Question number	Answer	Additional guidance	Mark
1(a)	An explanation that makes reference to: identification – knowledge (1 mark) and reasoning /justification – knowledge (1 mark): • the wavelength decreases because wavelength is the ratio of wave velocity to frequency (1) • and the wave velocity reduces at the boundary but the frequency remains the same (1)	allow the same number of waves per second arrive at the boundary as leave it for no change in frequency at the boundary	**(2)**

Question number	Indicative content	Mark
1(b)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** • point A reaches the glass block before point B • A moves into the glass block and slows down • as light travels more slowly in glass than in air • B is still in air so is travelling faster than A • this causes part of the wavefront to change direction/refract • by the time B reaches the block it will have travelled further than A • therefore, the whole wavefront changes direction/refracts towards the normal • at the other face, A exits first so the process is reversed • the wavefront changes direction again so it is parallel to its original direction/refracts away from the normal	**(6)**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3–4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5–6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Question number	Answer	Additional guidance	Mark
1(c)	Substitution into $v = \frac{s}{t}$ to find v (1) $v = \frac{1.5 \times 10^{11}}{500}$ Substitution into $v = f \times \lambda$ and unit conversion (1) $v = \frac{1.5 \times 10^{11}}{500} = f \times 670 \times 10^{-9}$ Transposition (1) Rearrangement (1) $f = \frac{\left(1.50 \times 10^{11}\right)}{500 \times \left(670 \times 10^{-9}\right)}$ Answer (1) 4.5 x 10^{14} (Hz)	***s*** is distance award full marks for correct numerical answer without working maximum 3 marks if λ in nm 4.4776 x 10^{14} (Hz)	**(4)**

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	**X** amplitude (1) **Y** wavelength (1)		**(2)**

Question Number	Answer	Acceptable answers	Mark
2(a)(ii)	**A**  (1)		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(b)(i)	mirror (1) linked to: (which is) converging / concave / parabolic (1)	reflector (reflection / reflects is insufficient) curved **ignore** any reference to lenses, converging lenses and eyepieces	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(b)(ii)	magnifies	makes it (look) bigger **ignore** closeness, clearness, more detail etc. **ignore** focus the image **ignore** zoomed in	**(1)**

Question Number		Indicative Content	Mark
QWC	***2 (c)**	A description including some of the following points evidence for • idea of Sun, Moon, stars or planets moving across the sky (not just orbiting) • in the same direction • pattern is repeated • appear to be going around the Earth • same every day evidence against • moons of {Jupiter/ other planet (with moons)} • appear to {orbit/ go around} {Jupiter/ other planet} • movement of Sun etc. not quite the same each day • planets do not move in a simple path • retrograde (west-east) motion of planets If no other marks scored • heliocentric model = Level 1	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description stating one fact for or against e.g. for – the Sun / stars move across the sky OR against - Jupiter has moons OR against - (Galileo) produced the {heliocentric / sun-centred} model • the answer communicates ideas using simple language and uses limited scientific terminology e.g. some correct names for the moving objects • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description involving (linked) facts e.g. the Sun and stars move across the sky **AND** do the same thing each day OR moons orbit Jupiter OR one fact for **AND** one against e.g. the sun moves across the sky but changes from day to day • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately e.g. correct names for the moving objects • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description of arguments for **AND** against, including at least one link. e.g. the Sun and stars move across the sky. Galileo observed moons, which orbit Jupiter. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Total for Question 5 = 12 marks