

MARKER CODE


 Pacific
Community
Communauté
du Pacifique


Student Personal Identification Number

South Pacific Form Seven Certificate

PHYSICS

2020

QUESTION and ANSWER BOOKLET (1)

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 <i>Uni- structural</i>	Level 2 <i>Multi- structural</i>	Level 3 <i>Relational</i>	Level 4 <i>Extended Abstract</i>	
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.	4	2	1	1	15% 38min
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.	4	-	2	-	10% 26min
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

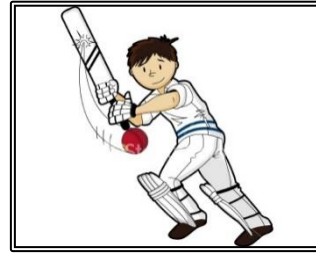
Check that this booklet contains pages 2–17 in the correct order and that none of these pages are blank.

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	<p>Circle the letter that represents the BEST answer.</p> <p>“The acceleration of an object is directly proportional to the net force acting on it and inversely proportional to its mass.”</p> <p>The above statement is referred to as</p> <p>A. Hooke’s Law. B. Newton’s First Law. C. Newton’s Third Law. D. Newton’s Second Law.</p>	<table border="1"> <thead> <tr> <th colspan="2">Unistructural</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Unistructural		1		0		NR			
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1.1b	<p>A 5000 kg jet plane lands on a runway and decelerates at 4 ms^{-2}.</p> <p>What is the average net force acting on the jet by the runway?</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<table border="1"> <thead> <tr> <th colspan="2">Multistructural</th> </tr> </thead> <tbody> <tr> <td>2</td> <td></td> </tr> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Multistructural		2		1		0		NR	
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1.1c	<p>Define momentum.</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<table border="1"> <thead> <tr> <th colspan="2">Unistructural</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Unistructural		1		0		NR			
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1.1d	<p>Determine the speed of an 85 g tennis ball that is moving with a momentum of 2.55 kgms^{-1}.</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<table border="1"> <thead> <tr> <th colspan="2">Multistructural</th> </tr> </thead> <tbody> <tr> <td>2</td> <td></td> </tr> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Multistructural		2		1		0		NR	
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1.1e James is a keen cricket player and is using his knowledge of physics to investigate the impulse force of the cricket ball on the bat and vice versa. Super slow and radar techniques captured the speed of the ball to be 25 ms^{-1} at the instant it hits the bat and -17 ms^{-1} when it leaves the bat. The mass of the ball is 0.16 kg .



Source: <http://clipart-library.com/cartoon-cricket.html>

Calculate the size of the impulse due to the contact.

Multistructural

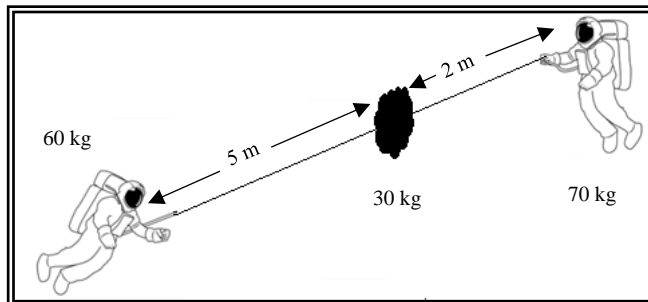
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1.1f Define the **centre of mass of a system**.

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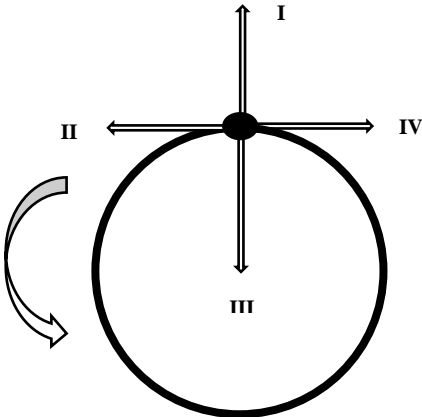
1.1g



A 60 kg astronaut, a 70 kg astronaut and a 30 kg rock are tied together by a light rope during a spacewalk. Calculate the position of the centre of mass of the system, using the 60 kg astronaut as the reference point.

