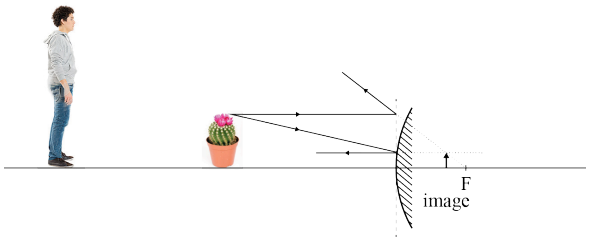
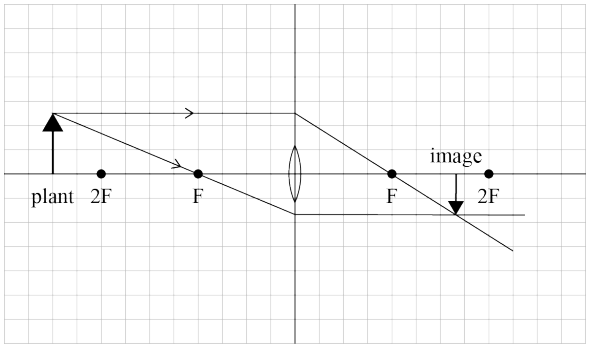
Assessment Schedule – 2016

Physics: Demonstrate understanding of waves (91170)

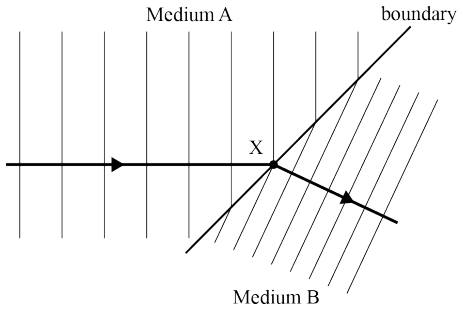
Assessment Criteria

Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ	**N1**	**N2**	**A3**	**A4**	**M5**	**M6**	**E7**	**E8**
No response; no relevant evidence.	Very little Achievement evidence.	Some evidence at Achievement level, but most is at the Not Achieved level.	A majority of the evidence is at the Achievement level.	Most evidence is at Achievement level.	Some evidence is at the Merit level.	A majority of the evidence is at the Merit level.	Evidence is provided for most tasks. The evidence at the Excellence level may have minor errors, or the evidence is weak.	Evidence is provided for most tasks and the evidence at the Excellence level is accurate.
-	1a	2a	3a	4a	1m + 3a	2m + 2a	1e+ 2m	1e + 2m + 1a

Evidence Statement

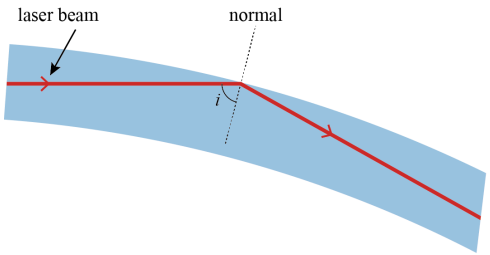
ONE (a)		Correct image position shown.		
(b)		Two rays correct.	Two rays correct with correct arrows **AND** image correct.	

(c)	• A **real image** occurs where rays converge, whereas a **virtual image** occurs where rays only appear to converge. • A virtual image is **upright**, virtual images cannot be projected on to a screen. A real image will be **inverted** / placing a screen or detector at the image will show the image.	One correct -description **OR** detection.	Correct description of detection **AND** explanation of difference between virtual and real image.	
(d)	$d_o = 60.0 \quad f = 40.0 \quad h_o = 10.0$ $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$ $\frac{1}{40} = \frac{1}{60} + \frac{1}{d_i}$ $\frac{1}{d_i} = \frac{1}{40} - \frac{1}{60}$ $d_i = 120\ c\text{m}$ $m = \frac{d_i}{d_o} = \frac{h_i}{h_o}$ $\frac{120}{60} = \frac{h_i}{10}$ $h_i = 20.0\ \text{cm}$ (or alternative formula)	Correct formula and substitution (using Descartes's or Newton's method).	Correct image distance.	Correct mathematical calculation and answers (with correct units and significant figures).

TWO (a)		Correct diagram drawn.		
(b)	Property of a wave that does not change: Frequency $v = f\lambda$ As the wave enters medium B, it slows down. Since **wavelength ∝ wave speed**, if the wavelength reduces (since frequency remains the same), the (wave) speed must reduce.	Correct property stated (**frequency**) **OR** wave speed is less.	Correct property stated **AND** correct **explanation** of reduced wave speed.	
(c)	$\frac{n_1}{n_2} = \frac{v_2}{v_1} = \frac{\lambda_2}{\lambda_1}$ $\frac{v_2}{3.3} = \frac{0.2}{0.3}$ $v_2 = 3.3 \times \frac{0.2}{0.3}$ $v_2 = 2.2 \text{ m s}^{-1}$	Correct formula and substitution.	Correct wave speed with units.	

(d)(i) (ii) (iii)	Diffraction. Correct diagrams for A and B, showing: • little diffraction of wave fronts for A • diffraction / semi-circular wave fronts for B • both diagrams show wavelength remains unchanged. The waves reached the lily using rock position B. (Diffraction is the spreading out of waves as they pass through a gap or around a barrier.) The closer the width of the gap is to the size of the wavelength of the waves the more the waves diffract and therefore spread out. Little diffraction with A because the gap is very much bigger than the wavelength and so waves do not diffract much and do not reach the lily. The **small gap for B is similar in size to the wavelength** of the incoming waves and waves would reach water lily because of significant diffraction.	Process named and **TWO** correct points.	Process named and **ALL** correct points.	Comprehensive answer linking reasoning to effect.

THREE (a)	Water and glass have different refractive indices, so bend light differently and the boundary of the water and glass is visible.	**Different** refractive indices.		
(b)	$n_1 \sin\theta_1 = n_2 \sin\theta_2$ Air-water interface: $1.00 \sin 32 = 1.33 \sin\theta_r$ $\sin\theta_r = \sin^{-1} \frac{1.00 \sin 32}{1.33}$ $\theta_r = 23.48°$ Water-glass interface: $1.33 \sin 23.48 = 1.52 \sin\theta_r$ $\sin\theta_r = \sin^{-1} \frac{1.33 \sin 23.48}{1.52}$ $\theta_r = 20°$ (This can be combined into a single equation.)	Correct substitution in Snell's Law.	Correct answer.	
(c)	• The angle of incidence has to be greater than the critical angle. • This is true for a ray going from a medium of higher refractive index (optical density) to one of lower refractive index.	**ONE** condition correctly stated.	**BOTH** conditions correctly stated.	

(d)(i)		**TWO** of: • correct path of beam • correctly labelled angle of incidence • use of Snell's Law.	**ALL** of: • correct path of beam • correctly labelled angle of incidence • use of Snell's Law including realisation that $\theta_r = 90°$. **OR** All correct but 1 error.	**ALL** correct **AND** n correctly calculated to 3 decimal places.
(ii)	$n_1 \sin\theta_1 = n_2 \sin\theta_2$ Water-air interface: $n_1 \sin 48.70 = 1.00 \sin 90$ $n_1 = \dfrac{1.00}{\sin 48.70}$ $n_1 = 1.331$			

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 13	14 – 19	20 – 24