EDUCATIONAL QUALITY AND ASSESSMENT PROGRAMME

PHYSICS

Assessment Scheme 2017

South Pacific Form Seven Certificate

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PhyA: Demonstrate understanding, by explanation and solving problems, of the physical phenomena, concepts, principles and relationships involved in mechanics.

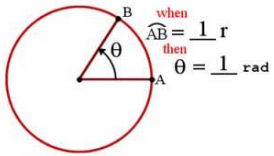
STRAND 1: MECHANICS

QUESTION 1.1: MOMENTUM

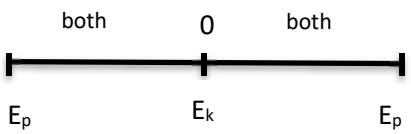
Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
1.1a	1	Momentum of a body is defined as the product of its mass and velocity.	Correct statement				Incorrect statement
1.1b	1	$I = \Delta p = p_f - p_i$ $= (70 \times 5.2) - 0$ $I = 364\ kgms^{-1}$	Correct working				Incorrect working
1.1c	2	$\Delta p = F\Delta t$ $F = \frac{\Delta p}{\Delta t} = \frac{364}{0.832} = 438\ N$	Recognizes the correct equation	Correct answer			Incorrect answer
1.1d	2	The total momentum of the collision is constant and the net force on the system is zero. The momentum of each player changes because during the collision each player is acted on by a non-zero net force. However, the total change in momentum of the system is zero. The final combined speed of the players is less than the speed of the individual players before collision.					

Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
		$p_{before} = p_{after}$ $(90 \times 3) + (95 \times -5) = (90 + 95)v$ $270 + -475 = 185v$ $-205 = 185v$ $v = 1.11\ ms^{-1}\ to\ the\ west$	Mentions any of these: • that the total momentum of the collision is conserved. • kE is not conserved • Not force is zero	Mentions that the combined final speed of the players is less than the individual initial speed of the players or final speed is to the West. Supports by calculation.			Invalid conceptual understanding
1.1e	3	The driver or passenger of a moving vehicle moves in the same direction and same speed as the moving vehicle. When the vehicle abruptly stops, the momentum of the driver can only be stopped by an external force. An airbag allows the change in momentum or impulse to take place over a longer time interval. As a result the average net force and the magnitude of the acceleration of the driver is therefore less causing less damage to the driver.	Mentions that the momentum of the driver/passenger equals the momentum of the moving vehicle.	When the vehicle stops abruptly, without the airbags, the momentum of the driver/passenger can only be stopped by an external force i.e. when the driver/passenger hits the dashboard /windshield but injuring them at the same time. Provides a number of ideas but linking is not clear.	Full explanation involving clear linking between necessity of air bags and momentum and impulse.		Invalid conceptual understanding

QUESTION 1.2: CIRCULAR AND ROTATIONAL MOTION

Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
1.2a	1		Correct diagram A circle with two radii enclosing an area of greater than 30^o but less than 90^o.				Incorrect diagram
1.2b	1	Source – central force OR centripetal force (central force has no torque about the centre of rotation → thus angular momentum is conserved.	Correct answer				Incorrect answer
1.2c	3	As there are no external torques on the system, the angular momentum (L) will be conserved. When Sarah draws the weights in, she concentrates the mass of the system closer to the centre of rotation, and so will decrease rotational inertia. As $L = I\omega$, a decrease in I will result in an increase in angular velocity, ω.	Mentions that drawing the weights in, concentrates the mass of the system closer to the center of rotation. Provides one correct idea.	Concentrating the mass at the centre of rotation decreases rotational inertia, I, increases angular speed, ω. Provides more than one correct idea but the linking between position and speed is not clear.	Full explanation showing clear linking.		Invalid conceptual understanding
1.2d	2	$L_{before} = L_{after}$ $I\omega_{before} = I\omega_{after}$ $37.7 = I(19)$ $I = 1.98\ kgm^2$	Incorrect answer but correct working	Understands and begins by stating that angular momentum is conserved. Correct answer and working.			Incorrect answer and working
1.2e	1	$32° = 32° \times \frac{2\pi radians}{360°} = 0.56\ radians$ OR $\frac{8\pi}{45}\ radians$	Correct answer				Incorrect answer