Multistructural

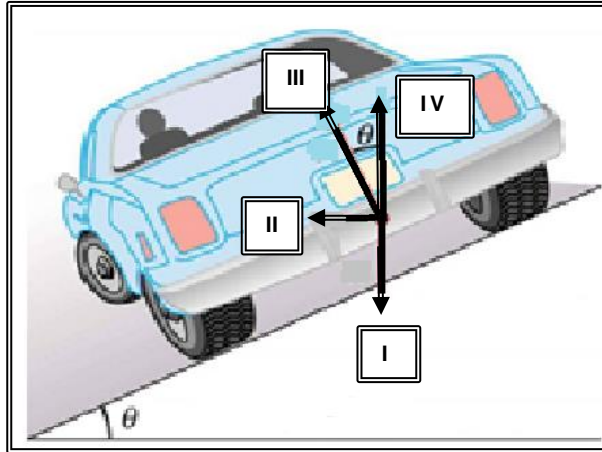
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1.1h	<p>A passenger sitting in the rear of a bus claims that she was injured as the driver slammed on the brakes, causing a suitcase to come flying towards her from the front of the bus.</p> <p>If you were the judge, what decision would you make of this case and why? Explain, using Newton's Laws.</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	<table border="1"> <thead> <tr> <th colspan="2">Multistructural</th> </tr> </thead> <tbody> <tr> <td>2</td> <td></td> </tr> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Multistructural		2		1		0		NR	
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1.1i	<p>A toy locomotive of mass 620 g moving at 20 cm s^{-1} collides with a carriage of mass 300 g moving at 42 cm s^{-1} in the opposite direction.</p> <p>Calculate the kinetic energy of the carriage before collision.</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	<table border="1"> <thead> <tr> <th colspan="2">Multistructural</th> </tr> </thead> <tbody> <tr> <td>2</td> <td></td> </tr> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Multistructural		2		1		0		NR	
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1.2	<p>CIRCULAR AND ROTATIONAL MOTION</p>											
1.2a	<p>Circle the letter that represents the BEST answer.</p> <p>Circular motion is the movement of an object along the circumference of a circle or rotation along a circular path.</p> <p>With reference to the diagram given on the right, identify the number that represents centripetal force.</p> <p>A. I B. II C. III D. IV</p> 	<table border="1"> <thead> <tr> <th colspan="2">Unistructural</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Unistructural		1		0		NR			
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1.2b	<p>Blood samples of individuals showing symptoms of COVID-19 were sent to laboratories for testing. In a lab, a centrifuge that rotates at 5 000 revolutions per minute is used to separate the components of blood. If the tubes of blood travel in a circle of radius 0.1 m and take 2 minutes to reach the top speed, calculate the angular acceleration of the tubes.</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	<table border="1"> <thead> <tr> <th colspan="2">Relational</th> </tr> </thead> <tbody> <tr> <td>3</td> <td></td> </tr> <tr> <td>2</td> <td></td> </tr> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Relational		3		2		1		0		NR	
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1.2c	<p>A horizontal disc of mass 2 kg and radius 5 cm rotates at 20 rpm about a vertical axis through its centre. Another disc of mass 1 kg and radius 10 cm which is at rest then drops onto the first disc, so that their centres coincide. The two discs lock together.</p> <p>Calculate the initial angular momentum of the system.</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	<table border="1"> <thead> <tr> <th colspan="2">Multistructural</th> </tr> </thead> <tbody> <tr> <td>2</td> <td></td> </tr> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Multistructural		2		1		0		NR			
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1.2d	<p>Circle the letter that represents the BEST answer.</p> <p>Angular impulse is best defined as the</p> <p>A. sum of torque and time.</p> <p>B. product of torque and time.</p> <p>C. quotient of torque and time.</p> <p>D. difference of torque and time.</p>	<table border="1"> <thead> <tr> <th colspan="2">Unistructural</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Unistructural		1		0		NR					
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1.2e

The figure below shows a free body diagram for a car on a frictionless banked curve.



Source: <https://courses.lumenlearning.com/suny-osuniversityphysics/chapter/6-3-centripetal-force/>

Circle the letter that represents the BEST answer.

Identify the number that best represents the net force on the car.

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

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1.3

SIMPLE HARMONIC MOTION

1.3a

Circle the letter that represents the BEST answer.

