

Paper 1 Higher

Question number	Answer	Mark
1(a)	<p>An answer that provides a description by making reference to:</p> <ul style="list-style-type: none"> transverse waves have oscillations perpendicular to direction of travel of the wave (1) whereas longitudinal waves have oscillations in the same direction as the direction of travel of the wave (1) 	(2)

Question number	Answer	Mark
1(b)(i)	<p>An answer that combines the following points of understanding to provide a logical description:</p> <ul style="list-style-type: none"> take time T for waves to pass a fixed point (1) and frequency = $\frac{\text{number of waves}}{\text{time taken}}$ (1) 	(2)

Question number	Answer	Mark
1(b)(ii)	A	(1)

Question number	Answer	Mark
1(b)(iii)	D	(1)

Question number	Answer	Additional guidance	Mark
2(a)	<p>An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (2 marks):</p> <ul style="list-style-type: none"> at the time, there was only naked-eye evidence (1) which indicated Sun/Moon/planets appear to move across the sky (1) in the same direction, same motion each day (1) 	allow valid alternatives, e.g. references to comets	(3)

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	<ul style="list-style-type: none"> The discussion attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2) Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3–4	<ul style="list-style-type: none"> The discussion is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2) Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5–6	<ul style="list-style-type: none"> The discussion is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2) Lines of reasoning are supported by sustained application of relevant evidence. (AO2)

Question number	Answer	Additional guidance	Mark
9(a)	<p>An explanation that makes reference to: identification – knowledge (1 mark) and reasoning /justification – knowledge (1 mark):</p> <ul style="list-style-type: none"> 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) 	<p>allow the same number of waves per second arrive at the boundary as leave it for no change in frequency at the boundary</p>	(2)

Question number	Indicative content	Mark
9(b)	<p>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.</p> <p>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.</p> <p style="text-align: center;">AO1 (6 marks)</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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
9(c)	<p>Substitution into $v = \frac{s}{t}$ to find v (1)</p> $v = \frac{1.5 \times 10^{11}}{500}$ <p>Substitution into $v = f \times \lambda$ and unit conversion (1)</p> $v = \frac{1.5 \times 10^{11}}{500} = f \times 670 \times 10^{-9}$ <p>Transposition (1) Rearrangement (1)</p> $f = \frac{(1.50 \times 10^{11})}{500 \times (670 \times 10^{-9})}$ <p>Answer (1) 4.5×10^{14} (Hz)</p>	<p>s is distance</p> <p>award full marks for correct numerical answer without working</p> <p>maximum 3 marks if λ in nm</p> <p>4.4776×10^{14} (Hz)</p>	(4)

Question number	Answer	Additional guidance	Mark
10(a)(i)	<p>An explanation that combines identification – knowledge (1 mark) and reasoning/justification – knowledge (3 marks):</p> <ul style="list-style-type: none"> causes 2 or 3 neutrons to be released (1) (and) one or more of these (released) neutrons are absorbed by other (U) nuclei (1) which cause further fission of U nuclei (1) and release further neutrons that can be absorbed, causing a chain reaction (1) 	<p>ignore U nucleus 'splits up'/eq</p>	(4)

Question number	Answer	Mark
10(a)(ii)	<p>Idea that to get a chain reaction the particle that impacts the nucleus must be the same as the one released (1)</p>	(1)

Question Number	Answer	Acceptable answers	Mark
4(a)(i)	C 310 nm		1

Question Number	Answer	Acceptable answers	Mark
4(a)(ii)	infrared (radiation)	infra red/ infra-red/ir/IR (condone) heat (radiation)	(1)

Question Number	Answer	Acceptable answers	Mark
4(a)(iii)	<p>suggestion including: (radiation) is absorbed (1)</p> <p>second mark can only be scored if first mark is scored</p> <p>by atmosphere (1)</p>	<p>blocked/stopped/reflected/filtere d/scattered ignore 'can't pass through' condone any named EM radiation</p> <p>by named gases</p> <p>e.g. 'carbon dioxide absorbs' scores 2</p>	2

Question Number	Answer	Acceptable answers	Mark
4b	<p>transposition (1) (f =) v/λ OR c/λ</p> <p>substitution (1) $3 \times 10^8 / 800 \times 10^{-9}$</p> <p>evaluation (1) 3.75×10^{14}</p> <p>hertz / Hz (1)</p>	<p>allow substitution and transposition in either order</p> <p>$3 \times 10^8 / 800$ shows transposition</p> <p>$3 \times 10^8 / 800 \times 10^{-9}$ scores for transposition and substitution $3 \times 10^8 = f \times 800 \times 10^{-9}$ just scores substitution mark</p> <p>ignore power of 10 errors until evaluation mark award full marks for correct answer with no working POT error gives 2 calculation marks, but check for unit e.g. kHz/GHz etc</p> <p>condone Hertz OR s^{-1} ignore hz or c.p.s accept correct SI prefix eg kHz, MHz, GHz, THz etc</p>	4

