No. 109/1

MARKER CODE

Pacific Community
Communauté du Pacifique

EQAP

Student Personal Identification Number						

South Pacific Form Seven Certificate

PHYSICS

2022

QUESTION and ANSWER BOOKLET

Time allowed: Three hours

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

INSTRUCTIONS

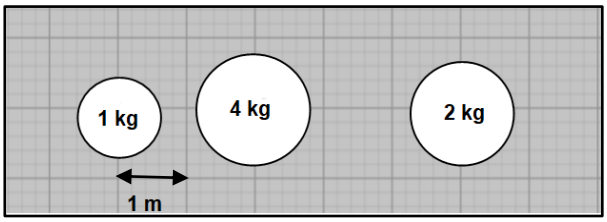
1. Write your **Student Personal Identification Number (SPIN)** in the space provided on the top right-hand corner of this page.
2. Answer **ALL QUESTIONS**. Write your answers in the spaces provided in this booklet.
3. If you need more space for answers, ask the Supervisor for extra paper. Write your 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 an understanding of the physical phenomena, concepts, principles and relationships involved in mechanics.	7	7	3	-	30% 78min
Strand 2: Waves Demonstrate an understanding of the physical phenomena, concepts, principles and relationships related to waves.	5	1	1	1	14% 36min
Strand 3: Electricity and Electromagnetism Demonstrate an 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 an 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 2–18 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

1.1	TRANSLATIONAL MOTION	*Assessor's use only*
1.1a	**Circle the letter that represents the BEST answer**. The point on an object where the total mass acts as if it is concentrated is called the _____. A. pivot B. centre of mass C. equilibrium point D. centre of rotation	**Unistructural** 1 ☐ 0 ☐ NR ☐
1.1b	Given below is a system of three shotput balls. With the 1 kg mass as the reference point, calculate the centre of mass of the system.  	**Multistructural** 2 ☐ 1 ☐ 0 ☐ NR ☐
1.1c	In any collision, momentum is conserved. Define **momentum**.	**Unistructural** 1 ☐ 0 ☐ NR ☐
1.1d	Calculate the speed of a 580 g basketball that has a momentum of 5.8 $kgms^{-1}$.	**Multistructural** 2 ☐ 1 ☐ 0 ☐ NR ☐

Assessor's use only

1.1e With reference to Newton's Third Law, explain why momentum is conserved in any collision.

Relational	
3	
2	
1	
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NR	

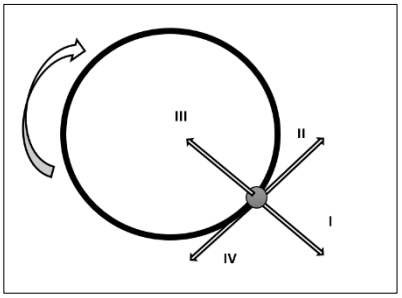
1.2 CIRCULAR AND ROTATIONAL MOTION

1.2a **Circle the letter that represents the BEST answer**.

Uniform circular motion involves objects that are moving in a circle and travelling at a constant speed.

With reference to the diagram given on the right, identify the number that represents **centripetal force**.

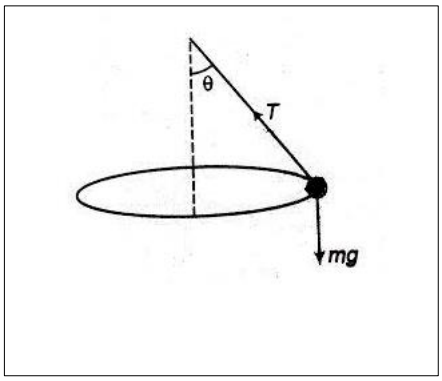
A. I
B. II
C. III
D. IV



Unistructural	
1	
0	
NR	

1.2b A conical pendulum is an example of a horizontal circular motion.

On the figure given below, draw arrow diagrams to indicate the forces of tension and weight that are acting on the object.

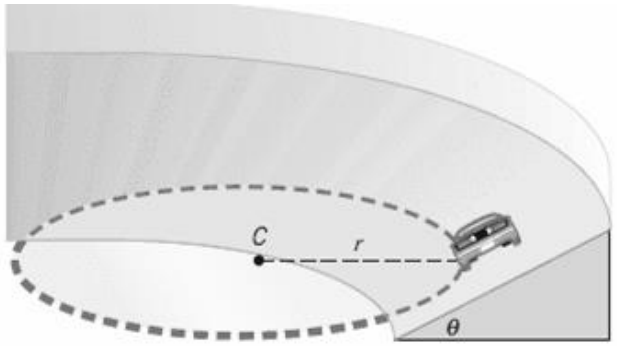


Multistructural	
2	
1	
0	
NR	

Assessor's use only

1.2c

The diagram below shows a car of mass 1500 kg travelling around a circular bend of radius 75 m and with 20º banking.



