

Question Number	Answer	Acceptable answers	Mark
<b>1 (a)</b>	<ul style="list-style-type: none"> <li>below 20 Hz (1)</li> <li>above {20 000 Hz / 20 kHz} (1)</li> </ul> <p>If Hz or kHz is not seen somewhere, the maximum score is 1 mark.</p>	<p>infrasound</p> <p>ultrasound</p> <p>(in either order)</p> <p>(no units needed for the names)</p>	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>1 (b) (i)</b>	C it is a longitudinal wave travelling faster than an S wave		<b>(1)</b>

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<b>1 (b) (ii)</b>	<p>Explanation linking the following:-</p> <p>MP1 refraction /changing speed (1)</p> <p>MP2 (due to) changing {material/medium /rock type / density} (1)</p>	<p>ignore changes in direction/ bending (in this case)</p> <p>rock becomes {more / less} {dense / compact}</p>	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>1 (b) (iii)</b>	<p>Explanation linking the following:-</p> <p>MP1 (S / transverse waves) they cannot travel through liquid (1)</p> <p>MP2 Earth's core is (at least part) {liquid/molten} (1)</p> <p>MP3 (so) (S waves) they cannot travel through core (to other side of Earth) (1)</p>	<p>Check diagram for creditworthy points.</p> <p>they can only travel through solids</p> <p>may be stated in part (ii)</p> <p>(S / transverse waves) they cannot be detected on opposite side of the Earth to (collision site / earthquake)</p>	<b>(3)</b>

Question Number	Answer	Acceptable answers	Mark
<b>1 (b) (iv)</b>	<p>Suggestion to include any two from:</p> <p>MP1 idea that {kinetic energy/force/ momentum} of meteor might cause the earthquake (1)</p> <p>MP2 (earthquakes happen where) plates slide {past/over/under/away from/against} each other (1)</p> <p>MP3 (plates move) suddenly</p> <p>MP4 (meteor collision) starts seismic waves /P/S (1)</p>	<p>(meteor) it has large amount of kinetic energy</p> <p>(earthquakes happen where) plates collide rub/move for slide</p> <p>(earthquakes happen when) large amount of energy released in / near Earth's surface</p> <p>(plates) jolt/jerk</p> <p>vibrations passing through the Earth condone earthquake waves</p> <p>{kinetic energy/force /momentum} of meteor can cause the plates to slide past each other = 2</p>	<b>(2)</b>

**(Total for Question 4 = 10 marks)**

Question Number	Answer	Acceptable answers	Mark
<b>2(a)(i)</b>	<input checked="" type="checkbox"/> <b>A</b> ultrasound waves have a frequency above 20 000 Hz		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2(a)(ii)</b>	<input checked="" type="checkbox"/> <b>C</b> sonar		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2(a)(iii)</b>	<p>a description including any <b>two</b> of the following:</p> <ul style="list-style-type: none"> <li>(ultrasound waves / pulses) go down (through the water) (1)</li> <li>(ultrasound waves are) reflected <b>off fish</b> (1)</li> <li>(reflected ultrasound waves) are received by boat (1)</li> <li>time delay (shows how deep fish are) (1)</li> </ul>	<p>on diagram, wave or ray indicated as downwards idea of wave moving towards or hitting fish</p> <p>on diagram, waves or rays reflected <b>off fish</b> idea of wave bouncing <b>off fish</b></p> <p>signal is timed</p> <p><b>ignore</b> fish emitting ultrasound</p>	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2(b)(i)</b>	(number of waves =) 5 (1)		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2(b)(ii)</b>	$60 \div 5$ (1) <b>or</b> $60 \div$ (their answer to 2(b)(i)) (1)	12 (cm) <b>or</b> ecf from number of waves	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>2(c)</b>	Substitution $1.7 \times 8$ (1)  Evaluation $14$ (cm/s) (1)	$13.6$ (cm/s)  give full marks for correct answer, no working  Power of 10 error max. 1 mark.	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>3(a)</b>	<input checked="" type="checkbox"/> <b>D</b> both transverse and longitudinal waves		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>3(b)</b>	<p>A description including <b>three</b> of the following points</p> <ul style="list-style-type: none"> <li>• molten rock/magma (in mantle) (1)</li> <li>• convection currents (in mantle) (1)</li> <li>• plates move (1)</li> <li>• build up of pressure/force/energy (when plates (not) sliding over/under/past (each other)) (1)</li> <li>• sudden movement when pressure becomes too great/is released (1)</li> <li>• This sudden movement of plates is an earthquake (1)</li> </ul>	<p>Marks can be awarded on a labelled diagram Description of convection currents or arrows on diagram plates rub together</p> <p>Jolt/jerk when pressure becomes too great/ is released</p>	<b>(3)</b>

