No. 109/3

EDUCATIONAL QUALITY AND ASSESSMENT PROGRAMME

PHYSICS

Scoring Rubric 2020

South Pacific Form Seven Certificate

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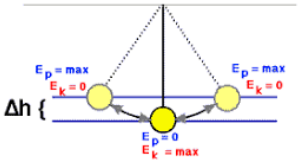
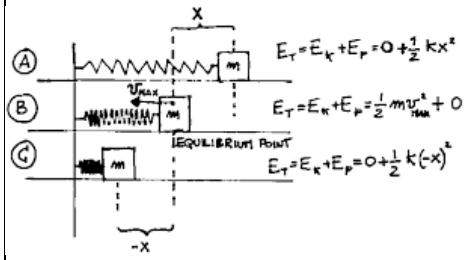
STRAND 1: Demonstrate understanding, by explanation and solving problems, of the physical phenomena, concepts, principles and relationships involved in mechanics.

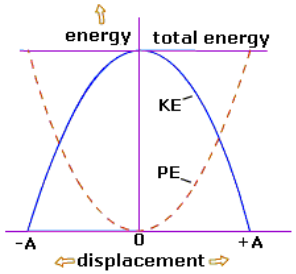
STRAND 1: MECHANICS

1.1 TRANSLATIONAL MOTION

Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
1.1a	1	D	Correct answer				Incorrect answer
1.1b	2	$\sum F = ma$.....(i) $= 5000 \times 4$.....(ii) $= 20\,000\ N$ in the direction opposite to the motion of the plane.	Steps (i) or (ii)	Correct final answer Or slip in calculation			Incorrect answer
1.1c	1	It is the product of the mass and velocity of a body.	Correct statement or anything to that effect				Incorrect definition
1.1d	2	$v = \frac{p}{m}$.....(i) $= \frac{2.55}{0.085} \ldots\ldots\ldots (ii)$ $v = 30\ ms^{-1}$	Step (i) or (ii)	Correct final answer Or slip in calculation			Incorrect answer
1.1e	2	$I = Ft$.....(i) $= \Delta p = mv_f - mv_i$.....(ii) $= (0.16 \times -17) - (0.16 \times 25)$...(iii) $= -2.72 + -4$ $I = -6.72\ Ns$.....(iv) $I = 6.72\ Ns$ away from the bat	Steps (i) or (ii)	Correct final answer Or slip in calculation			Incorrect answer
1.1f	1	It is the average position of all the mass in a system. OR Point within a system at which its total man can be considered to be acting.	Correct definition or anything to that effect.				Incorrect definition
1.1g	2	$c.o.m. = \frac{m_1r_1 + m_2r_2 + m_3r_3 \ldots\ldots}{m_1 + m_2 + m_3 \ldots\ldots}$(i) $= \frac{60\times0 + 30\times5 + 70\times7}{60+30+70}$.....(ii) $= \frac{640}{160}$ $= 4\ m\ from\ 60\ kg\ mass$	Steps (i) and (ii) OR Steps (ii) and (iii)	Correct final answer Or slip in calculation			Incorrect answer

Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
1.1h	2	The inertia of the suitcase would keep it moving forward as the bus stops. There would be no tendency for the suitcase to be thrown backward towards the passenger. The case should be dismissed.	Mentions the case be dismissed without any reasoning.	Full explanation with correct verdict.			Invalid conceptual understanding.
1.1i	2	$k.E = \frac{1}{2}mv^2$.....(i) $= \frac{1}{2} \times 0.3 \times (0.42)^2$.....(ii) $k.E = 0.03\,J$	Step (i) or (ii)	Correct final answer Or correct working and slip in calculation			Incorrect answer
1:2 CIRCULAR AND ROTATIONAL MOTION							
1.2a	1	C	Correct answer				Incorrect answer
1.2b	3	$\omega = \frac{5000\,rev}{min} \times \frac{1\,min}{60\,s} \times \frac{2\pi rad}{1\,rev}$ $\omega = 523.6\,rads^{-1}$ $\alpha = \frac{\omega_f - \omega_i}{t}$.....(i) $= \frac{523.6-0}{120}$ $\alpha = 4.36\,rads^{-2}$	Step (i) OR Correct value for $t = 120$	Correct value for ω	Correct answer OR Correct working and 'slip' in calculation		Incorrect answer
1.2c	2	$L = Iw$.....(i) $= \frac{1}{2}mr^2 \times w$.....(ii) $= \frac{1}{2} \times 2 \times (0.05)^2 \times 2.09$ $L = 5.23 \times 10^{-3}\,kgm^2rads^{-1}$ $\omega = \frac{20\,rev}{min} \times \frac{1\,min}{60\,s} \times \frac{2\pi rad}{1\,rev}$ $\omega = 2.09\,rads^{-1}$	Steps (i) or (ii) or the	Value of $\omega = 2.09\,rads^{-1}$ OR Correct answer OR Correct working and 'slip' in calculation			Incorrect answer
1.2d	1	B	Correct answer				Incorrect answer
1.2e	1	B	Correct answer				Incorrect answer

Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
1.3: SIMPLE HARMONIC MOTION							
1.3a	1	C	Correct answer				Incorrect answer
1.3b	3	 E_k = Kinetic Energy E_p = Potential Energy  At the equilibrium position, for both cases, the mass and the bob possess maximum kinetic energy and PE = 0, because Δh = 0. When the spring is stretched a distance, +*x*, KE = 0 but PE is a maximum. Even for a bob, PE = mgh or PE = mgA. For a pendulum, the bob momentarily stops at the extremes (+A and –A) before returning to the equilibrium position and beyond. The combined graph looks like the one below.	Attempts to draw either the energy diagram for a swinging pendulum or he mass on a spring.	Draws one of the diagrams and describes the energy the bob or mass possess at the equilibrium and at the ends.	Full explanation, drawn the total energy diagram and one of the two.		Invalid conceptual understanding.

Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
							
1.3c	3	$T = 2\pi\sqrt{\frac{l}{g}}$ .....(i) $= 2\pi\sqrt{\frac{0.15}{9.8}}$ $T = 0.78\ s$	Step 1	Step 1 and correct conversion of length i.e. 0.15	Correct answer OR Correct working with a 'slip' in calculation		Incorrect answer

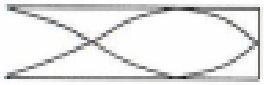
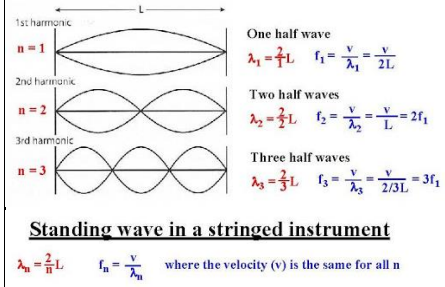
STRAND 2: Demonstrate understanding, by explanation and solving problems, of the physical phenomena, concepts, principles and relationships involved in waves.

STRAND 2: WAVES

2.1: WAVE PROPERTIES

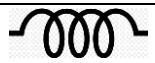
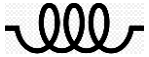
Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
2.1a	1	Is the distance between two consecutive crests (or troughs).	Correct answer Or Correct diagram				Incorrect answer
2.1b	2	Wavelength Frequency Medium Temperature Density Time	Mentions any one from the list	Two with or more			Invalid conceptual understanding.
2.1c	1	It is light of single wavelength or single frequency or one color	Mentions any of these				Incorrect definition
2.1d	4	Violet has a shorter wavelength compared to blue. Shorter wavelength causes fringes to be closer. $\lambda \propto x$ If the screen was brought closer, L decreases which causes the fringes to be closer. $L \propto x$ If the set-up is submerged in water, the speed of light decreases. This in turn decreases the wavelength. A decrease in wavelength decreases x	Recognizes the correct formula $n\lambda = \frac{dx}{L}$ Mentions one correct observation	Mentions two or more correct observations	One correct effects stating its correct relation to the cause.	Full explanation	Invalid conceptual understanding

Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
		which means that the fringe separation decreases. $In\ water, v \downarrow \Rightarrow \lambda \downarrow$ $when\ \lambda \downarrow x \downarrow$ $because\ \lambda \propto x,$ $the\ fringes\ will\ be\ closer.$					

Item #	Skill Band	Evidence	Student Response level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
2.2: SOUND WAVES							
2.2a	1	$440 + 4 = 444\ Hz$ $440 - 4 = 436\ Hz$	Mentions both 436 Hz and 444 Hz.				Incorrect answer
2.2b	1	$\lambda = \frac{v}{f} = \frac{340}{20000} = 0.017\ m\ (1.7\ cm)$	Correct answer OR Correct working with a 'slip' in calculation				Incorrect answer
2.2c	2		Pipe open at one end	Correct diagram			Incorrect answer
2.2d	3	 First Harmonic $f_1 = 50\ H = \frac{v}{1.2}$ $\therefore\ v = 60\ ms^{-1}$ Second Harmonic $f_2 = \frac{60}{0.6} = 100\ Hz$ Third Harmonic $f_3 = \frac{60}{0.4} = 150\ Hz$	A correct waveform pattern with its corresponding calculation OR Correct value of $v = 60$	Draws all three standing wave patterns correctly with no calculation OR Two correct calculations plus two corresponding waveforms	Full explanation plus the 3 correct waveform patterns		Invalid conceptual understanding

STRAND 3: ELECTRICITY AND ELECTROMAGNETISM

3.1 DC CIRCUITS AND CAPACITANCE

Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
3.1a	1	$I_1 = I_2 + I_3$ OR $I_1 - I_2 - I_3 = 0$	Correct equation OR $\sum I_{entering} = \sum I_{leaving}$				Incorrect equation
3.1b	1	$-3I_1 - 2I_2 = -6$ OR $-3I_1 - 2I_2 + 6 = 0$	Correct equation.				Incorrect equation
3.1c	3	$C = \frac{k\varepsilon_0 A}{d}$ .....(i) $d = \frac{k\varepsilon_0 A}{C}$ .....(ii) $= \frac{7.5\times(8.85\times10^{-12})\times(1.6\times0.02)}{(1.0\times10^{-8})}$ .....(iii) $d = 2.12 \times 10^{-4}$m	Step (i) OR (ii) which is making d the subject of the formula	Correct substitution (iii) OR Mention of (1.6×0.02)	Correct working OR 'slip' in calculation		Incorrect working and answer
3.2: ELECTROMAGNETIC INDUCTION							
3.2a	1	 OR  https://www.cleanpng.com/png-inductor-electromagnetic-coil-electronic-symbol-el-2962691/	Correct diagram OR 				Incorrect diagram

