR |	
1.2f	When all the objects are released together as shown in the diagram below, the sphere will always reach the bottom of the slope first, followed by the solid cylinder, with the hoop or hollow cylinder last.  *Source*: *https://www.phys.hawaii.edu/~morse/P170Af13-24.pdf* Explain how rotational inertia affects the motion of sphere. _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	**Relational** 3 | 2 | 1 | 0 | NR |	

1.3	**SIMPLE HARMONIC MOTION**	*Assessor's use only*
1.3a	Simple harmonic motion (SHM) is an oscillatory motion. If we draw a displacement versus time graph for SHM, we get a sine curve. State the SHM equation for displacement. _____ _____ _____	**Unistructural** 1 0 NR
1.3b	The acceleration of an object in SHM is zero when velocity is greatest, i.e. when displacement is zero. It is the greatest when velocity is zero, i.e. when displacement is a maximum. State the SHM equation for acceleration. _____ _____ _____	**Unistructural** 1 0 NR
1.3c	All real mechanical systems do not oscillate indefinitely because forces of friction retard or dampen the motion. A system can be underdamped, critically damped or overdamped, as shown in the diagram below.  Define **overdamped oscillation**. _____ _____ _____ _____	**Unistructural** 1 0 NR

Assessor's use only

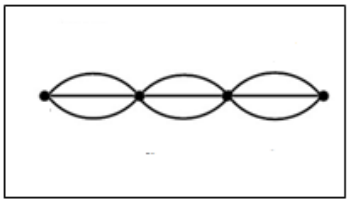
1.3d	Calculate the angular frequency of a 1 kg mass hanging on a spring with a force constant 10 Nm^{-1}.	**Multistructural** 2 1 0 NR
1.3e	A spring stretches 4.1 cm when a 10 g object is hung from it. The object is replaced with a block of mass 25 g which oscillates in simple harmonic motion. Calculate the period of motion.	**Relational** 3 2 1 0 NR

STRAND 2: WAVES

Assessor's use only

2.1	WAVE PROPERTIES	
2.1a	**Circle the letter that represents the BEST answer**. _____ is defined as the maximum distance from the equilibrium (rest) position that the particle of a medium moves, due to pulse or wave. A. Amplitude B. Wavelength C. Wave factor D. Phase angle	**Unistructural** 1 0 NR
2.1b	Define **diffraction**. _____ _____ _____ _____	**Unistructural** 1 0 NR
2.1c	A wave is a disturbance that transfers energy through matter or space. List **two** variables that affect wave speed. _____ _____ _____ _____ _____ _____	**Multistructural** 2 1 0 NR

Assessor's use only

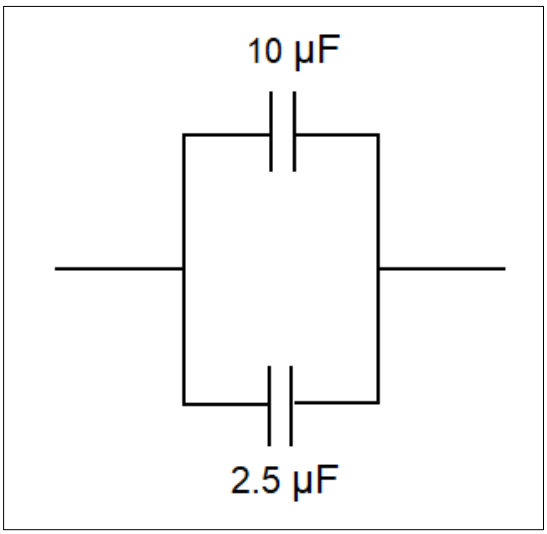
2.1d	In a Young's experiment, a pair of parallel narrow slits are 0.10 cm apart placed 2.0 m in front of a screen are illuminated with monochromatic light of 671 nm. How far is the third bright fringe from the central maxima on the screen? _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	**Relational** 3 2 1 0 NR
2.2	**SOUND WAVES**	
2.2a	The diagram below shows a standing wave formed by forced vibrations of a string.  Define **standing wave**. _____ _____ _____	**Unistructural** 1 0 NR
2.2b	Resonance is an important concept in oscillatory motion. Define **resonant frequency**. _____ _____ _____ _____	**Unistructural** 1 0 NR

