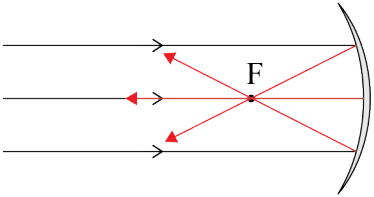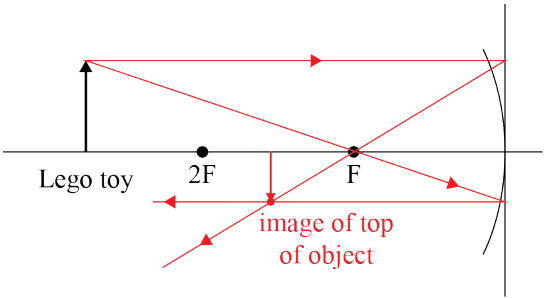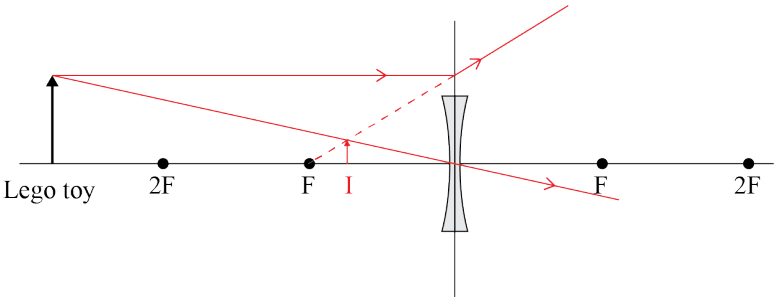**Assessment Schedule – 2019**

Physics: Demonstrate understanding of waves (91170)

Evidence Statement
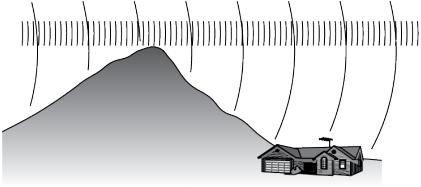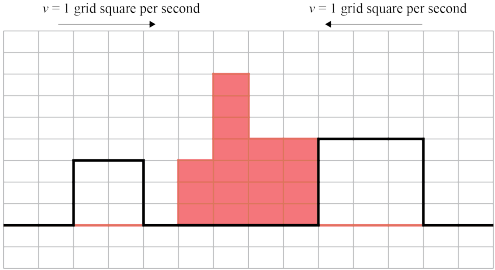
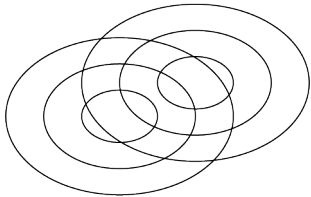| Q	Evidence	Achievement	Merit	Excellence
ONE (a)	Rays meet at focal point. 	• Ray diagram with all three rays (including arrows) reflected through the focal point.		
(b)	$d_o = 30$ cm, $h_i = 2$ cm, $h_o = 3$ cm Using $$\frac{d_i}{d_o} = \frac{h_i}{h_o}$$ $$d_i = d_o \times \frac{h_i}{h_o}$$ $$d_i = 30 \times \frac{2}{3} = 20 \text{ cm}$$ Substitute into: $$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o} = \frac{1}{20} + \frac{1}{30} = \frac{1}{12}$$ $f = 12$ cm	• d_i calculated or f found correctly from incorrect d_i.	• Correct answer for both d_i and f.	

(c)(i)	Ray diagram drawn and arrows in place.	• TWO correct rays . OR image correctly identified.	• Part (i). OR Part (ii) correct.	• Complete answer.
	Lego toy 2F F image of top of object Image correctly drawn as real, inverted diminished.			
(ii)	The effect of increasing the radius of curvature would be to increase the focal length, and so the image would form further away from the mirror.			
(d)	Ray diagram completed. Lego toy 2F F I F 2F Virtual image formed at I.	• Image is virtual. OR Any TWO rays drawn correctly.	• Correct diagram, both rays and image identified as virtual.	

	Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
	NØ	**N1**	**N2**	**A3**	**A4**	**M5**	**M6**	**E7**	**E8**
	No response; no relevant evidence. (e.g. 0A)	Very little Achievement evidence. (e.g. 1A)	Some evidence at the Achievement level, but most is at the Not Achieved level. (e.g. 2A OR 1M)	A majority of the evidence is at the Achievement level. (e.g. 3A OR 1M + 1A)	Most evidence is at the Achievement level. (e.g. 4A OR 2A + 1M)	Some evidence is at the Merit level. (e.g. 1A + 2M OR 3A + 1M)	A majority of the evidence is at the Merit level. (e.g. 3M OR 2A + 2M)	Evidence is provided for most tasks. The evidence at the Excellence level may have minor errors, or the evidence is weak. (e.g. 1E + 2M OR 1E + 1M + 2A)	Evidence is provided for most tasks and the evidence at the Excellence level is accurate. (e.g. 1E + 2M + 1A)

Q	Evidence	Achievement	Merit	Excellence
TWO (a)	Using $n_1 \sin\theta_1 = n_2 \sin\theta_2$ $n_1 = 1$ $\sin(90° - 36°) = 1.45 \sin\theta_2$ Angle = 34°	• Correct answer (Allow $\theta_1 = 36°$ for substitution as shown in diagram giving 24°.)		
(b)	Refraction and the result of changing speed in the medium cause the change of direction (only because of angle of incidence).	• Correct term OR identified change of speed.	• Complete answer.	
(c)	Total Internal Reflection. Cladding must have lower refractive index than core, or similar response re density, as total internal reflection occurs only if moving from high to low refractive index medium.	• Total Internal Reflection identified. OR • Refractive indices discussed.	• Discussion of difference in refractive index.	
(d)	$v = 3.00 \times 10^8 \text{ m s}^{-1}, f = 3.53 \times 10^{14} \text{ Hz}.$ $\dfrac{v}{f} = \lambda$ $\lambda = 8.5 \times 10^{-7}$ Using $\dfrac{n_1}{n_2} = \dfrac{\lambda_2}{\lambda_1}$ Substitute value for λ_1. $\lambda_2 = 8.50 \times 10^{-7} \times \dfrac{1}{1.45}$ Correct answer 586 nm or 5.86×10^{-7} m.	• Either correct value for λ_1. OR Recognition of correct formulae for calculating λ_2.	• Correct answer, minor errors.	• Correct answer with correct unit.

Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ	**N1**	**N2**	**A3**	**A4**	**M5**	**M6**	**E7**	**E8**
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Q	Evidence	Achievement	Merit	Excellence
THREE (a)	Working including conversion to Hz. $T = \dfrac{1}{f}$ $f = 95 \times 10^6$ So $T = 1.05 \times 10^{-8}$ s So 10.5 ns	• This is a show answer.		
(b)	Diffraction is the phenomenon. Wave diagrams show longer waves diffracting over and down mountain with smaller just passing on. So longer wavelengths would give better reception. 	• One point.	• Both points.	
(c)	 Pink shaded bit is the answer.	• Correct shape or correct placement of both pulses incorrectly added.	• Correct answer	

(d)	• Constructive or destructive interference. • Where it is constructive the waves are in phase and anti nodes will form and so amplify the signal. • Where they are out of phase a node will form and there will be no signal. • Links path difference to wavelength.	• Constructive or destructive interference named.	• Constructive or destructive interference linked to signal quality.	• Complete answer.

Not Achieved			**Achievement**		**Achievement with Merit**		**Achievement with Excellence**	
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Other combinations are also possible. (Using a=1; m=2; e=3) However, for M5 or M6, at least one Merit question needs to be correct. For E7 or E8, the Excellence needs to be correct.

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 14	15 – 19	20– 24