



SECRETARIAT OF THE PACIFIC BOARD
FOR EDUCATION QUALITY

***Marking
Schedule
2014***

**South Pacific
Form Seven
Certificate**

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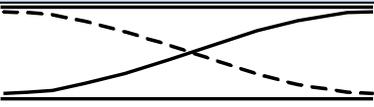
PhyB: Demonstrate understanding, by explanation and solving problems, of the physical phenomena, concepts, principles and relationships involved in waves

SECTION A: WAVES

QUESTION 1: THE TWO LASERS

Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
A1a	1	$\lambda = (d x)/L = (1.40 \times 10^{-2} \times 1.44 \times 10^{-4}) / 3.09$ $= 6.524 \times 10^{-7} \text{m}$	Correct working			Incorrect working	
A1b	1	The fringes would be closer together.	Correct answer			Incorrect answer	
A1c	2	The wavelength of violet is shorter than the wavelength of red. Since $x = \lambda L/d$, if the wavelength is shorter, the distance of separation of the bright fringes, x , will be shorter. Therefore the fringes are closer together.	Full explanation	Related effect to wavelength		Incorrect answer	
A1d	1	$v = f\lambda \Rightarrow f = \frac{v}{\lambda}$ $= \frac{1.6 \times 3.0 \times 10^8}{6.524 \times 10^{-7}}$ $= 7.36 \times 10^{14}$	Correct working			Incorrect working	
A1e	1	$\theta_{n=2} = \tan^{-1}(\frac{1}{2} \times 1.90/3.09) = 17.0897$ $d = n\lambda / \sin\theta,$ $\Rightarrow d = 2 \times 652.4 \times 10^{-9} / \sin 17.0897$ $\Rightarrow d = 4.44 \times 10^{-6} \text{ m}$	Correct working	Attempts to use an angular approach to solve the problem		Incorrect working	

QUESTION 2: THE PIPES

Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
A2a	1	 <p>Antinode at ends; node in the middle</p>	Correct answer			Incorrect answer	
A2b	1	$\lambda = 2 \times \text{pipe length} = 2 \times 0.435 = 0.870 \text{ m}$	Correct answer			Incorrect answer	
A2c	1	$v = f\lambda$ and there are $\frac{4}{3}\lambda$ in the pipe $\Rightarrow \lambda = \frac{4}{3}L = 1.33333 \times 0.435 = 0.58$ $\Rightarrow f = \frac{340}{0.58} = 586 \text{ Hz}$	Correct working			Incorrect working	
A2d	1	$522 - 510 = 12 \text{ beats per second}$	Correct answer			Incorrect answer	
A2e	3	<p>Because the two waves have slightly different frequencies, when they arrive at the observer the phase difference between them varies regularly between in phase and opposite phase. When they are in phase, the interference is constructive so the sound is loud, when they are out of phase the sound is softer.</p>	Full explanation	Describes the effect of different phases and links to interference	States the fundamental idea of interference	Invalid conceptual understanding	Full explanation and uses a diagram to explain more fully how beats are formed.

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

SECTION B: MECHANICS

QUESTION 3: GEOEYE-1

Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
B1a	1	Gravity	Correct answer			Incorrect answer	
B1b	1	$F = \frac{GM_1M_2}{r^2}$ $F = \frac{6.67 \times 10^{-11} \times 1260 \times 5.98 \times 10^{24}}{(7.06 \times 10^6)^2}$	Correct working			Incorrect working	
B1c	1	$1.01 \times 10^4 = \frac{mv^2}{r}$ $v = \sqrt{\frac{1.01 \times 10^4 \times 7.06 \times 10^6}{1260}}$	Correct working			Incorrect working	
B1d	1	$a = \frac{GM}{r^2}$ $a = (6.67 \times 10^{-11} \times 5.98 \times 10^{24}) / (7.06 \times 10^6)^2$	Correct working	Equate $F=ma$ to GMm/r^2		Incorrect answer	
B1e	3	<p>According to Newton's Law of Gravitation ($F = GMm/r^2$), decreasing the radius would cause an increase in gravitational force on the satellite. This larger force acting as the centripetal force ($F = mv^2/r$), as well as r being reduced will require a higher v to maintain the satellite at smaller orbit. ($v^2 = Gm/r$). The origin of the extra velocity is a decrease in GPE and an associated increase in E_k.</p>	Full explanation involving either energy or force.	Indicates a larger force will require a larger velocity	States velocity increases	Invalid conceptual understanding	Full explanation involving both concepts.

QUESTION 4: THE POLISHING MACHINE

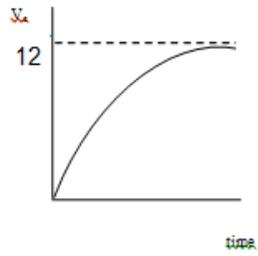
Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
B2a	1	1.29×10^2 revs per min $1 \text{ rev} = 2\pi$ $129 \times 2\pi / 60$	Correct working			Incorrect working	
B2b	1	$\omega_f = \omega_i + \alpha t \Rightarrow \alpha = \frac{\omega_f - \omega_i}{t}$ $= \frac{13.5 - 0}{12.0}$	Correct working			Incorrect working	
B2c	1	The original data is given to three sig figures	Correct answer			Incorrect answer	
B2d	1	Mass and position of mass from the centre of rotation	Correct answer			Incorrect answer	
B2e	1	$\tau = I\alpha$ $= 0.119 \times 1.13$ $= 0.134 \text{ Nm}$	Correct answer			Incorrect answer	
B2f	1	No external torques are acting	Correct answer			Incorrect answer	
B2g	2	$I_b \omega_b = I_f \omega_f$; $0.119 \times 13.5 = I_f \times 9.5$ $I_f = 0.169$ and $I = I_f - I_{\text{drum}}$	Correct working	Used conservation of angular momentum		Incorrect working	
B2h	1	Kinetic energy of the gemstones and heat	Correct answer			Incorrect answer	