The situation where the system oscillates with its amplitude gradually decreasing to zero is called

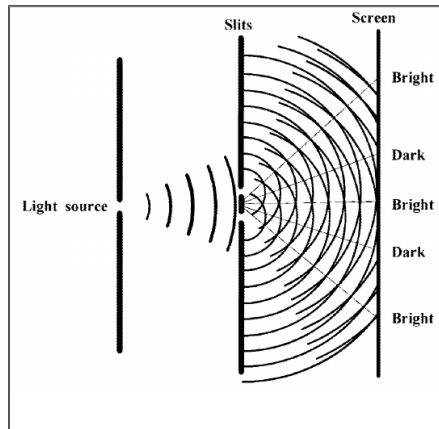
- A. resonance.
- B. overdamped.
- C. underdamped.
- D. critically damped.

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STRAND 2: WAVES
Assessor's use only

2.1	WAVE PROPERTIES											
2.1a	Define wavelength . _____ _____ _____ _____	<table border="1"> <thead> <tr> <th colspan="2" data-bbox="1252 405 1465 450">Unistructural</th> </tr> </thead> <tbody> <tr> <td data-bbox="1252 450 1358 495">1</td> <td data-bbox="1358 450 1465 495"></td> </tr> <tr> <td data-bbox="1252 495 1358 539">0</td> <td data-bbox="1358 495 1465 539"></td> </tr> <tr> <td data-bbox="1252 539 1358 584">NR</td> <td data-bbox="1358 539 1465 584"></td> </tr> </tbody> </table>	Unistructural		1		0		NR			
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2.1b	Energy can be transmitted or sent through a medium in the form of a pulse. A series of pulses is known as a wave. List two variables that affect wave speed. _____ _____ _____ _____ _____	<table border="1"> <thead> <tr> <th colspan="2" data-bbox="1252 909 1465 954">Multistructural</th> </tr> </thead> <tbody> <tr> <td data-bbox="1252 954 1358 999">2</td> <td data-bbox="1358 954 1465 999"></td> </tr> <tr> <td data-bbox="1252 999 1358 1043">1</td> <td data-bbox="1358 999 1465 1043"></td> </tr> <tr> <td data-bbox="1252 1043 1358 1088">0</td> <td data-bbox="1358 1043 1465 1088"></td> </tr> <tr> <td data-bbox="1252 1088 1358 1133">NR</td> <td data-bbox="1358 1088 1465 1133"></td> </tr> </tbody> </table>	Multistructural		2		1		0		NR	
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2.1c	Define monochromatic light . _____ _____ _____ _____	<table border="1"> <thead> <tr> <th colspan="2" data-bbox="1252 1305 1465 1350">Unistructural</th> </tr> </thead> <tbody> <tr> <td data-bbox="1252 1350 1358 1395">1</td> <td data-bbox="1358 1350 1465 1395"></td> </tr> <tr> <td data-bbox="1252 1395 1358 1440">0</td> <td data-bbox="1358 1395 1465 1440"></td> </tr> <tr> <td data-bbox="1252 1440 1358 1485">NR</td> <td data-bbox="1358 1440 1465 1485"></td> </tr> </tbody> </table>	Unistructural		1		0		NR			
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- 2.1d In a double-slit interference experiment, light from a lamp passes through a colour filter that transmits blue light only. The blue light passes through two narrow parallel slits and forms alternating bright and dark bands on a distant screen.



Source: https://www.researchgate.net/figure/interference-Youngs-double-slit-method-His-interest-in-wave-behaviour-led-him-also-to_fig2_265044889

Predict, with reasons, the effect on the interference pattern if:

- (i) the blue light is replaced by a violet one;
- (ii) the screen is brought close to the double slits; and
- (iii) the set-up is submerged in water.

(i).

(ii).

(iii).

**Extended
Abstract**

4

3

2

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2.2	SOUND WAVES											
2.2a	<p>A particular piano string is supposed to vibrate at a frequency of 440 Hz. In order to check its frequency, a tuning fork, known to vibrate at a frequency of 440 Hz, is sounded at the same time the piano key is struck, and a beat frequency of 4 beats per second is heard.</p> <p>Find the possible frequencies at which the string could be vibrating.</p> <hr/> <hr/>	<table border="1"> <thead> <tr> <th colspan="2">Unistructural</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Unistructural		1		0		NR			
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2.2b	<p>The range of human hearing extends from approximately 20 Hz to 20 000 Hz.</p> <p>Calculate the maximum wavelength of sound wave that could be detected by human ears. Use speed of sound as 340 ms⁻¹.</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	<table border="1"> <thead> <tr> <th colspan="2">Unistructural</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Unistructural		1		0		NR			
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2.2c	<p>The human ear canal is about 2.8 cm long.</p> <p>If it is regarded as a tube, open at one end and closed at the eardrum, draw the wave pattern formed by the third harmonic.</p>	<table border="1"> <thead> <tr> <th colspan="2">Multistructural</th> </tr> </thead> <tbody> <tr> <td>2</td> <td></td> </tr> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Multistructural		2		1		0		NR	
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2.2d



