PH1HP

Question 4

question	answers	extra information	mark
4(a)	refracted into the block, angle r < i		1
	refracted correctly out of block, two rays in air parallel	judge by eye if first mark not scored allow **1** mark for correct refraction shown as ray leaves the block	1
4(b)(i)	the angle of refraction is (always) less than the angle of incidence		1
	the angle of refraction increases as the angle of incidence increases	accept angle i and angle r are **not** directly proportional accept there is positive correlation	1
4(b)(ii)	(for the same angle of incidence) the angle of refraction in plastic is less than the angle of refraction in water	accept (for the same angle of incidence) plastic refracts light more than water accept it is less	1
4(c)(i)	accept any sensible suggestion to do with being able to see inside (during daylight hours) eg able to (see to) work / cook inside	accept to see what they are doing lights up the room is insufficient ignore no need to pay for electricity	1
4(c)(ii)	accept any <u>ethical</u> suggestion, eg • fair access to energy for all • unequal use of energy resources • consequences for the future of decisions made now • damage to global environment affects all	damage to the environment is insufficient	1
Total			**7**

Question	Answers	Extra information	Mark	AO spec ref
4(a)(i)	440 (sound) waves produced in one second	accept vibrations / oscillations for waves	1	AO1 1.5.1i
4(a)(ii)	0.773 (metres)	allow **2** marks for an answer that rounds to 0.773 allow **2** marks for an answer of 0.77̇2̇ allow **2** marks for an answer of 0.772 allow **1** mark for correct substitution ie 340 = 440 × λ	3	AO2 1.5.1j
4(b)	(sound is) louder as amplitude is larger higher pitch/frequency as more waves are seen	do **not** accept the converse waves are taller is insufficient reference to wavelengths alone is insufficient waves are closer together is insufficient	1 1 1 1	AO1 AO3 1.5.3b
Total			8	

Question	Answers	Extra information	Mark	AO spec ref
1(a)	(sound waves) which have a frequency higher than the upper limit of hearing for humans **or** a (sound) wave (of frequency) above 20 000 Hz	sound waves that cannot be heard is insufficient a wave of frequency 20 000 Hz is insufficient	1	AO1 3.1.2a
1(b)	640	an answer of 1280 gains **2** marks allow **2** marks for the correct substitution ie 1600 × 0.40 provided no subsequent step allow **2** marks for the substitution $\frac{1600 \times 0.80}{2}$ provided no subsequent step allow **1** mark for the substitution 1600 × 0.80 provided no subsequent step allow **1** mark for the identification that time (boat to bed) is 0.4	3	AO2 3.1.2c
1(c)	any **one** from: • pre-natal scanning / imaging • imaging of a named organ (that is not surrounded by bone), eg stomach, bladder, testicles • Doppler scanning blood flow	accept heart do **not** allow brain **or** lungs (either of these negates a correct answer)	1	AO1 3.1.2d

Question 1 continues on the next page . . .

Question 1 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
1(d)	advantage any **one** from: • (images are) high quality or detailed or high resolution • (scan) produces a slice through the body • image can be viewed from any direction • an image can be made of <u>any</u> part (inside the body) • easier to diagnose **or** see a problem (on the image)	clearer / better image is sufficient allow images are (always) 3D / 360° allow whole body can be scanned	1	AO1 3.1
	disadvantage any **one** from: • (the X-rays used **or** scans) are ionising • mutate cells **or** cause mutations **or** increase chances of mutations • turn cells cancerous **or** produce abnormal growths **or** produce rapidly growing cells • kill cells • metal/lead/glass/concrete shielding is needed	allow a description of what ionising is allow for cells: DNA / genes / chromosomes / nucleus / tissue damage cells is insufficient can be dangerous (to human health) unqualified, is insufficient	1	
Total			**7**	

Question number	Answer	Additional guidance	Mark
9(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
9(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
9(c)	Substitution into $v = \dfrac{s}{t}$ to find v (1) $v = \dfrac{1.5 \times 10^{11}}{500}$ Substitution into $v = f \times \lambda$ and unit conversion (1) $v = \dfrac{1.5 \times 10^{11}}{500} = f \times 670 \times 10^{-9}$ Transposition (1) Rearrangement (1) $f = \dfrac{\left(1.50 \times 10^{11}\right)}{500 \times \left(670 \times 10^{-9}\right)}$ 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)**

SECTION B

Question			Answer	Marks	AO element	Guidance
16	**(a)**		Arms move at 90^0 to wave direction / **AW** (1)	1	2.1	E.g. arms move at right angles to the wave (1)
	(b)	**(i)**	2 waves pass the same point (1) each second (1)	2	2 x 1.1	
		(ii)	Use of velocity = frequency x wavelength / 2 x 2 (1) 4 m/s (1) 12/4 = 3 s (1)	3	1.2 2.1 2.1	**ALLOW** use of speed = distance/time to calculate final answer
	(c)		Any one from: Reflections return at different times / **AW** speed of ultrasound is known / **AW** (1) **AND** Times indicate depth (of tissue boundaries) / **AW** (1) Depth can be calculated by speed x time (1)	3	1.1 2 x 2.1	
	(d)		1st column: shows up soft tissues / **AW** (1) 2nd column: pregnancy scans / **AW** (1) 3rd column: mutations / damage to DNA (1)	3	1.1 2.2 1.1	 **ALLOW** other uses of scans e.g. scanning tissues other than bones (1) **ALLOW** cancer (1)