Calculate the maximum speed the car can go around this bend.

Multistructural	
2	
1	
0	
NR	

1.2d

A girl of mass 35 kg stands on the outside rim of a playground roundabout as shown in the diagram.

If the girl is 3 m from the centre and the roundabout rotates at a constant speed of 2.8 rad s^{-1}, calculate the angular momentum of the girl.

Source: dreamstime.com

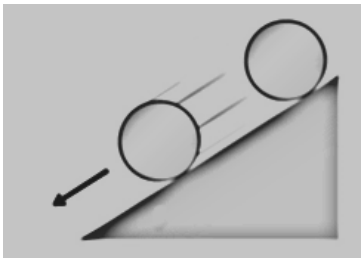
Multistructural	
2	
1	
0	
NR	

Assessor's use only

1.2e

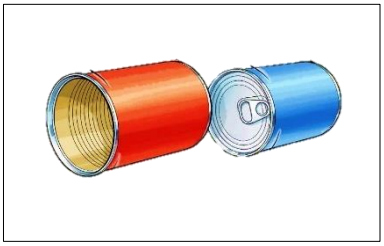
A solid sphere rolls down a slope as shown in the diagram below.

Describe the energy changes that take place using both rotational and translational energy.



Multistructural	
2	
1	
0	
NR	

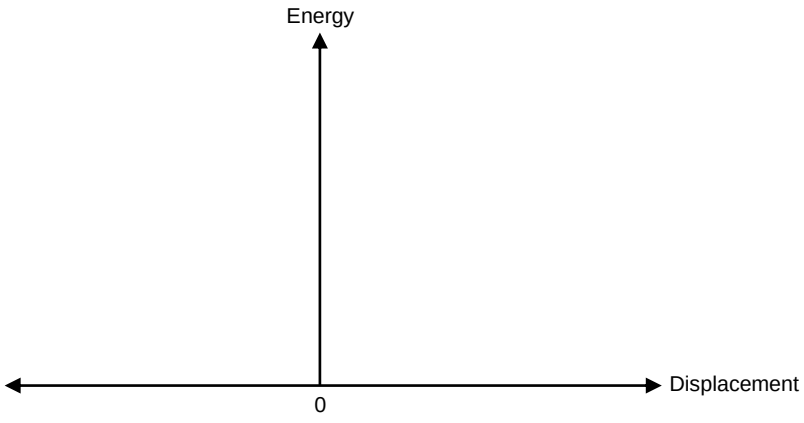
1.2f



A solid cylinder and a hollow cylinder are shown above.

Explain how mass, radius and internal structure of the two cylinders, can be used to describe their rotational inertia.

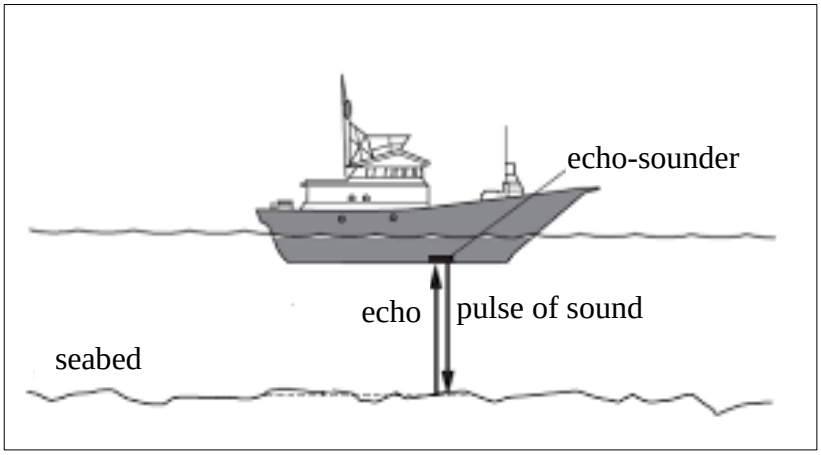
Relational	
3	
2	
1	
0	
NR	

1.3	**SIMPLE HARMONIC MOTION**	*Assessor's use only*
1.3a	Simple harmonic motion (SHM) is a special type of repetitive motion. State the SHM equation for velocity. _____ _____ _____	**Unistructural** 1 0 NR
1.3b	When the object undergoing SHM passes through the equilibrium position, it will have a maximum velocity. State the SHM equation for maximum velocity. _____ _____ _____	**Unistructural** 1 0 NR
1.3c	An object undergoing SHM, completes 10 vibrations in 2 seconds. Calculate the angular frequency of the object. _____ _____ _____ _____ _____	**Multistructural** 2 1 0 NR
1.3d	The total energy of an SHM is constant and is the sum of its potential energy and kinetic energy. On the Energy versus Displacement axes given below, draw the potential energy, kinetic energy and total energy using graphs and correct labels.  	**Relational** 3 2 1 0 NR