Question Number	Answer	Acceptable answers	Mark
<b>3(c)</b>	<p>relevant values 110 and 10 seen anywhere(1)</p> <p>100 (s) (1)</p> <p><b>acceptable range 95 to 105</b> (s)</p>	<p>(could be on chart)</p> <p>tolerance +/- 5 s give full marks for correct answer, no working</p>	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>3(d)</b>	<p>any vertical line of 10 squares on graph between P- wave and S- wave (1)</p> <p>OR times eg 52 (s) – 32(s) Range (48 to 56 ) – (29 to 35)</p> <p>220 (km) (1)</p>	<p>Range 9 to 11 squares</p> <p>range 200 to 240 (km)</p> <p>give full marks for correct answer, no working</p>	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>3(e)</b>	a description including <b>two</b> of the following: <ul style="list-style-type: none"> <li>• longitudinal / sound (wave) (1)</li> <li>• (frequency) less than <u>20 Hz</u> (1)</li> </ul>	<u>Frequency</u> below range/too low for (normal) human ear	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
4(a)	A 23 000 Hz		(1)

Question Number	Answer	Acceptable answers	Mark
4(b)	<p>Any one from the following points</p> <ul style="list-style-type: none"> <li>sonar / ranging (1)</li> <li>(medical) scanning(1)</li> <li>medical treatment (1)</li> <li>animal communication (1)</li> <li>cleaning(1)</li> </ul>	<p><b>Accept</b></p> <p>foetal/tumours</p> <p>shattering kidney stones /destroying cancer cells</p> <p>dog whistles</p>	(1)

Question Number	Answer	Acceptable answers	Mark
4(c)	<p>An explanation linking the following points</p> <ul style="list-style-type: none"> <li>a reference to frequency/pitch/hearing range (1)</li> <li>(frequency/pitch) is high(er) for cats RA (1)</li> </ul> <p>[The points must be linked for the second mark]</p>	<p>Accept Hz</p> <p>Cat detects high(er) frequency/pitch for 2 mark</p> <p>ignore incorrect value of frequency for ultrasound if a comparison made (tested in 1a)</p> <p>cat can hear &gt;20000 Hz (2)</p> <p>humans cannot hear &gt; 20000 Hz / ORA (2)</p> <p>amplitude too low / too quiet is 1 mark only if no other marks awarded</p>	(2)

Question Number	Answer	Acceptable answers	Mark
<b>4(d)(i)</b>	substitution (1) 340 x 0.047  evaluation (1) 16 (m)	15.9(8) (m)  give full marks for correct answer, no working	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>4(d)(ii)</b>	Any two from the following points <ul style="list-style-type: none"> <li>Idea of speed (1)</li> <li>correct difference identified e.g. sound slower RA (1)</li> </ul>	It/ infrared/light/em waves travel(s) faster/quicker scores 2 marks  Ignore references to time	<b>(2)</b>



Question Number	Answer	Acceptable answers	Mark
<b>5(a)</b>	<p>A description including the following points</p> <ul style="list-style-type: none"> <li>(Particles) vibrate/oscillate (1)</li> <li>(vibration) parallel to direction of wave / propagation (1)</li> </ul>	<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><b>Accept</b> they vibrate in the same direction that the wave is going (for 2 marks)</p>	<b>(2)</b>

Question Number	Answer	Acceptable answers	Mark
<b>5(b)</b>	<b>B</b> the frequency of infrasound is too low		<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>5(c) (i)</b>	<p>transposition (1) <math>t = \text{distance} \div \text{speed}</math></p> <p>substitution (1) <math>(2 \times )2500 \div 340</math></p> <p>evaluation (1) 14.7 (s)</p>	<p><b>This is a “show that” question, there must be evidence of calculation</b></p> <p><b>Ignore</b> factor of 2 until final evaluation <math>2500 \div 340 = 2</math> marks</p> <p>14.7 is evidence of calculation = 3 marks</p> <p>There are other ways to use the data e.g. <math>5000 \div 15 = 333</math> (m/s) (which is about 340 m/s) <math>2500 \div 7.5 = 333</math> (m/s) (which is about 340 m/s)</p> <p><b>OR</b> <math>340 \times 15 = 5100</math> (m) (which is about 5000 m) Give marks for transposition, substitution and evaluation clearly shown</p>	<b>(3)</b>

Question Number	Answer	Acceptable answers	Mark
<b>5(c)(ii)</b>	<p>Any <b>one</b> of the following points</p> <ul style="list-style-type: none"> <li>• idea of a conversation (1)</li> <li>• (4000 m is) a longer distance taking a longer time (to reach other elephant) (1)</li> <li>• time needed for waves to travel is about 24 s (1)</li> <li>• time gap between calls (sufficient) for elephant to hear a reply (1)</li> <li>• call lasts long enough to be identified by other elephants (OWTTE) (1)</li> </ul>	<p>longer distance and call takes (some) time</p> <p>waiting to see if there is a reply/response (from another elephant)</p>	<b>(1)</b>

Question Number	Answer	Acceptable answers	Mark
<b>5(d)</b>	<p>A description linking the following points</p> <ul style="list-style-type: none"> <li>• detecting/ locating/ monitoring (infrasound) (1)</li> <li>• volcanic eruptions / underground explosions / earthquakes / nuclear explosions / meteor strikes (1)</li> </ul>	<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>	<b>(2)</b>