

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

Question Number	Answer	Acceptable answers	Mark
1(b)	<p>A description including two of the following</p> <ul style="list-style-type: none"> • (bat) emits /sends /makes (ultra)sound /it / signal/wave(1) • signal/wave /(ultra)sound reflects/bounces(back)/rebounds (off moth/prey) (1) • bat's (ears) detect reflected (ultra)sound (1) • reflection is used to estimate distance (to moth) (1) 	<p>On diagram idea of something emitted e.g. line (with arrow) from anywhere on /near bat or outgoing waves</p> <p>On diagram idea of something reflected e.g. line with arrow from anywhere on /near moth or reflected waves (from moth)</p> <p>idea of reflection detected e.g. bat hears the reflected (ultra)sound/wave/signal</p> <p>idea of bat analyses data e.g. bat times how long (it takes) for reflected wave to get back</p> <p>Ignore idea that it listens for noises from prey</p>	(2)

Question Number	Indicative content	Mark
QWC	<p>*1(c) A description linking some of the following</p> <ul style="list-style-type: none"> • ultrasound does not cause damage to (healthy) cells / ORA • idea of real-time image with ultrasound • ultrasound uses non-ionising radiation • idea that (consultant) can change image position during ultrasound scan • 3D image possible with ultrasound • ultrasound safer for consultant • ultrasound machines more portable • ultrasound can be used to measure blood flow rates • ultrasound gives detail of soft tissue • X-rays are more suitable for bony structures • X-rays produce higher resolution images • X-rays are more suitable for parts of body containing gas (lungs, intestines) <p>This list is not exhaustive. Give credit for other plausible suggestions</p>	(6)
Level	0	No rewardable material
1	1-	<ul style="list-style-type: none"> • a limited description with no comparison or contrast ie describes a use/fact about ultrasound OR X-rays eg Ultrasound can be used to look at a foetus (unborn child) • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	3-	<ul style="list-style-type: none"> • a description giving some attempt at comparison or contrast ie describes a use of ultrasound AND X-rays eg Ultrasound can be used to look at a fetus. X-rays are used to detect broken bones OR Ultrasound can be used to look at a fetus because it's safer (than X-rays) • 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 description with clear comparison and/or contrast ie describes a use of ultrasound AND X-rays, one of which is detailed, AND a clear comparison Ultrasound can be used to monitor a fetus. In ultrasound the waves reflect off soft tissue. X-rays (are used to look at bones because they) are absorbed by bones OR Ultrasound can be used to monitor a fetus. In ultrasound the waves reflect off soft tissue. X-rays are used to look at bones but not used for fetus because they can damage DNA/cause mutations of cells • 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
1 (d)	substitution (1) $5000 \times 0.000\ 003$ evaluation (1) $0.015\ (m)$ evidence of dividing by 2 (1) $(5000 \div 2) \times 0.000003$ $7.5 \times 10^{-3}\ (m)$ scores 3 marks	ignore powers of 10 until evaluation e.g. 5000×0.0003 etc gains 1 mark or $.15 / 1.5/15$ etc gains 1 mark $1.5 \times 10^{-2} / 0.015$ gains 2 marks $7.5/0.75/0.075$ etc gains 2 $0.0075\ (m)$ scores 3 marks give full marks for correct answer, no working	(3)

Question Number	Answer	Acceptable answers	Mark
2(a)	D		(1)

Question Number	Answer	Acceptable answers	Mark
2(b)(i)	(sudden) decrease in speed	refraction / change direction	(1)

Question Number	Answer	Acceptable answers	Mark
2(b)(ii)	a description linking <ul style="list-style-type: none"> • the (speed) increases (1) with any one of <ul style="list-style-type: none"> • as depth increases (1) • linearly (1) • from 11.8 to 14 (km/s) (1) • by 2.2 	accelerates travels further into the mantle / material becomes more dense steadily / evenly from >11 and < 12 to >13 and <14 2 to 3	(2)

Question Number	Answer	Acceptable answers	Mark
2(b)(iii)	substitution (1) $12 = 5800 \div t$ transposition (1) $t = 5800 \div 12$ evaluation (1) 480 (s)	Substitution and transposition can be in either order 8 minutes A value which correctly rounds to 480 give full marks for correct answer, no working	(3)

Question Number	Answer	Acceptable answers	Mark
2(c)	<p>an explanation linking</p> <ul style="list-style-type: none"> • impossible to predict earthquakes (1) <p>with one of</p> <ul style="list-style-type: none"> • (because) no pattern to {results/forces} (1) • (because) not able to predict force needed to make block start sliding (1) • the movement of (tectonic) plates is similar to the movement of the block (over the rough surface) (1) 	<p>difficult to predict</p> <p>results {(very) different/not (very) close/not concordant}</p> <p>as force needed for plates to start sliding is unpredictable</p> <p>(ignore references to strength of earthquake)</p>	(2)