Assessor's use only

1.3e	All real mechanical systems do not oscillate indefinitely because energy is always lost as damped SHM. Define **critically damped oscillation**. _____ _____ _____ _____	**Unistructural** 1 0 NR
1.3f	Anna sits in front of a piano and sings a loud brief note. She was shocked to hear the piano singing the same note back at her. Her teacher explained that this is an effect of forced vibrations. Define **forced vibrations**. _____ _____ _____ _____	**Unistructural** 1 0 NR

STRAND 2: WAVES

2.1	**WAVE PROPERTIES**	*Assessor's use only*
2.1a	**Circle the letter that represents the BEST answer**. _____ is defined as the distance between adjacent pulses in a wave. A. Amplitude B. Wavelength C. Wave factor D. Phase angle	**Unistructural** 1 | 0 | NR |
2.1b	**Circle the letter that represents the BEST answer**. The bending of a wave around the edges of an opening or an obstacle is called _____. A. dispersion B. diffraction C. refraction D. interference	**Unistructural** 1 | 0 | NR |
2.1c	**Use the diagram below to answer the question that follows.**  To calculate the depth of the sea, a ship sends out a sound wave (as shown in the diagram) and receives an echo after 1 second. If the speed of sound in water is 1500 ms^{-1}, how deep is the water? _____ _____ _____ _____ _____	**Multistructural** 2 | 1 | 0 | NR |

Assessor's use only

2.1d	Yellow sodium light of wavelength 590 nm is shone through a double slit arrangement onto a screen 0.55 m away. The slit separation is 0.037 mm. Calculate the distance from the third dark fringe to the central maxima on the screen. _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	**Relational** 3 2 1 0 NR
2.2	**SOUND WAVES**	*Assessor's use only*
2.2a	**Circle the letter that represents the BEST answer**. The superposition of two waves of the same frequency and amplitude moving in opposite directions to each other is called _____. A. sound wave B. standing wave C. transverse wave D. longitudinal wave	**Unistructural** 1 0 NR
2.2b	**Circle the letter that represents the BEST answer**. The natural frequency of an oscillating system is called _____. A. linear frequency B. driving frequency C. angular frequency D. resonant frequency	**Unistructural** 1 0 NR

Assessor's use only

2.2c

There are three ways to alter the frequency produced by a guitar string. These are:

- changing the length of the vibrating string with your finger;
- changing the heaviness (mass per metre) of the string; and
- changing the tension force in the string by turning the tuning pegs.

Predict, with reasons, how these changes affect the frequency of sound of a stretched string.

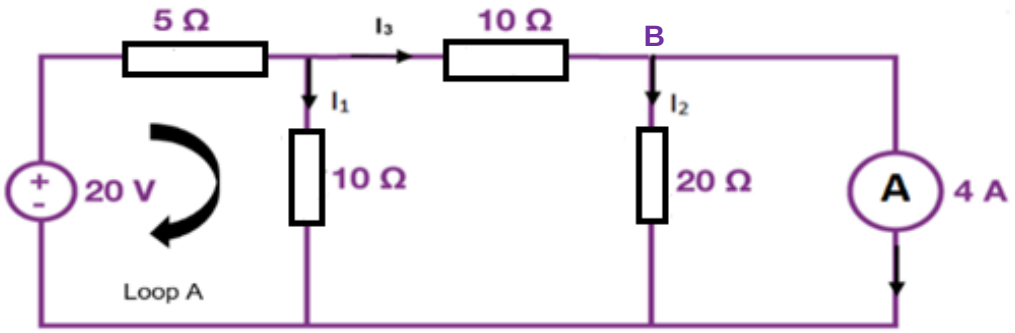
Extended Abstract	
4	
3	
2	
1	
0	
NR	

2.2d

Two tuning forks that have frequencies of 460 and 464 Hz, respectively, are struck simultaneously. Calculate the beat frequency.