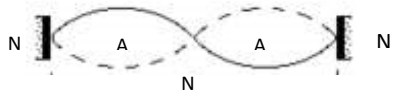
QUESTION 1.3: SIMPLE HARMONIC MOTION

Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
1.3a	2	The pendulum bob swings between two extreme points 2.8 m apart. The maximum displacement of the bob from the middle position (equilibrium) is its amplitude. Thus the amplitude is 1.4 m. The number of complete oscillations per second it its frequency, f = 0.625 Hz.	Describes only one of the two terms.	Describes both the terms correctly OR calculates values of A and f correctly.			Invalid conceptual understanding
1.3b	1	$a_{max} = -\omega^2 y$	Correct formula				Incorrect formula
1.3c	1	$v_{max} = \omega y$	Correct formula				Incorrect formula
1.3d	3		Shows any **one** of E_k, E_p or both correctly	Shows any **two** of E_k, E_p or both correctly	The bob possesses E_k at the equilibrium position and E_p at the extremes. It possesses both E_k and E_p between the extremes and the equilibrium position.		Invalid conceptual understanding

PhyB: Demonstrate understanding, by explanation and solving problems, of the physical phenomena, concepts, principles and relationships involved in waves

STRAND 2: WAVES

QUESTION 2.1: MUSICAL NOTES

Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
2.1a	1	A standing wave is formed by two travelling waves with the same frequency, speed and amplitude travelling in opposite directions.	Correct statement				Incorrect statement
2.1b	2	$L = 0.65\ m$ $\lambda = 2L = 2(0.65) = 1.3m$	Uses the correct equation.	Correct answer			Incorrect answer
2.1c	2		Correct diagram, incorrect or no label. Correct label, incorrect diagram.	Correct diagram, correct label of one N and one A			Incorrect diagram
2.1d	1	$\lambda = \frac{v}{f} = \frac{3.0 \times 10^8}{99 \times 10^6} = 3.0\ m$	Correct answer				Incorrect answer
2.1e	1	$v = f\lambda = 500 \times 3.0$ $= 1500 = 2 \times 10^3 ms^{-1}$	Correct answer				Incorrect answer
2.1f	3	Each instrument not only produces the fundamental frequency but also higher harmonics. The harmonics produced nary in number and loudness. So when the harmonics add up, they give a different resultant wave and so a different sound quality or timbre.	States that not just a single frequency is produced Provides one correct idea	An understanding of superposition and resultant wave Provides more than one correct idea but the linking between notes and sounds and comparison	Full explanation with clear linking between notes and sounds and comparison between the two instruments		Invalid conceptual understanding

				between the two instruments are not clear.			
Item #	**Skill Band**	**Evidence**	**Student Response Level**				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
2.1g	4	The shorter the string, the shorter the wavelength, so the frequency is higher. The greater the tension force, the faster the wavespeed, the higher the frequency. Heavier strings have a greater mass per metre, thus the wavespeed is lower. Thus heavier strings produce low frequency waves.	Makes some relation to the wave equation, $v = f\lambda$	Tries to relate the changes to wavelength or wavespeed.	Correctly matches the changes to the effect on wavelength or wavespeed.	Full explanation	Invalid conceptual understanding

PhyC: Demonstrate understanding, by explanation and solving problems, of the physical phenomena, concepts, principles and relationships involved in electricity and electromagnetism.

STRAND 3: ELECTRICITY AND ELECTROMAGNETISM

QUESTION 3.1: DC CIRCUITS AND CAPACITANCE

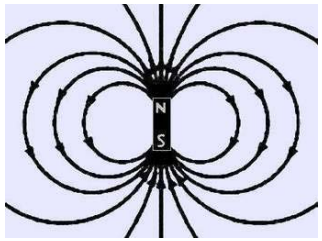
Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
3.1a	1	Capacitance is the ability of a body to store an electric charge.	Correct definition.				Incorrect statement.
3.1b	2	To provide the current for a camera flash, or an electric fence. To provide a backup current when the battery in an electronic device has to be changed.	Lists only **one** use.	Provides any **two** uses.			Incorrect answer
3.1c	1	The current through a conductor is directly proportional to the voltage across it provided the temperature of the conductor is constant.	Correct statement Accept V = IR				Incorrect statement
3.1d	3	When the voltage drops from 12 V to 4.4 V, it changes by 7.6 V. As a percentage of the initial voltage, the change in voltage is approx.: $\frac{7.6}{12} \times \frac{100}{1} = 63\%$ The time taken for the voltage to drop by 63% is approximately equal to the time constant, τ, given by $\tau = RC = 25 \times 0.10 = 2.5\ s$ Time constant, τ, is the period of time during which the voltage rises by 63% of the amount it has still to go, no matter what the voltage is at the time you choose to start from. The greater the value of the time constant, the longer it will take the capacitor to charge or discharge.	Calculates the theoretical value of time constant using the formula, $\tau = RC$= 2.5s	Showing the drop voltage is a 63% change and relates this to time constant.	Full explanation and full calculation		Invalid conceptual understanding