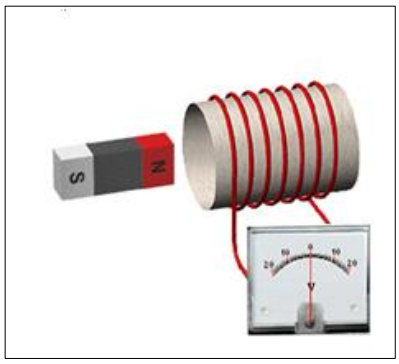
Assessor's use only

2.2c	Predict with reasons, how changes in the medium of wave travel will affect the speed of sound wave.	**Extended Abstract** 4 3 2 1 0 NR
2.2d	Define the **Doppler effect**.	**Unistructural** 1 0 NR

STRAND 3: ELECTRICITY AND ELECTROMAGNETISM

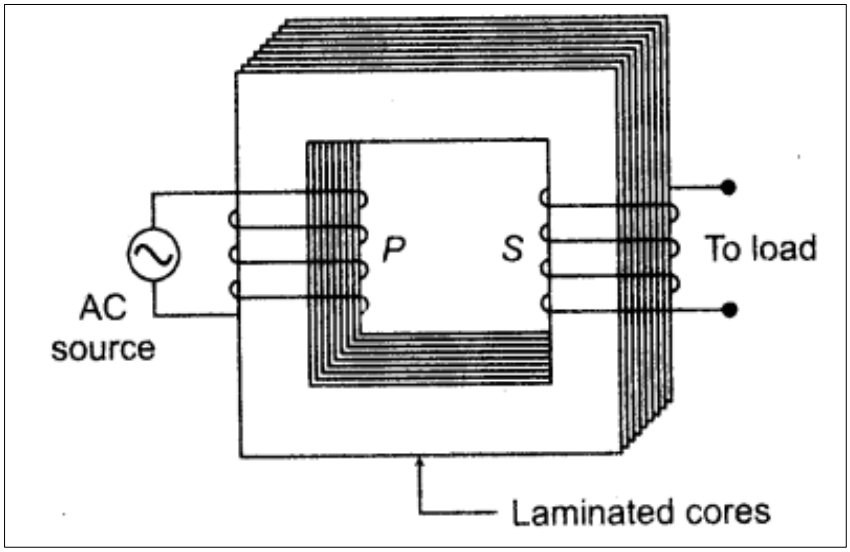
Assessor's use only

3.1	DC CIRCUITS AND CAPACITANCE	
3.1a	Define **capacitance**. _____ _____ _____	**Unistructural** 1 0 NR
3.1b	State **Kirchhoff's Current Law**. _____ _____ _____	**Unistructural** 1 0 NR
3.1c	The diagram below shows part of a circuit where two capacitors are connected parallel to each other. Calculate the effective capacitance of the circuit.  _____ _____ _____ _____ _____ _____ _____ _____	**Multistructural** 2 1 0 NR

3.2	**ELECTROMAGNETIC INDUCTION**	*Assessor's use only*
3.2a	When a conductor is rotated in a magnetic field, emf is induced. Faraday discovered that the induced emf equals the rate of change of magnetic flux.  *Source*: *https://www.daenotes.com/electronics/basic-electronics/faraday-laws-of-electromagnetic-induction* Define **magnetic flux**. _____ _____ _____ _____	**Unistructural** 1 0 NR

Assessor's use only

3.2b Given below is a diagram of a demonstration transformer.



Source: *https://www.learncbse.in/important-questions-for-class-12-physics-cbse-ac-devices/*

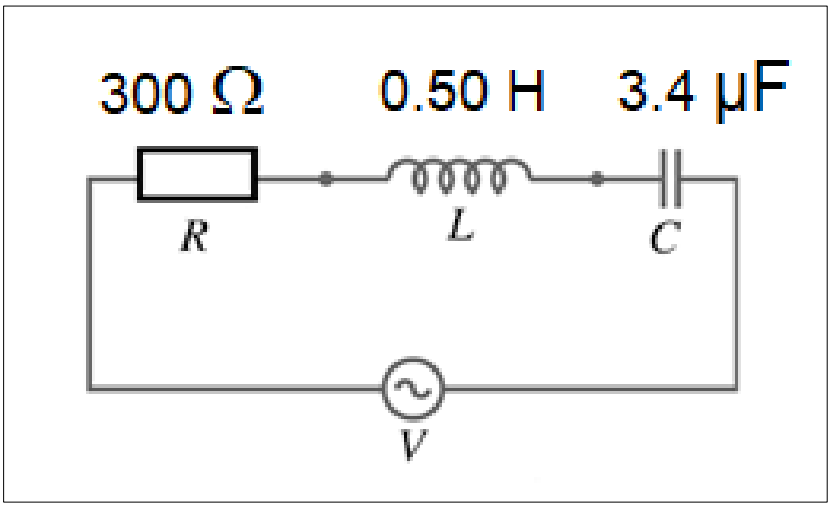
Explain how a transformer works.