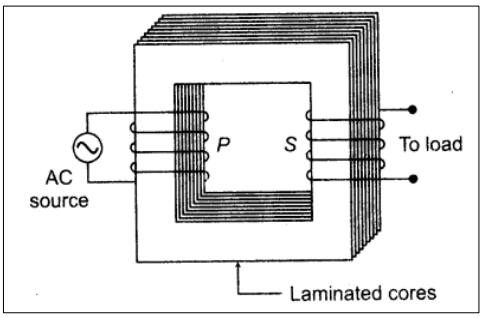
Unistructural	
1	
0	
NR	

STRAND 3: ELECTRICITY AND ELECTROMAGNETISM

3.1	DC CIRCUITS AND CAPACITANCE *Assessor's use only*	
	Use the information in the diagram below to answer questions 3.1a and 3.1b.  	
3.1a	With reference to junction B, write Kirchhoff's Current Law.	**Unistructural**: 1 ☐ 0 ☐ NR ☐
3.1b	Use Kirchhoff's Voltage Law to write an equation for the potential difference around Loop A.	**Unistructural**: 1 ☐ 0 ☐ NR ☐
3.1c	A sheet of polystyrene of dielectric constant 2.5 is placed between two parallel plates of area 0.25 m^2. The plates are 2 mm apart. Calculate the capacitance of the plates, given that the absolute permittivity of free space is $\varepsilon_o = 8.85 \times 10^{-12}\ Fm^{-1}$.	**Relational**: 3 ☐ 2 ☐ 1 ☐ 0 ☐ NR ☐

3.2	**ELECTROMAGNETIC INDUCTION**	*Assessor's use only*

3.2a Given below is a schematic diagram of a transformer.



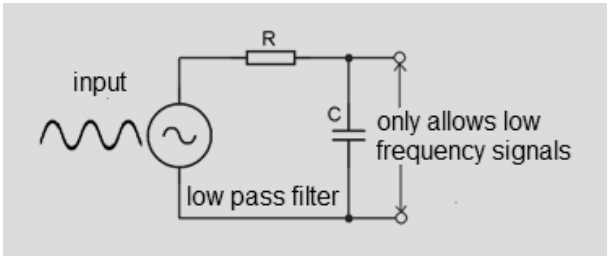
Source: *https://www.learncbse.in/important-questions-for-class-12-physics-cbse-ac-devices/*

State the role of a transformer.

Unistructural	
1	
0	
NR	

3.3	**AC CIRCUITS**

3.3a The diagram below is of a low pass filter.



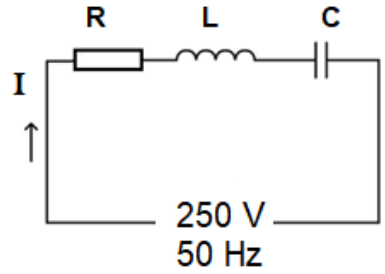
Source: *https://circuitdigest.com/tutorial/passive-low-pass-filter*

Explain how capacitors can filter-out low frequency signals.

Relational	
3	
2	
1	
0	
NR	

Assessor's use only

3.3b

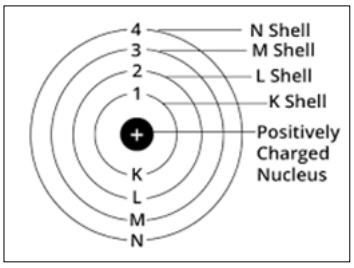
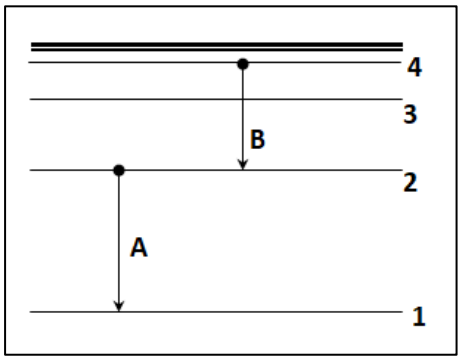


An RLC circuit with R = 20 Ω, L = 0.2 H and C = 80 μF are connected to an AC outlet of 250 V, 50 Hz as shown above.