Question Number	Answer	Acceptable answers	Mark
4c	<p>An explanation linking star moving (relative to Earth) (1)</p> <p>and any one from wavelength is {smaller/decreased / shorter} (1)</p> <p>OR</p> <p>towards Earth (1)</p>	<p>{blue shift / opposite of red shift}</p> <p>frequency is {larger / bigger / higher / increased}</p> <p>towards {'us' / (our) Sun}</p> <p>Max 1 mark if mark 2 and 3 contradict</p>	2

Question Number	Answer	Acceptable answers	Mark
5(a)(i)	B position X		(1)

Question Number	Answer	Acceptable answers	Mark
5(a)(ii)	Description to include: <ul style="list-style-type: none"> • magnify (1) second mark can only be scored if first mark is scored • image {of the Moon/formed by the objective lens} (1) 	enlarge/make bigger etc ignore zoom/zoom in real/intermediate image image at X unqualified 'image' is insufficient ignore ideas of focusing	(2)

Question Number	Answer	Acceptable answers	Mark
5(b)(i)	A description including any three of <ul style="list-style-type: none"> • make wave (on water surface) (1) • {look at / observe} movement of cork (1) • (if cork and wave move) in same directions, wave is longitudinal (1) • (if cork and wave move) at right angles then wave is transverse (1) 	(cork moves) {horizontally /left and right} wave is longitudinal definition of longitudinal (cork moves) vertically /up and down wave is transverse definition of transverse full marks can be scored from a suitably labelled diagram	(3)

Question Number	Indicative Content	Mark									
QWC	<p>*5(b) (ii)</p> <p>An explanation including some of the following points (Changes are in bold type: reasons follow a bullet point)</p> <table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; width: 33%;">changes</th> <th style="text-align: left; width: 33%;">detail</th> <th style="text-align: left; width: 33%;">reason</th> </tr> </thead> <tbody> <tr> <td>wavelength changes decreases</td> <td>decreases</td> <td>(because) speed</td> </tr> <tr> <td>direction changes decreases</td> <td>towards the normal</td> <td>because speed left hand end meets</td> </tr> </tbody> </table> <p>surface first</p> <p>Relevant technical terms are refract and normal. One at least should be mentioned at levels 2 and 3 for full marks.</p> <p>Marks can be scored for the use of $v = f \lambda$ in any relevant way such as linking 'slower v' to 'smaller λ' by saying v is proportional to λ (at constant f)</p> <p>Notes:</p> <ul style="list-style-type: none"> • A correct unlabelled diagram can score up to 3 marks. • If conflict, between words and diagram go with words. • Ignore density arguments • If candidate contradicts the question and states that wave speed increases causing direction to change to (further) away from the normal or refract away from the normal, the maximum mark is level 1, 2 marks. 	changes	detail	reason	wavelength changes decreases	decreases	(because) speed	direction changes decreases	towards the normal	because speed left hand end meets	(6)
changes	detail	reason									
wavelength changes decreases	decreases	(because) speed									
direction changes decreases	towards the normal	because speed left hand end meets									

Level	0	No rewardable content
1	1 - 2	<ul style="list-style-type: none"> • a limited explanation including two simple changes OR one detailed change OR one simple change with a reason e.g. the wavelength changes and the direction changes OR the wavelength decreases OR the waves change direction because the speed is less • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	<ul style="list-style-type: none"> • a simple explanation including one simple change, one detailed change AND a linked reason to either change e.g. the direction changes, the wavelength decreases because the waves slow down OR two detailed changes with reason not given/unclear for 3 marks e.g. the wavelength decreases and the wave bends towards the normal OR as shown on a diagram • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	5 - 6	<ul style="list-style-type: none"> • a detailed explanation including two detailed changes AND a reason for each. e.g. the wavelength decreases because the waves slow down and the wave bends towards the normal because the left hand side slows down first • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Question Number	Answer	Acceptable answers	Mark
3(a)	<p>A description including the following points</p> <ul style="list-style-type: none"> • (Particles) vibrate/oscillate (1) • (vibration) parallel to direction of wave / propagation (1) 	<p>Both marks may be awarded for a clear diagram</p> <p>move backwards and forwards/to and fro/ push and pull Accept idea of (a series of) compressions and rarefactions</p> <p>in the same direction as wave travel /energy transfers</p> <p>Accept they vibrate in the same direction that the wave is going (for 2 marks)</p>	(2)

Question Number	Answer	Acceptable answers	Mark
3(b)	B the frequency of infrasound is too low		(1)