Relational	
3	
2	
1	
0	
NR	

3.3	**AC CIRCUITS**	*Assessor's use only*

3.3a

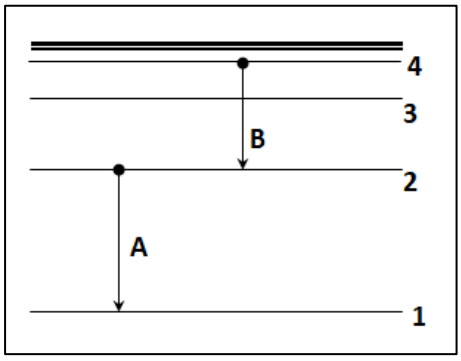
An inductor (L = 0.50 H), a capacitor (C = 3.4 μF) and a resistor (R = 300 Ω) are connected in series to a 150 V, 60 Hz power supply, as shown in the diagram below.



Using a phasor diagram or otherwise, determine the phase angle.

Relational	
3	
2	
1	
0	
NR	

STRAND 4: ATOMIC AND NUCLEAR PHYSICS

4.1	**ATOMIC PHYSICS** *Assessor's use only*	
4.1a	Ionisation energy is the minimum amount of energy required to remove an electron from an isolated atom. 1.50 eV 3.43 eV 13.6 eV 19.7 eV From the list above, identify the ionisation energy of a hydrogen atom. _____ _____ _____	**Unistructural** 1 0 NR
	Use the information given below to answer questions 4.1b and 4.1c. The diagram shows possible jumps of the electron from a higher to a lower state in a hydrogen atom.  	
4.1b	Identify the type of electromagnetic energy or part of the spectrum that is emitted by the electron jump in A. _____ _____ _____	**Unistructural** 1 0 NR

Assessor's use only

4.1c

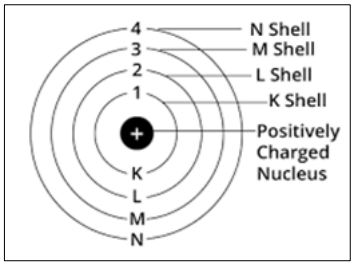
The frequency of the photon emitted by jump B is 4.57×10^{14} Hz .

Determine the wavelength of the photon. (speed of light = 3×10^{8} ms^{-1})

Multistructural	
2	
1	
0	
NR	

4.1d

Bohr model of the atom was proposed by Neil Bohr in 1915. It came into existence with the modification of Rutherford's model of an atom.



Source: https://byjus.com/chemistry/bohrs-model/

Discuss the postulates and limitations of Bohr's theory.

Extended Abstract	
4	
3	
2	
1	
0	
NR	

Assessor's use only

4.2	**NUCLEAR PHYSICS**	
	Use the information given below to answer questions 4.2a and 4.2b. Unlike nuclear fission reactions, the universe is full of instances of nuclear fusion reactions. Every star uses them to produce energy.	
4.2a	Define **nuclear fusion.** _____ _____ _____ _____	**Unistructural** 1 0 NR
4.2b	Define **nuclear fission.** _____ _____ _____ _____	**Unistructural** 1 0 NR
4.2c	Uranium, U, atomic number 92, and mass number 238, is a radioactive chemical element. It emits an alpha particle and thereby changes into another element, Thorium, Th. Balance the nuclear equation below for the radioactive decay described above. $^{238}_{92}U \rightarrow \quad Th +$ _____ _____	**Multistructural** 2 1 0 NR

Assessor's use only

4.2d	There are two types of nuclear chain reactions; controlled and uncontrolled reactions. Differentiate between controlled and uncontrolled reactions. _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	**Relational** 3 2 1 0 NR

THE END