Source: <https://www.lazada.sg/products/etersummer-toy-guitar-for-kids-21-6-string-wooden-guitar-safety-mini-guitar-toys-gifts-with-pick-and-string-for-children-under-14-i293142727-s486001664.html>

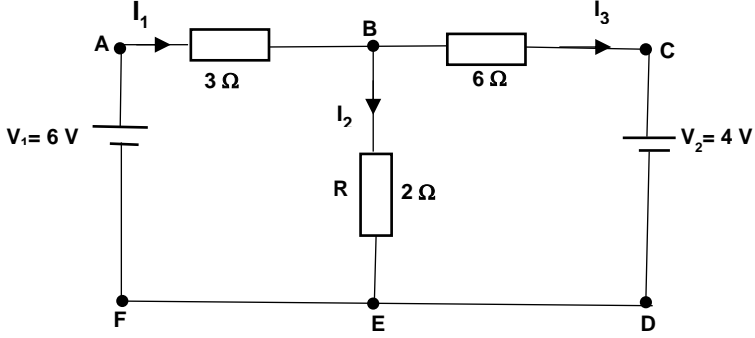
A guitar vibrates in its fundamental mode of 50 Hz. The string is 60 cm long.

Use illustrations and calculations to explain the first three harmonic series of the guitar. Use speed of sound as 340 ms^{-1} .

Relational	
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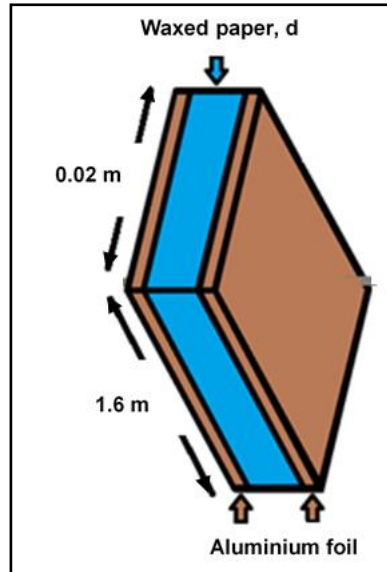
STRAND 3: ELECTRICITY AND ELECTROMAGNETISM

Assessor's use only

<p>3.1</p>	<p>DC CIRCUITS AND CAPACITANCE</p> <p>Use the information given below to answer questions 3.1a and 3.1b.</p> <p>Given below is a complex electrical circuit that has more than one voltage source. To determine the value of an unknown voltage, current or resistance, one needs to use and apply Kirchhoff's (two) Laws.</p> 									
<p>3.1a</p>	<p>Write Kirchhoff's current rule at junction B.</p> <p>_____</p> <p>_____</p> <p>_____</p>	<table border="1"> <thead> <tr> <th colspan="2">Unistructural</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Unistructural		1		0		NR	
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<p>3.1b</p>	<p>Write down the loop rule for loop ABEFA.</p> <p>_____</p> <p>_____</p> <p>_____</p>	<table border="1"> <thead> <tr> <th colspan="2">Unistructural</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Unistructural		1		0		NR	
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3.1c

One day Edward dismantled an old radio and found a capacitor inside which he pulled apart. It consisted of two long sheets of aluminium foil separated by a sheet of waxed paper, as shown here. The capacitor had a value of $1.0 \times 10^{-8} \text{ F}$ written on it.



Source: <https://cdn.sparkfun.com/assets/a/f/3/b/2/51969be3ce395f662c000000.png>

If the permittivity of free space, $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$ and the dielectric constant of waxed paper, $k = 7.5$, calculate the thickness of the waxed paper, d .

Relational	
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3.2

ELECTROMAGNETIC INDUCTION

3.2a

Draw the symbol of an inductor.