QUESTION 3.2: ELECTROMAGNETIC INDUCTION

Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
3.2a	2	When the magnet is moved into and out of the coil of wire, the galvanometer needle momentarily deflects. There is no deflection in the needle when the magnet is held stationary inside the coil of wire. It is found that any relative motion between the coil and the field produces a voltage across the terminals of the coil. To get an induced current (hence an induced emf), there needs to be change in the magnetic flux.	**Either** fully describes the observations **or** describes the production of induced emf	Full explanation			Invalid conceptual understanding
3.2b	1	Inductance is the effect in a circuit when a changing current causes an opposing induced voltage.	Correct definition				Incorrect definition
3.2c	3	One of the two purposes of transformers is to change the voltage supply to an appliance either up or down. Not all electrical appliances run on 240 V electricity. Some need more (step-up), others need less (step-down). It would be expensive and inefficient to supply homes with input power lines at all the voltages needed, so these appliances come with appropriate transformers built into them or provided for connection into the 240 V power line.	Mentions the purpose of a transformer. Provides one correct idea (it may be the purpose of a transformer or some other relevant idea)	Provides more than one correct idea but no linking between structure and how it works	Full explanation showing clear linking between the parts or structure of a transformer and how it works		Invalid conceptual understanding

Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
3.2d	4	Modern safety features are employed to prevent thermal and shock hazards. Modern household and industrial wiring requires the three-wire system which has several safety features: Circuit breakers and fuses prevent thermal overload thus interrupt excessive current. Protective case around the appliance prevents shock. A GFI (ground fault interrupter) is a safety device that works on electromagnetic induction. Live current must equal neutral current such that they induce equal and opposite emfs in the coil. GFI compares the live current and the neutral current. If the difference exceeds the safety limit, GFI interrupts the circuit and the circuit breaker trips.	Mentions the two hazards of electricity. One correct idea	Mentions three-wire system, circuit breakers (fuse), protective case A number of correct ideas are provided but ideas are disjointed. i.e. linking between working of electric circuits and safety are not linked.	Describes how GFI works as well as links these clearly to induction and modern safety	Full discussion including descriptions, clear linking as well as examples from everyday applications.	Invalid conceptual understanding

QUESTION 3.3: MAGNETIC FIELD

Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
3.3a	1	Magnetic field is a region in space where iron or other magnetic material will experience a force.	Correct answer				Incorrect answer
3.3b	1		Correct answer -Direction (N to S) -Field lines not crossing nor meeting				Incorrect answer
3.3c	2	$\phi = BA$ $= (0.2)(2 \times 10^{-3})$ $\phi = 4 \times 10^{-4}\ Wb$	Identifying correct formula OR mentioning $A = \left(2 \times 10^{-3}\right)$	Correct answer			Incorrect answer

PhyD: Demonstrate understanding, by explanation and solving problems, of the physical phenomena, concepts, principles and relationships involved in atomic and nuclear physics.

STRAND 4: ATOMIC AND NUCLEAR PHYSICS

QUESTION 4.1: RADIOACTIVITY

Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
4.1a	3	There are three types of radiation namely alpha, beta and gamma. Alpha radiation travel at about one-tenth the speed of light, its penetrating power is not very great, have a range of only a few centimeters in air, and is slightly deflected by a magnetic field. Beta radiation travel at about nine-tenth the speed of light, more penetrating than alpha, can penetrate up to 30 cm in air and is easily deflected by a magnetic field. Gamma radiation travel at the speed of light, can penetrate 30 cm of lead, and is undeflected by a magnetic field.	Has one property comparison correct	Has two properties comparisons correct	Full explanation		Invalid conceptual understanding
4.1b	1	Nuclear fusion is an energy-producing reaction in which two light nuclei are forced together to form a heavier nuclei.	Correct definition				Incorrect definition
4.1c	1	Nuclear fission occurs when a large nucleus splits into smaller fragments, releasing energy.	Correct definition				Incorrect definition
4.1d	2	$^{226}_{88}Ra \longrightarrow {}^{222}_{86}Rn + {}^{4}_{2}\alpha + \gamma$	Has **either** the reactants **or** the products written correctly	Correct answer			Incorrect answer

Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
4.1e	4	A controlled chain reaction is one in which the energy released is maintained at a preset level and does not exceed this level. An uncontrolled chain reaction is one in which energy is released in increasing and uncontrollable amount. Both types of chain reaction require nuclear fuel, a transmutation. A controlled chain reaction uses control rods to absorb surplus neutrons as necessary whereas an uncontrolled chain reaction does not require control rods to absorb surplus neutrons thus the rate of nuclear transmutations continue to increase with an accompanying increase in the release of energy.	Defines the two types of nuclear chain reactions OR Mentions reaction involves very high energy	States the requirements of each type of nuclear chain reactions	Relates to the work of control rods	Full explanation	Invalid conceptual understanding