



**EDUCATIONAL QUALITY AND
ASSESSMENT PROGRAMME**

***Marking
Schedule
2015***

**South Pacific
Form Seven
Certificate**

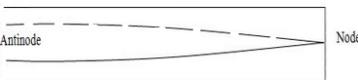
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PhyB: Demonstrate understanding, by explanation and solving problems, of the physical phenomena, concepts, principles and relationships involved in waves

SECTION A: WAVES

QUESTION 1: SOUND

Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
A1a	1		Correct diagram with labels			Incorrect working	
A1b	1	$L = \lambda/4$ $\Rightarrow \lambda = 4L = 4 \times 0.130 = 0.520 \text{ m}$	Correct working			Incorrect answer	
A1c	1	$v = f\lambda \Rightarrow f = \frac{v}{\lambda}$ $= 340/0.520$ $= 654 \text{ Hz}$	Correct answer			Incorrect answer	
A1d	2	Since Ben is moving towards Emma, the waves Emma receives are reduced in wavelength but since they arrive with an unaltered speed their frequency increases.	Full explanation	States that wavelength reduced		Invalid conceptual understanding	
A1e	2	$f' = f \frac{v_w}{v_w - v_s}$ $1110 = \frac{1100 \times 340}{340 - v_s}$ $v_s = 340 - \frac{1100}{1110} \times 340$	Correct working	Uses correct equation and values but is unable to successfully rearrange		Incorrect working	

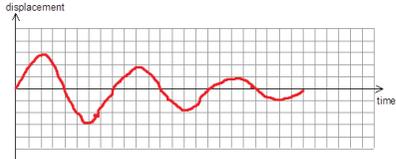
Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
A1f	1	$v/f = \lambda$ $\Rightarrow \lambda = 340/1100$ $L = \lambda/4$ $L = 0.0773 \text{ m}$	Correct working			Incorrect answer	
A1g	1	$f_n = nf_1$ $= 3 \times 1100 = 3300 \text{ Hz}$ Alternative approach using $L = \frac{3}{4} \lambda$ acceptable	Correct working			Incorrect answer	
A1h	1	Interference	Correct statement			Incorrect working	
A1i	1	$n\lambda = dx/L$ $\lambda = v/f$ $\lambda = 340/2000 = 0.17 \text{ m}$ $x = \lambda L/d = 0.17 \times 10/1 = 1.7 \text{ m}$ (alternative approach with $d \sin \theta = n\lambda$ acceptable)	Correct working			Incorrect answer	
A1j	3	In an open field no reflections are possible other than from the ground. In a closed room with hard walls and sharp angles reflections are likely. As waves are coming from other locations the conditions required for two source interference are no longer met. Other places of constructive and destructive interference could result.	Full explanation	Describes the effect of different reflection and links to interference	States the fundamental idea of reflection	Invalid conceptual understanding	Full explanation and uses additional information to show deeper understanding (such as ground reflections)

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

SECTION B: MECHANICS

QUESTION 2: VERTICAL BUNGY

Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
B1a	1	$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{531}{4990}} = 2.05 \text{ s}$	Correct working			Incorrect answer	
B1b	1	$\omega = \frac{2\pi}{T} = \frac{2\pi}{2.0496} = 3.07$	Correct working			Incorrect working	
B1c	1	$v=A\omega$ $v=4.20 \times 3.0655$ $v=12.9$	Correct working			Incorrect working	
B1d	1	In the middle of the motion/equilibrium position	Correct statement			Incorrect answer	
B1e	1	$E_k = \frac{1}{2}mv^2$ $=1/2 \times 531 \times 12.9^2$ $=4.40 \times 10^4 \text{ J}$ (alternative approach using $1/2kA^2$ acceptable)	Correct answer			Incorrect answer	

Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
B1f	2		Correct diagram showing decay and unchanged period	Decay shown but period alters		Incorrect working	
B1g	3	The two bungy cords share half the weight and therefore stretch half as much as a single cord of identical k . To replace these two with a single cord of different k this would need the cord to hold twice as much for the same extension. This requires the 'new' bungy to have a spring constant = $2 \times$ the original spring constant.	Full explanation	Realises that the new spring must stretch by the same amount as the individual springs	States the fundamental idea of more force requires stiffer spring	Invalid conceptual understanding	Full explanation and uses additional information such as a mathematical approach to prove the result

QUESTION 3: THE CIRCULAR SWING

Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
B2a	1	Tension and weight (or equivalent)	Correct answer			Incorrect answer	
B2b	1	John is not moving (accelerating) vertically	Correct answer			Incorrect answer	
B2c	1	John is moving in circular motion – this requires an unbalanced force	Correct answer			Incorrect answer	
B2d	1	$F=mg$ $=65.0 \times 9.80$ $=637 \text{ N}$	Correct answer			Incorrect answer	
B2e	2	$T\cos 15 = 637$ $T=637/\cos 15^\circ$ $T=659$	Correct working	Attempts to resolve into components		Incorrect working	
B2f	1	The centripetal force is the horizontal component of the tension. $659.471 \times \sin 15^\circ = 171 \text{ N}$ Could also use Pythagoras' theorem	Correct working			Incorrect working	
B2g	2	$F = mv^2/r$ where $F = 170.684 \text{ N}$ and $m = 65.0 \text{ kg}$ r is the radius of the circle $= 5.6 \times \sin 15^\circ$ $r=1.4494 \text{ m}$ after rearranging $v = 1.95 \text{ m s}^{-1}$	Correct answer	Uses incorrect r value to calculate v		Incorrect answer	

Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
B2h	1	$W = Fd$ $= 250 \times 6$ $= 1500 \text{ J}$	Correct working			Incorrect working	
B2i	1	$v = r\omega$ $\omega = 2.3 / 0.051$ $= 45.1 \text{ rad s}^{-1}$	Correct working			Incorrect working	
B2j	3	Rotational kinetic energy is proportional to rotational inertia. Rotational inertia is proportional to mass and position ² of that mass. The blade has a lot of its mass distributed at a larger radius. Provided the mass of the axle is not too much greater than the mass of the blade the rotational inertia of the blade will be larger than that of the axle. More rotational kinetic energy can be stored.	Full explanation	States that rotational kinetic energy is proportional to the position ² and states that this must be the reason for the increased stored energy	States the fundamental idea rotational inertia as being important	Invalid conceptual understanding	Full explanation and uses additional information such as a mathematical approach to prove the result

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 4: THE ELECTRIC TOOTHBRUSH

Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
C1a	1	The cells are in series	Correct answer			Incorrect answer	
C1b	1	$V=E/q$ $E=Vq$ $E=3.00 \times 1 = 3.00 \text{ J}$	Correct working			Incorrect working	
C1c	1	$P=VI$ $I=P/V=5/2.8$	Correct working			Incorrect working	
C1d	2	When the switch is closed current develops in the circuit. This will cause a voltage drop across the internal resistors. This will lead to a drop in voltage across the battery.	Full explanation	States that this is because a current is drawn		Invalid conceptual understanding	
C1e	3	Current = 1.79 A Total voltage drop is 2.8 V EMF = 3V Therefore net voltage across resistors is 0.2 V $V=IR=0.2 = 1.79 \times R$; $R_1+R_2 = 0.112$ ohms	Full working	Calculates net voltage across resistors of 0.2 V	States that total voltage drop is 2.8V	Invalid working	Full Kirchhoff's law proof.

QUESTION 5: MOTORS AND AC

Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
C2a	1	$I=V/R$ $=150/15$	Correct working			Incorrect working	
C2b	1		Correct diagram			Incorrect diagram	
C2c	1	$V_s^2 = V_r^2 + V_L^2$ $240^2 = 150^2 + V_L^2$ $V_L = \sqrt{240^2 - 150^2}$	Correct working			Incorrect working	
C2d	1	$X_L = V_L / I$ $= 187 / 10$	Correct working			Incorrect working	
C2e	1	$Z = V / I$ $= 240 / 10$ $= 24.0 \text{ ohms (could also use impedance equation)}$	Correct calculation			Incorrect calculation	

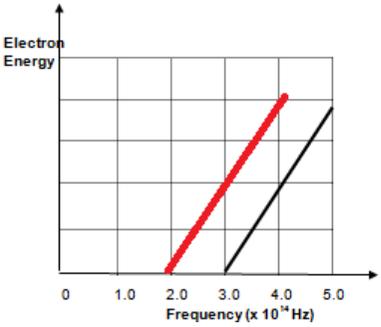
Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
C2f	1	$X = \omega L$ $18.734 = \omega L$; $\omega = 113.55$ $\omega = 2\pi f$ $f = 113.55 / 2\pi$ $f = 18.1 \text{ Hz}$	Correct answer	Correctly uses $X = \omega L$		Incorrect answer	
C2g	1	Increase	Correct statement			Incorrect statement	
C2h	2	As the frequency increases the reactance increases. This will lead to an increased impedance. This will result in a reduced current which will lead to a reduced voltage.	Full description	States that impedance is increased		Incorrect description	
C2i	3	Add a capacitor. With the existing circuit the supply voltage leads the current. The angle needs to be reduced to zero. By adding a capacitor (with voltage 180 degrees out of phase with the inductor) the inductor voltage can be cancelled out if the reactance of the two components (capacitor and inductor) are the same. This will result in the supply voltage being in phase with the current.	Full description	Partial description	Identifies that a capacitor needs to be added	Incorrect answer	Fully 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 6: THE LIGHT METER

Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
D1a	1	h – Planck’s constant f – frequency of the photon ϕ - work function	Correct definition for all three symbols			Incorrect answer	
D1b	1	$E=hf$ $=6.63 \times 10^{-34} \times 6.16 \times 10^{14}$ $=4.08 \times 10^{-19} \text{ J}$	Correct answer			Incorrect answer	
D1c	1	Brighter light means more photons. Therefore more electrons and so more current	Correct description			Incorrect description	
D1d	1	No time delay	Correct statement			Incorrect statement	
D1e	1	No current	Correct statement			Incorrect statement	
D1f	3	By turning on the battery so that the electrons are just stopped the energy used by the battery will be eV. This energy must be equal to the kinetic energy of the released electrons. This gives an indirect measurement of the electron’s kinetic energy	Full explanation	Partial explanation	Understands that the battery must do work	Incorrect answer	Full explanation and shows that mathematically $eV = \frac{1}{2}mv^2$

Item #	Skill Band	Evidence	Student Response Level				
			Excellent	Moderate	Low	Weak	Exceed
D1g	1	$hf - E_k = \phi$ $6.63 \times 10^{-34} \times 6.16 \times 10^{14} - 5.6 \times 10^{-20} =$ $3.52 \times 10^{-19} \text{ J}$	Correct answer			Incorrect answer	
D1h	2		Parallel line and a line that will have a smaller y intercept	Parallel line or a line that will have a smaller y intercept		Incorrect answer	