Assessment Schedule – 2007

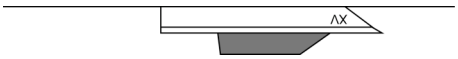
Physics: Demonstrate understanding of wave and light behaviour (90182)

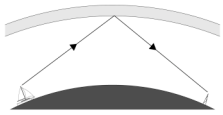
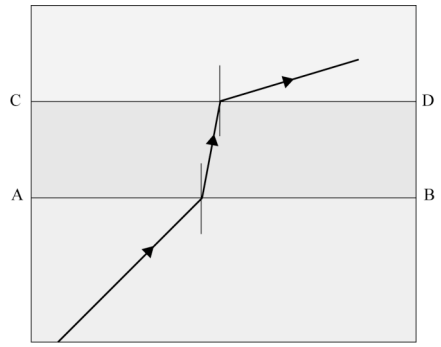
Evidence Statement

Note: Minor computational errors will not be penalised. A wrong answer will be accepted as correct provided there is sufficient evidence that the mistake is not due to a lack of understanding. Such evidence includes:

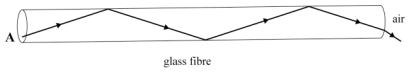
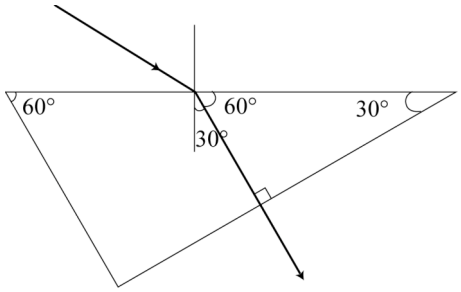
- the last written step before the answer is given has no unexpanded brackets or terms and does not require rearranging
- the power of any number that is multiplied by a power of 10 is correct.

Correct units and significant figures are required only in the questions that specifically ask for them.

Question	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
ONE (a)		[1] Correct image.		
(b)	Virtual. Because rays of light do not come from the image.	[1] States virtual.	[1] States virtual and gives correct explanation.	
(c)	D = 0.85 + 0.25 + 0.25 = 1.35 m	[2] Correct answer.		
(d)	$T = \frac{60}{20} = 3.0$ s	[2] Correct answer.		
(e)	Distance covered in one period: $d = 4 \times$ amplitude $= 4 \times 0.15 = 0.60$ m $v = \frac{d}{t} = \frac{0.60}{3.0} = 0.20$ ms^{-1}	[2] Correct answer for *d*.	[2] Correct working and answer [COE possible from (d)].	
(f)	$\lambda = \frac{v}{f} = \frac{3.0 \times 10^8}{8.5 \times 10^9} = 0.035$ m (accept 3.5 x 10^{-2} m or 0.04 m.)	[2] Correct working and answer.		
(g)	$v = f\lambda = 4.60 \times 10^{14} \times 4.35 \times 10^{-7}$ $= 2.00 \times 10^8$ $\frac{n_1}{n_2} = \frac{v_2}{v_1} \Rightarrow \frac{1.50}{n_2} = \frac{2.20 \times 10^8}{2.00 \times 10^8}$ $n_2 = 1.36$	[2] Correct answer for *v*.	[2] Achieved plus correct substitution for second step.	[2] Correct working and answer.

TWO (a)	• Sound waves are longitudinal waves whereas radio waves are transverse waves. • Sound waves travel slower than radio waves. • Sound waves need a medium to travel through, radio waves can travel through vacuum. • Sound waves are mechanical waves, while radio waves are electromagnetic waves.	[1] Any one point made clearly.		
(b)		[1] A ray from the boat reflected off the ionised layer to the coast guard with arrows (ruled).		
(c)	$t = \frac{d}{v} = \frac{340000}{3.0 \times 10^8} = 0.0011$ s $= (1.1 \times 10^{-3}$ s)	[2] Correct working and answer using 340 km.	[2] Correct working and answer.	
(d)	$135 - 90 = 45°$	[2] Correct working and answer.		
(e)	 Along AB the ray bends towards the normal. Along CD the ray bends away from the normal.	[1] Bending at either boundary is correct (ruled).	[1] Correct bending at BOTH boundaries (the angle of refraction along CD must be greater than the angle of incidence along AB) (ruled).	
(f)	1 Along the boundary AB the ray moves from a layer of medium refractive index/optical density to higher refractive index/optical density, its speed decreases, so it bends towards the normal. 2 Along the boundary CD the ray moves from a layer with high refractive index/ optical density to lower refractive index/optical density, its speed increases, so it bends away from the normal.		[1] Either statement is correct and relates to the given situation. OR Relates the angle of bending to the relative refractive index	[1] BOTH statements are correct and relate to the given situation.

THREE (a)	$v = \frac{d}{t} = \frac{100}{54} = 1.85$ $T = \frac{60}{15} = 4.0$ s $f = \frac{1}{4.0} = 0.25$ Hz $\lambda = \frac{v}{f} = \frac{1.85}{0.25} = 7.4$ m (Accept $\lambda = v \times T = 1.85 \times 4 = 7.4$ m)		[2] Correct working and answer for v and T or f.	[2] Correct working and answer.
(b)	Distance between the horn and the boat, $D_1 = v \times t = 335 \times 0.84$ = 281.4 m Distance from the horn to the building, and from the building to the boat $D_2 = v \times t = 335 \times (5.8 + 0.84)$ = 2224.4 m Distance between the building and the horn = $(D_2 - D_1) / 2$ = (2224.4 – 281.4) / 2 = 971.5 m (= 970 m) OR other valid method.	[2] Calculation of D_1.	[2] Correct working answers for D_1 and D_2 shown.	[2] Correct working and answer.
(c)	Sound waves travel through vibration of particles. The particles in air are relatively further apart compared with those in iron. So the rate of collision (energy transfer) in iron is greater than in air, therefore the sound wave travels faster in iron. (OR in air the particles are far apart compared to those in iron, so the rate of collision is slower). OR The internal bonds of atoms in iron are much stronger than the gaseous bonds between air molecules. Also in iron, the atoms are pushed together more tightly than the molecules in air. So they bump into each other more frequently, allowing the energy from the sound waves to travel faster.		[1] Relates the particle distance to the speed.	[1] Relates the particle distance to the speed, and the rate of collision to the increase in speed.

FOUR (a)	1 The ray must travel within an optically denser medium towards a less dense medium. 2 The angle of incidence at the boundary of two media must be greater than the critical angle.	[1] Either statement is correct.	[1] BOTH statements are correct.	
(b)		[1] Diagram shows internal reflection. (ruled)	[1] Correct diagram for internal reflection, and the ray bends away from the normal when it exits.	
(c)	Violet.	[1] Correct answer.		
(d)	White light contains 7 different wavelengths (frequencies). Different wavelengths travel at different speeds in optic fibre. So all the wavelengths would not arrive all at once and each wavelength would exit at a different time, making the data less clear.	[1] Mentions different colours have different speeds in the fibre.	[1] Mentions different wavelengths/ frequencies have different speeds in the fibre. OR Mentions different colours have different speeds in the fibre and relates to time of arrival.	[1] Correct explanation relating different speeds to time of arrival.
(e)	 Angle of refraction = 30°	[2] Correct answer.	[2] Correct working and answer.	

Judgement Statement

	Achievement	Achievement with Merit	Achievement with Excellence
Criterion One	4 × A1	2 × M1 + 4 × A1	1 × E1 + 3 × M1 + 3 × A1
Criterion Two	3 × A2	2 × M2 + 3 × A2	1 × E2 + 2 × M2 + 3 × A2