Assessment Schedule – 2007

Level Three Physics: Demonstrate understanding of wave systems (90520)

Evidence Statement

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
1(a) P2	2½ waves in the pipe $\Rightarrow 28.5 = \frac{5\lambda}{2} \Rightarrow \lambda$ = **11.4 cm** **OR 0.114 m**	[2] Correct answer		
1(b) P2	5th harmonic OR 4th overtone	[1] Correct answer		
1(c) P2	λ(fundamental) = $2L$ = 0.570 m $f = \frac{v}{\lambda} = \frac{340}{0.570} = 596.49$ = **596 Hz** **OR 596 s^{-1}** OR f(5th harmonic) = 5 × f(fundamental) $f(5\text{th H}) = \frac{v}{\lambda(5\text{th } H)}$ $\Rightarrow f(\text{fund}) = \frac{340}{5\times 0.114} = 596.49$ = **596 Hz**		[2] Correct answer	
1(d) P3	When particular incident waves that have the fundamental frequency (wavelength) are reflected at the pipe ends, they superpose (interfere) with the waves travelling in the opposite direction, to produce a standing wave.	[1] Idea of incident and reflected waves combining to produce standing waves. **OR** Idea of vibration of air at the right frequency causing resonance to produce a standing wave.	[1]Achievement plus clear implication that the wave has to "fit" the pipe. **OR** The driving frequency matches the length of the pipe causing resonance.	
1(e) P3	Opening the last hole makes the pipe shorter. This means the note will have a shorter wavelength and so a higher frequency.	[1] Change in pipe length changes wavelength (frequency). **OR** Opening the air hole causes the wavelength to decrease which causes the frequency to increase	[1]**Decrease** in pipe length linked to **decrease** in wavelength and hence increase in frequency. **OR** Achieved plus speed of he wave stays the same.	[1]Merit plus speed of the wave stays the same.
2(a) P4	There is no relative motion between Carlie and the source of the waves so she hears the sound at the frequency it is produced at. The motion of the float towards Edward means that there is an apparent change in wavelength, and hence frequency, making the pitch of the note he hears different from its true pitch.	[1] Carlie and source travelling at same speed **OR** Edward and source travelling at different speeds.	[1] Link made between different speeds AND a change in wavelength AND frequency. **Watch out for contradictions**	[1] Merit **plus** both Achievement points made (**why** Carlie hears the true frequency AND **why** Edward hears a higher pitch) to show clear understanding of the need for relative motion to observe Doppler effect. See evidence.
2(b) P4	$f` = f(\frac{v_w}{v_w - v_s}) \Rightarrow f = f`(\frac{v_w - v_s}{v_w})$ $\Rightarrow f = 673\,(\frac{340-1.2}{340}) = 670.625$ = **671 Hz**	[2] Correct re-arrangement **AND** must use $v_w - v_s$	[2] Correct re-arrangement and answer	

2(c) P5	To hear beats the listener must receive **both** frequencies so that interference between the two waves can cause the louds and softs. In this situation Carlie hears **only** the true frequency, Edward hears **only** the apparent frequency. Neither of them hears both frequencies.	[1] Idea that both frequencies must be heard **OR** idea of how beats are formed. **OR** No interference from another source	[1] Correct explanation for why both frequencies are not heard by both people, **AND** about how beats are formed.	
2(d) P5	$\lambda`_{away} - \lambda`_{towards} = 0.0032$ $\lambda`_{towards} = \lambda(\frac{340-1.2}{340}) = 0.99647\lambda$ $\lambda`_{away} = \lambda(\frac{340+1.2}{340}) = 1.00353\lambda$ $\Rightarrow \lambda(1.00353 - 0.99647) = 0.0032$ $\Rightarrow \lambda = 0.453258$ m $v = f\lambda \Rightarrow f = \frac{340}{0.453258} = 750.125$ = **750 Hz**	[2]Correct identification of $\lambda`_{away} - \lambda`_{towards} = 0.0032$ **OR** Correct calculations of both apparent wavelengths **OR** [1]Correct wavelength and frequency of note/correct application of Doppler Effect.	[2] Correct wavelength ($\lambda`_{away} - \lambda`_{towards} = 0.45333$) **OR** Correct answer consistent with incorrectly calculated wavelength.	[2] Correct answer
3(a) P6	violet / blue	[1] Correct answer		
3(b) P6	This is a **SHOW** question $n\lambda = d\sin\theta$ n = 1, $\theta = 49.8°$, $\lambda = 5.65 \times 10^{-7}$ m $\Rightarrow d = \frac{5.65\times10^{-7}}{\sin 49.8} = 7.39726 \times 10^{-7}$ $= 7.40 \times 10^{-7}$ m If rounding is incorrect or sf is incorrect then it is only A2 and no unit grade.	[2] Correct working [1] Answer given to 3sf, and THREE answers given with a correct unit.(cannot include 3b).		
3(c) P7	Violet light from DVD would be produced when $\sin\theta = \frac{438\times10^{-9}}{7.3973\times10^{-7}}$ $\Rightarrow \theta = 36.31°$ So angle from CD must be 36.31 – 20.4 = 15.91° CD track spacing is $d = \frac{438\times10^{-9}}{\sin 15.91}$ $= 1.5978 \times 10^{-6}$ = **1.60×10^{-6} m**	[2] Correct answer to DVD's $\theta = 36.31°$ **Or** [1] Correct track spacing of CD.	[2] Correct answer consistent with incorrectly calculated angle **Or** Achieved plus correct value of CD's angle (= 15.91°).	[2] Correct answer
3(d) P8	Because the tracks are further apart, when light is shone onto a CD constructive interference for any particular colour occurs at smaller angles. This means that the spectra for a CD are narrower and closer together. Since the maximum possible angle at which interference can occur is 90°, with a CD more spectra will fit in than with a DVD.	[1] Idea of smaller angle for constructive interference /diffraction / spectra.	[1] Larger spacing linked to smaller angle for constructive interference /diffraction / spectra.	[1] Complete answer links wavelengths to slit spacing and angle for constructive interference/diffraction / spectra. **AND** must mention that maximum interference that can occur is at 90°

Judgement Statement

	Achievement	Achievement with Merit	Achievement with Excellence
Criterion 1	$4 \times A1$	$2 \times A1 + 3 \times M1$	$2 \times A1 + 2 \times M1 + 2 \times E1$
Criterion 2	$3 \times A2$	$2 \times A2 + 2 \times M2$	$2 \times A2 + 2 \times M2 + 1 \times E2$