B2i	1	$v=A\omega$ $2.15 \times 10^{-3} \times 13.5$	Correct working			Incorrect working	
B2j	1	$a=A\omega^2$ $2.15 \times 10^{-3} \times (13.5)^2$	Correct working			Incorrect working	
B2k	2	To stay connected an object must move in SHM with the box. They must accelerate down at the same rate as the box. They will do this if the maximum acceleration is less than "g".	Full explanation	Partial explanation		Incorrect conceptual understanding.	
B2l	3	Using the reference circle. Working out the angle caused by a displacement of 2mm. $\sin\theta=2/2.15$ $\theta=68.47$ degrees. The total angle when the displacement is less than 2mm is $2 \times 68.47 + 180 = 316.94$ degrees so that leaves 43.06 degrees. As a percentage that is 12.0%.	Full description	A minor error has been made in the calculation. All logic correct.	An angle is calculated	No appropriate response	Full description and uses an original approach to solving the problem

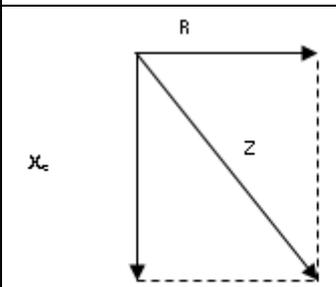
PhyC: Demonstrate understanding, by explanation and solving problems, of the physical phenomena, concepts, principles and relationships involved in electricity and electromagnetism.

SECTION C: ELECTRICITY AND ELECTROMAGNETISM

QUESTION 5: CAPACITORS

Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
C1a	1	$100+40+20$ $=160 \mu\text{F}$	Correct answer			Incorrect answer	
C1b	1	$1/100 + 1/40 + 1/20$ $=0.085 = 1/C$	Correct working			Incorrect working	
C1c	1	Three drawn in series	Correct description			Incorrect description	
C1d	2		Full description	Shape correct		Incorrect answer	
C1e	1	$\tau=RC$ $=1 \times 10^6 \times 11.8 \times 10^{-6}$ $=11.8 \text{ s}$	Correct calculation			Incorrect calculation	
C1f	2	The current is reduced if the resistance increases. With a reduced current less charge flows per second. An increased time constant results.	Full description	A link to current exists		Incorrect answer	

QUESTION 6: AC CIRCUITS

Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
C2a	1	$X=1/\omega C$ $=1/(2\pi \times 50 \times 11.8 \times 10^{-6})$	Correct working			Incorrect working	
C2b	1		Correct working			Incorrect working	
C2c	2	$Z=(R^2+X^2)^{0.5}$ $=(205^2+270^2)^{0.5}$	Correct working	Attempt to add vectorially.		Incorrect working	
C2d	3	Angle formed between Z and R will give the correct angle between I and V_s . $\theta=\sin^{-1}(205/339)$ $=52.8$ degrees	Full calculation	Minor calculation error	Attempts to calculate an angle based on resistance values	Incorrect answer	Full calculation and in-depth description of rationale
C2e	1	$I=V/Z = 12/339$ $I= 0.0354$ A	Correct calculation			Incorrect calculation	

C2f	1	$X = \omega L$ $= 2\pi \times 50 \times 0.125$	Correct working			Incorrect working	
C2g	1	$f = 1 / (2\pi \times (LC)^{0.5})$ $f = 1 / (2\pi \times (0.125 \times 11.8 \times 10^{-6})^{0.5})$	Correct working			Incorrect working	
C2h	3	<p>The system can move towards resonance by a) Increasing the frequency from 50 towards the 131 Hz resonant frequency. b) Reduce the reactance of the capacitor from 270 Ω towards the 39.3 Ω of the inductor, which is done by increasing the value of the capacitor. c) Increase the reactance of the inductor from 39.3 Ω towards the 270 Ω of the capacitor, which is done by increasing the value of the inductor.</p>	Full description	Partial description	Identifies a factor	Incorrect answer	Full explains and details why the changes will give the desired result

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

SECTION D: ATOMIC AND NUCLEAR PHYSICS

QUESTION SEVEN: THE BOHR ATOM

Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
D1a	1	UV	Correct answer			Incorrect answer	
D1b	1	$E=hcR/3^2$ $=6.63 \times 10^{-34} \times 3 \times 10^8 \times 1.097 \times 10^7 / 9$	Correct working			Incorrect working	
D1c	1	$E=(E_1-E_3)$ $=2.181933 \times 10^{-18} - 2.42437 \times 10^{-19}$	Correct working			Incorrect working	
D1d	1	$f=E/h$ $=1.939469 \times 10^{-18} / 6.63 \times 10^{-34}$	Correct working			Incorrect working	
D1e	1	$\lambda=v/f$ $=3 \times 10^8 / 2.9253 \times 10^{15}$	Correct working			Incorrect working	
D1f	2	Visible transition since red therefore a transition to $n=2$ is required. Must be the lowest energy so $n=3$ to $n=2$.	Full description	A link to $n=2$		Incorrect answer	
D1g	1	Same as E_1 therefore $2.18 \times 10^{-18} \text{J}$	Correct answer			Incorrect answer	
D1h	3	Electrons only exist in certain quantum levels or states. When an electron jumps from a higher energy level to a lower energy level a photon is emitted of discrete frequency (colour). Since only certain states are allowed only certain colours are emitted.	Full explanation	Partial explanation	Understands quantum states	Incorrect answer	Full explanation and shows by calculation how this idea leads to individual lines.