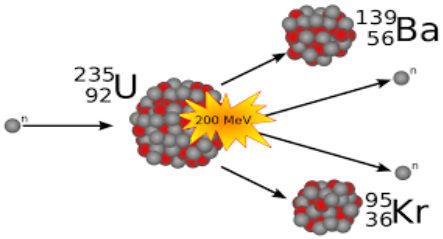
Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
3.3: AC CIRCUITS							
3.3a	1	The voltage across a capacitor always lags behind the current by 90° OR The current across the capacitor leads the voltage by 90°	Anything to that effect				Incorrect answer
3.3b	3	Capacitors and inductors respond differently to a change in frequency. As the frequency increases • The reactance of a capacitor gets smaller, so V_c becomes less • The reactance of an inductor increases, so V_L becomes greater. At resonance though, the circuit has the maximum current for a given V_s when the impedance (Z) has its minimum value which reduces to R. When the two reactances are equal i.e. $X_L = X_C$, the current cancels out leaving $V_C = V_L$ and this is when the circuit is said to be at resonance or has reached resonant frequency. Radio and TV channel tuning are examples of application of resonant frequency.	Mentions any of these facts At resonance $X_L = X_C$ Or $V_C = V_L$ OR $f_o = \frac{1}{2\pi\sqrt{LC}}$ OR either maximum I (current) OR minimum Z (impedance) OR Draws a phasor diagram	Mentions two or more facts	Full explanation stating the cause and effect Derivation of $f_o = \frac{1}{2\pi\sqrt{LC}}$		Invalid conceptual understanding

STRAND 4: 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

4.1 ATOMIC PHYSICS

Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
4.1a	1	D	Correct answer				Incorrect answer
4.1b	1	$1\ eV = 1.602 \times 10^{-19}\ J$ $\therefore 4.0 \times 10^{-19}\ J = \frac{4.0 \times 10^{-19}}{1.602 \times 10^{-19}}$ $= 2.50\ eV$	Correct answer				Incorrect answer
4.1c	2	$E = hf$.....(i) $= (6.63 \times 10^{-34})(3.82 \times 10^{14})$.....(ii) $E = 2.53 \times 10^{-19} J$	Steps (i) or (ii)	Correct working OR 'slip' in calculation			Incorrect answer
4.1d	3	$E_K = hf - \Phi$.....(i) $= (6.63 \times 10^{-34})(6.45 \times 10^{14}) - 3.31 \times 10^{-19}$ $= (4.28 \times 10^{-19}) - (3.31 \times 10^{-19})$ $E_K = 9.66 \times 10^{-20}\ J$	Step (i)	Correct substitution OR Gets 4.28×10^{-19}	Correct working OR 'slip' in calculation		Incorrect working
4.2: NUCLEAR PHYSICS							
4.2a	1	II	Correct answer				Incorrect answer
4.2b	1	III	Correct answer				Incorrect answer
4.2c	2	${}^{226}_{88}Ra \rightarrow Rn^{222}_{86} + \alpha^4_2 + \gamma$	Gets either the reactant or the products correctly written i.e. symbol, mass number and atomic number	Gets both the reactant and products correct and correctly written			Incorrect answer

Item #	Skill Band	Evidence	Student Response Level				
			Unistructural	Multistructural	Relational	Extended Abstract	Weak
4.2d	4	Fission is a nuclear reaction where a large nucleus splits into smaller fragments. When this happens, each fragment has less mass per nucleon. This lost mass is released as energy in the form of kinetic energy and gamma rays. This happens in a controlled way in a nuclear reactor or in the explosion of an atomic bomb. In a fission reaction, one neutron is needed to start the reaction but 2 to 3 neutrons are produced as products. If these neutrons then collide with more nuclei, the number of reactions will suddenly grow very large – a chain reaction will occur. In a nuclear reactor, a moving neutron hits Uranium $\left(U_{92}^{235}\right)$ which breaks into Krypton and Barium i.e. $\left(Kr_{36}^{95}\right)$and $\left(Ba_{56}^{139}\right)$ respectively.  https://partiko.app/@rifkan/what-do-you-know-about-nuclear-fission Two main concerns of fission reactions is • Safety-accidents at nuclear power plants have released radiation into the environment, the worst by far, being in 1986 at Chernobyl	Defines Fission	Mentions the fuel OR the product	Describes the reaction involved with simple diagrams	Mentions the downside of Fission reaction	Invalid conceptual understanding

		• Nuclear wastes-highly radioactive productsof nuclear reactors often have very long hal-lives.The disposal of these wastes is a major problem, as they must be stored for thousands of years.					

THE END