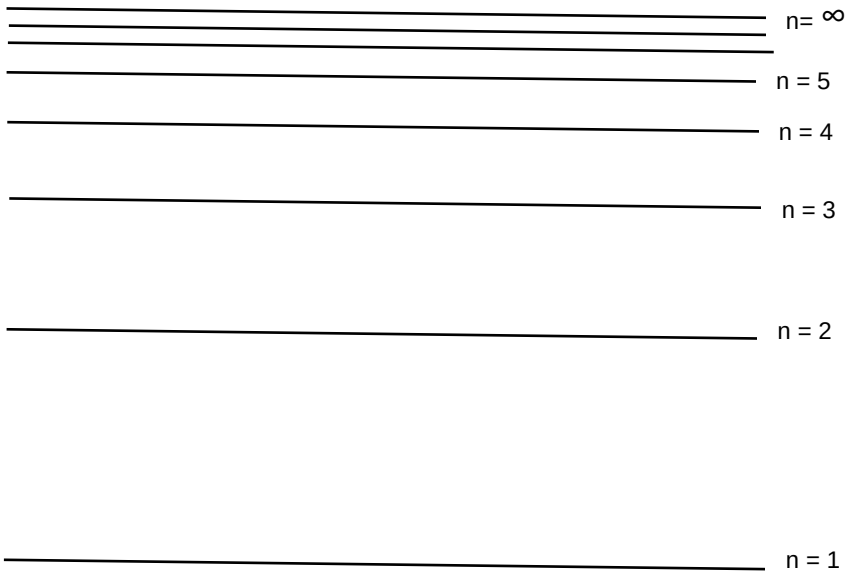
Calculate the total impedance of the circuit.

Multistructural	
2	
1	
0	
NR	

STRAND 4: ATOMIC AND NUCLEAR PHYSICS

4.1	ATOMIC PHYSICS	*Assessor's use only*
4.1a	Bohr's 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/* State **one** limitation of Bohr's theory. _____ _____ _____ _____	**Unistructural** 1 0 NR
	Use the information given below to answer question 4.1b. 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 B. _____ _____ _____	**Unistructural** 1 0 NR

Assessor's use only

4.1c	Describe the basic structure of the atom.	**Multistructural** 2 | 1 | 0 | NR |
4.1d	The diagram below shows a partially drawn energy level diagram of a hydrogen atom.  With the aid of the above diagram, illustrate the different energy states of Balmer, Brackett, Lyman and Paschen spectral lines.	

Assessor's use only

Relational	
3	
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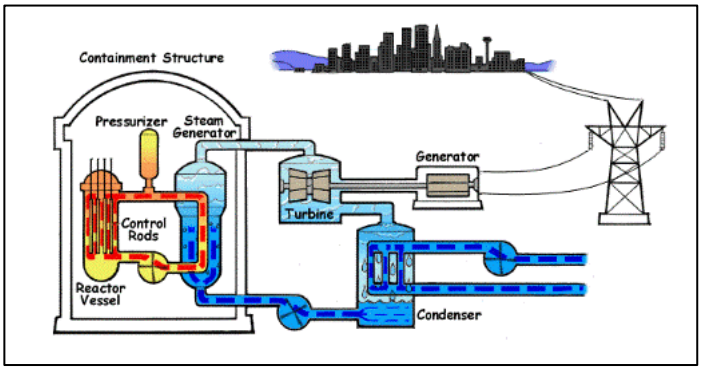
1	
0	
NR	

Assessor's use only

4.2	**NUCLEAR PHYSICS**	
	Use the information given below to answer questions 4.2a and 4.2b. I. A reaction in which a nuclide splits into two smaller nuclides and release energy. II. A reaction in which two smaller nuclides combine into one larger nuclide and release energy. III. A reaction in which a nucleus breaks apart and releases an alpha particle or beta particle or gamma radiation. IV. A process in which two nuclei, or a nucleus and an external subatomic particle, collide to produce one or more new nuclides.	
4.2a	Which of the above statements, I, II, III and IV best defines **nuclear fusion**? _____ _____	**Unistructural** 1 0 NR
4.2b	Which of the above statements, I, II, III and IV best defines **nuclear fission**? _____ _____	**Unistructural** 1 0 NR
4.2c	Actinium-225 of atomic number 89 is an isotope of actinium. It undergoes alpha decay to Francium-221 with atomic number 87. Balance the nuclear equation below for the radioactive decay that is described above. $^{225}_{89}Ac \rightarrow {}_{87}Fr +$ _____ _____	**Multistructural** 2 1 0 NR

Assessor's use only

4.2d The diagram given below is of a nuclear fission reactor.



Source: *https://www.pmfias.com/nuclear-fission-nuclear-reactor-types/*

A nuclear reactor is a system that contains and controls sustained nuclear chain reactions.

Discuss how fission fuel reacts in relation to what it produces and its impact on the environment.

Extended Abstract	
4	
3	
2	
1	
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NR	

THE END