Unistructural	
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<p>3.3</p>	<p>AC CIRCUITS</p>													
<p>3.3a</p>	<p>A capacitor in a DC circuit limits the flow of current, such that it approaches zero after some time.</p> <p>State the effect of a capacitor on the behaviour of a circuit containing an AC voltage source.</p> <hr/> <hr/> <hr/>	<table border="1"> <thead> <tr> <th colspan="2">Unistructural</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Unistructural		1		0		NR					
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<p>3.3b</p>	<p>Explain the significance of resonant frequency.</p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	<table border="1"> <thead> <tr> <th colspan="2">Relational</th> </tr> </thead> <tbody> <tr> <td>3</td> <td></td> </tr> <tr> <td>2</td> <td></td> </tr> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Relational		3		2		1		0		NR	
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STRAND 4: ATOMIC AND NUCLEAR PHYSICS
Assessor's use only

4.1	ATOMIC PHYSICS													
4.1a	<p>Circle the letter that represents the BEST answer.</p> <p>In the latter part of the 19th century, experiments showed that, when light is incident on certain metallic surfaces, electrons are emitted from the surfaces.</p> <p>This phenomenon is known as</p> <p>A. proton. B. photon. C. photoelectrons. D. photoelectric effect.</p>	<table border="1"> <thead> <tr> <th colspan="2">Unistructural</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Unistructural		1		0		NR					
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4.1b	<p>Yellow light with a frequency of approximately 6.0×10^{14} Hz is the predominant frequency in sunlight. The energy carried by a photon having this frequency is 4.0×10^{-19} J.</p> <p>What is the eV (electron volt) equivalent of this energy?</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<table border="1"> <thead> <tr> <th colspan="2">Unistructural</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Unistructural		1		0		NR					
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4.1c	<p>Calculate the energy of the photons of infrared radiation of frequency 3.82×10^{14} Hz.</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<table border="1"> <thead> <tr> <th colspan="2">Multistructural</th> </tr> </thead> <tbody> <tr> <td>2</td> <td></td> </tr> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Multistructural		2		1		0		NR			
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4.1d	<p>The emitter plate in a photoelectric cell has work function of 3.31×10^{-19} J. Blue light of frequency 6.45×10^{14} Hz is shone onto the emitter plate.</p> <p>Calculate the maximum kinetic energy of the emitted electrons.</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<table border="1"> <thead> <tr> <th colspan="2">Relational</th> </tr> </thead> <tbody> <tr> <td>3</td> <td></td> </tr> <tr> <td>2</td> <td></td> </tr> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Relational		3		2		1		0		NR	
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4.2	NUCLEAR PHYSICS											
	<p>Use the information given below to answer questions 4.2a and 4.2b.</p> <p>Listed below are characteristics of radioactive radiations:</p> <p>I. Travels at the speed of light.</p> <p>II. Travels at about one-tenth $\left(\frac{1}{10}\right)$ the speed of light.</p> <p>III. Travels at about nine-tenths $\left(\frac{9}{10}\right)$ the speed of light.</p> <p style="text-align: right;"><i>Assessor's use only</i></p>											
4.2a	<p>Identify which of the three characteristics (I, II, and III) listed above is of alpha radiation.</p> <p>_____</p> <p>_____</p>	<table border="1"> <thead> <tr> <th colspan="2">Unistructural</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Unistructural		1		0		NR			
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4.2b	<p>Identify which of the three characteristics (I, II and III) listed above is of beta radiation.</p> <p>_____</p> <p>_____</p>	<table border="1"> <thead> <tr> <th colspan="2">Unistructural</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Unistructural		1		0		NR			
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4.2c	<p>Radium, Ra, atomic number 88, and mass number 226, is a radioactive chemical element discovered by Marie Curie. It emits an alpha particle and gamma rays, and thereby changes into another element, Radon, Rn.</p> <p>Write a balanced nuclear equation for the radioactive decay described above.</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<table border="1"> <thead> <tr> <th colspan="2">Multistructural</th> </tr> </thead> <tbody> <tr> <td>2</td> <td></td> </tr> <tr> <td>1</td> <td></td> </tr> <tr> <td>0</td> <td></td> </tr> <tr> <td>NR</td> <td></td> </tr> </tbody> </table>	Multistructural		2		1		0		NR	
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