Question Number	Answer	Acceptable answers	Mark
3 (ai)	D ultrasound waves (1)		(1)

Question Number	Answer	Acceptable answers	Mark
3 (aii)	<p>Any 3 from</p> <ul style="list-style-type: none"> emits (high frequency/ultra) (sound)(1) (sound is) reflected (off fish) (1) (reflection) detected by Dolphin (1) dolphin (estimates) time between (sending and receiving) sounds (1) dolphin is able to change time into (estimate of) distance (1) 	<p>Makes/sends out/produces (ultra sound/signal/wave)</p> <p>Uses 'high frequency sound' is insufficient</p> <p>(sound) bounces off (fish) or echoes</p> <p>towards dolphin</p> <p>1st three marks can be scored on the diagram. ie unless stated otherwise, assume any waves/rays starting at dolphin are ultrasound. Rays do not need to be straight</p>	(3)

Question Number	Answer	Acceptable answers	Mark
3 (b)	An explanation including: <ul style="list-style-type: none"> Infrasound (1) Plus one from: <ul style="list-style-type: none"> Decrease/change in amplitude is least (1) can be detected/'heard' further away (1) 	Marks are independent Stays the biggest/stays high. Has a bigger amplitude would travel the furthest/further	(2)

Question Number	Answer	Acceptable answers	Mark
3 (ci)	B seismic waves (1)		(1)

Question Number	Answer	Acceptable answers	Mark
3 (cii)	(there is a) difference/change in density (1)	more/less/too dense (reach a) boundary (between different materials) Ignore 'the waves cannot travel through liquids/oil'	(1)

Question Number	Answer	Acceptable answers	Mark
3 (d)	Substitution into correct equation(1) $v = 15 \times 125$ Evaluation (1) 1875 Unit (1) m/s	Power of 10 error max 1 mark for numerical answer 2 marks for correct numerical answer even with no working shown ms^{-1} not mps 1.875 km/s or 6750 km/h gain 3 marks If numerical answer incorrect, accept any correctly-written unit of speed: eg km/s or km/hr or miles per hour / mph	(3)

Total for Question 4 = 11 marks

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

Question Number	Answer	Acceptable answers	Mark
4(a)(ii)	moons (1) heliocentric (1)	must be in correct order	(2)

Question Number	Answer	Acceptable answers	Mark
4(a)(iii)	A description including two of the following points Reflecting telescope has mirror(s) (1) Galilean telescope has only lenses (1) Reflecting telescope can gather more light / can have a larger objective (1) Image viewed from the side of reflecting telescope (1) Image viewed from end of Galilean telescope. (1)	refracting telescope reverse argument	(2)

Question Number	Answer	Acceptable answers	Mark
4(b)(i)	5 (cm) (1) 8 (cm) (1)	+5 -5 0.08 m 80 mm	(2)

Question Number	Answer	Acceptable answers	Mark
4(b)(ii)	B		(1)

Question Number	Answer	Acceptable answers	Mark
5(ai)	A		(1)

Question Number	Answer	Acceptable answers	Mark
5(aii)	A description linking plates move / slip / separate (relative to each other) (1) sudden (release of energy) (1)	plate rubs against each other friction between plates plate boundary shifts jerk / jolt	(2)

Question Number	Answer	Acceptable answers	Mark
5(bi)	substitution (1) $0.65 = 80 / t$ transposition (1) $t = 80 / 0.65$ (123 seconds)	transposition and substitution can be in either order . Allow reverse calculations eg speed = $80/120$ (1) = 0.67 (about 0.65) (1) or distance = 0.65×120 (1) = 78 km (about 80) (1).	(2)

Question Number	Answer	Acceptable answers	Mark
5(bii)	A description linking any three detection of arrival of P and S waves (1) measurement of difference in arrival times (1) calculation of distance (from epicentre to station) (1) triangulation/using three / several stations (1)	Reward suitable labelled diagram	(3)

Question Number	Answer	Acceptable answers	Mark
5(b)(iii)	<p>A suggestion including any two of the following</p> <p>Infrasound (1)</p> <p>some animals can hear waves below human frequency range / 20 Hz (1)</p> <p>they could hear P waves arriving before the (stronger) S waves arrive (1)</p>	<p>Some animals have greater audio / tactile sensitivity than humans</p>	(2)