Question Number	Answer	Acceptable answers	Mark
3(c)(i)	<p>transposition (1) $t = \text{distance} \div \text{speed}$</p> <p>substitution (1) $(2 \times)2500 \div 340$</p> <p>evaluation (1) 14.7 (s)</p>	<p>This is a "show that" question, there must be evidence of calculation</p> <p>Ignore factor of 2 until final evaluation $2500 \div 340 = 2$ marks</p> <p>14.7 is evidence of calculation = 3 marks</p> <p>There are other ways to use the data e.g. $5000 \div 15 = 333$ (m/s) (which is about 340 m/s) $2500 \div 7.5 = 333$ (m/s) (which is about 340 m/s)</p> <p>OR $340 \times 15 = 5100$ (m) (which is about 5000 m) Give marks for transposition, substitution and evaluation clearly shown</p>	(3)

Question Number	Answer	Acceptable answers	Mark
3(c)(ii)	<p>Any one of the following points</p> <ul style="list-style-type: none"> • idea of a conversation (1) • (4000 m is) a longer distance taking a longer time (to reach other elephant) (1) • time needed for waves to travel is about 24 s (1) • time gap between calls (sufficient) for elephant to hear a reply (1) • call lasts long enough to be identified by other elephants (OWTTE) (1) 	<p>longer distance and call takes (some) time</p> <p>waiting to see if there is a reply/response (from another elephant)</p>	(1)

Question Number	Answer	Acceptable answers	Mark
3(d)	<p>A description linking the following points</p> <ul style="list-style-type: none"> • detecting/ locating/ monitoring (infrasound) (1) • volcanic eruptions / underground explosions / earthquakes / nuclear explosions / meteor strikes (1) 	<p>Ignore references to ultrasound and infrared</p> <p>idea of need for a detecting instrument (1)</p> <p>idea of infrasound (waves) travelling through a medium (1)</p>	(2)

Question Number	Answer	Acceptable answers	Mark
6(a)(i)	A infrared and microwaves		(1)

Question Number	Answer	Acceptable answers	Mark
6(a)(ii)	C lower frequency than ultraviolet		(1)

Question Number	Answer	Acceptable answers	Mark
6(b)(i)	<p>A description including two of the following points</p> <p>Either</p> <ul style="list-style-type: none"> UV penetrates the skin / can damage normal cells/ cause cell mutation/ionise cells (1) can cause (skin) cancer / can cause premature ageing (1) <p>OR</p> <ul style="list-style-type: none"> UV penetrates the eye / can damage/mutate cells in the eye (1) can cause cataracts / damage to the retina (macular degeneration) (1) 	<p>Ignore "harm" or "harmful" Accept "tissue" for cells</p> <p>sunburn</p> <p>can cause (snow) blindness</p>	(2)

Question Number	Answer	Acceptable answers	Mark
6(b)(ii)	<p>An explanation linking two of the following points</p> <ul style="list-style-type: none"> (ultraviolet/it) has a higher frequency (than infrared) (1) (therefore ultraviolet/it) has higher (photon) energy (1) (ultraviolet/it) penetrates further /(ultraviolet/it) causes ionisation (1) 	<p>Accept reverse argument if clearly about IR</p> <p>has a shorter wavelength</p>	(2)

**5PH1H/01 Mark Scheme
November 2011**

Question Number	Answer	Acceptable answers	Mark
1(a)	A		(1)

Question Number	Answer	Acceptable answers	Mark
1(b)(i)	(number of waves =) 7 (1) (distance between floats =) 7×0.8 (1)	Accept 5.6 (m) give full marks for correct answer, no working e.c.f from number of waves if clear 6.4 (m) for 1 mark	(2)

Question Number	Answer	Acceptable answers	Mark
1(b)(ii)	C		(1)

Question Number	Answer	Acceptable answers	Mark
1(b)(iii)	Any one from the following points <ul style="list-style-type: none"> • size (1) • mass (1) • speed (1) • direction of travel (1) 	small light slow fast momentum how far away weight power ke	(1)

Question Number	Answer	Acceptable answers	Mark
1(c)	<ul style="list-style-type: none"> • change of direction (1) • towards the normal (1) • λ shorter than in deep water (1) 	Ignore reflection of EITHER ray or wave must not reach normal if ray and wave contradict then no mark λ shorter for all complete waves in shallow water, at least 2λ drawn, judge by eye	(3)

Question Number	Answer	Acceptable answers	Mark
3(a)(i)	D		(1)

Question Number	Answer	Acceptable answers	Mark
3(a)(ii)	B		(1)

Question Number	Answer	Acceptable answers	Mark
3(b)	substitution: (1) $3.0 \times 10^8 = 1.5 \times 10^{10} \times \lambda$ transposition: (1) $\lambda = c/f$ or $(\lambda =) \frac{3.0 \times 10^8}{1.5 \times 10^{10}}$ evaluation: (1) 0.02 (m)	Give full marks for correct answer, no working Allow substitution and transposition in either order if clear Ignore powers of 10 until evaluation e.g. 3/1.5 2 marks $\lambda = f/c$ (0) then 1.5/3 1 mark bald 1.5/3 0 mark 2×10^{-2} (m) ignore formula triangle	(3)

Question Number	Answer	Acceptable answers	Mark
3(c)	An explanation linking two of the following points <ul style="list-style-type: none"> wavelength / frequency (1) are different (1) OR <ul style="list-style-type: none"> toaster on for longer (1) (so) much more energy (1) 	wavelength for toaster different from wavelength for remote. Scores 2 power / intensity of toaster greater than for remote for 2 marks	(2)

Question Number	Answer	Acceptable answers	Mark
3(d)	<p>An explanation linking three of the following points</p> <ul style="list-style-type: none"> • gammas change cell growth / eq (1) • (so can) cause uncontrolled growth (1) • (but also can) be focussed to (kill cancer cells)(1) • without damaging other cells 	<p>kill / damage cells</p> <p>mutate/damage DNA</p> <p>concentrated / aimed at tumour / penetrate</p>	(3)

Question Number	Answer	Acceptable answers	Mark
4(a)	C		(1)

Question Number	Answer	Acceptable answers	Mark
4(b)	5 (cm)	5.0, +5, -5, ±5 ignore unit	(1)

Question Number	Answer	Acceptable answers	Mark
4(c)	<ul style="list-style-type: none"> A difference in f or λ (however described) (1) <p>This difference correctly qualified by one of</p> <ul style="list-style-type: none"> Relationship to each other (1) Relationship to audible sound (1) Frequency or wavelength data (1) 	<p>Accept pitch for frequency</p> <p>IS has longer λ than audible (1)</p> <p>US > 20kHz (1)</p> <p>IS has lower f (than US) (2 marks)</p> <p>information shown on a labelled sketch of the sound spectrum</p>	(2)

Question Number	Answer	Acceptable answers	Mark
4(d)	<p>An explanation linking the following points</p> <ul style="list-style-type: none"> corks as plates / water as mantle (1) water heated (underneath) (1) convection currents mentioned(1) 	<p>labels on diagram</p> <p>corks as crust / water as magma /lava</p> <p>reference to heat in the Earth</p> <p>arrow on diagram</p>	(3)

Question Number	Answer	Acceptable answers	Mark
1(a)(i)	C travel with the same speeds in a vacuum, have different frequencies		(1)

Question Number	Answer	Acceptable answers	Mark
1 (a)(ii)	{damage to/ionise/mutate} {cells / DNA/tissue/ organs/ fetus} / cause {cancer/tumour}	kills cells/bacteria	(1)

Question Number	Answer	Acceptable answers	Mark
1 (b)(i)	Gamma, γ , γ , γ	UV, ultraviolet (rays/waves/radiation) Ignore X-rays	(1)

Question Number	Answer	Acceptable answers	Mark
1 (b)(ii)	one correct use (for UV/X-ray/gamma ray)	for example, (UV) – sunbeds, sterilise, detect banknotes (X-ray) - viewing internal organs / broken bones/airport security (gamma ray) – treat /cure cancer, kill {cells/bacteria}	(1)
		If one incorrect example is given, this mark is lost	

Question Number	Answer	Acceptable answers	Mark
1 (c)(i)	one from: MP1 heating of (body/human/internal) {cells / organs/tissues} (1) MP2 {heating/boiling/exciting / vibrating} water (in the body) (1)	Accept heating of blood Ignore damages, burns, cancer, mutates, heating (on its own), skin	(1)

Question Number	Answer	Acceptable answers	Mark
1 (c)(ii)	<p>explanation to include any three of:</p> <p>MP1 (Phones/ they) use lower frequencies / RA (1)</p> <p>MP2 lower frequency: lower energy / RA (1)</p> <p>MP3 lower {frequency/energy} less (potential) danger / RA (1)</p> <p>MP4 (phones /they) emit less (intense) radiation RA (1)</p> <p>MP5 phones are less powerful (1)</p>	<p>wavelength can suitably replace frequency eg use longer wavelength condone use lower MHz (comparison needed not just values quoted)</p> <p>Accept lower frequency (not energy) does {less /no} {damage/harm} for 2 marks</p> <p>ignore references to penetration ignore references to energy replacing power here</p> <p>For 2 marks -The resonant frequency of water molecules is the same as the oven frequency</p>	(3)

(Total for Question 1 = 8 marks)