

## **Mark Scheme**

Q1.

| Question Number | Answer                                                                                                                                                                                                                                                                                                      | Mark     |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
|                 | <p>The only correct answer is D <math>\left(\frac{1}{4 \times 0.005}\right)</math></p> <p>A is not correct because this gives the time period of the wave<br/>B is not correct because this gives half the time period of the wave<br/>C is not correct because the denominator is half the time period</p> | <b>1</b> |

Q2.

| Question Number | Answer                                                                                                                                                                                                                                                        |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                 | <p><b>D is the correct answer</b></p> <p>A is not correct because this gives the time period of the wave.<br/>B is not correct because this gives half the time period of the wave.<br/>C is not correct because the denominator is half the time period.</p> |

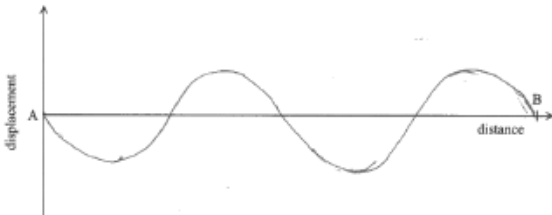
Q3.

| Question Number           | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Mark     |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| (a)                       | <p>Measure the position of the microphone<br/>Or measure the distance of the microphone from the speaker (1)</p> <p>Move microphone gradually until crest on the lower trace lines up with the trough of the top trace and measure the position (1)<br/>Or move microphone until traces are next in antiphase</p> <p>(Calculate the) distance moved by the microphone (which) is the wavelength (1)</p> <p>A method to determine the time period <math>T</math> from the oscilloscope [e.g. time period is approx. 5 x the timebase of the oscilloscope] (1)</p> <p>Multiply wavelength by <math>1/T</math> (1)</p> <p>(Do not award MP5 for “use <math>v = f\lambda</math>”)</p>                       | 5        |
| (b)                       | <p>Amplitude of the upper trace has increased<br/>Or trough of one trace is (again) aligned to top of the other trace. (1)</p> <p>Photograph 3 had the microphone closer to the loudspeaker<br/>Or Microphone has been moved a whole number of wavelengths. (1)</p> <p>(Sound) intensity varies with distance from loudspeaker (1)</p> <p>(For “amplitude”, allow “height” or “vertical displacement” but not “size” or “displacement”)</p> <p>(To award both MP1 and MP2, the statements need to be linked i.e. first alternative in MP1 linked to first alternative in MP2)<br/>(MP2 via second alternative can be awarded if candidate states that the microphone has been moved one wavelength)</p> | 3        |
| <b>Total for question</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>8</b> |

Q4.

| Question Number    | Answer                                                                                                                                                                                                                                                                                                                                         | Mark |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| (a)                | <p>Uses at least 3 waves to determine <math>T</math> (1)</p> <p>Use of <math>f = 1/T</math> (1)</p> <p><math>f =</math> in range 375 to 425 Hz (1)</p> <p><u>Example of calculation</u></p> $T = \frac{5 \times 1.5 \times 10^{-3} \text{ s}}{3} = 2.5 \times 10^{-3} \text{ s}$ $f = \frac{1}{2.5 \times 10^{-3} \text{ s}} = 400 \text{ Hz}$ | 3    |
| (b)                | <p>Wavelength of wave 1 is three times the wavelength of wave 2 or (1)</p> <p>Wavelength of <math>4\lambda</math> seen for wave 1 and <math>\frac{4}{3}\lambda</math> seen for wave 2</p> <p>So frequency of wave 1 is a third the frequency of wave 2 (1)</p> <p>Because the speed of sound is constant and <math>v = f\lambda</math> (1)</p> | 3    |
| (c)                | <p>Draws line of best fit and calculates gradient (1)</p> <p><math>v =</math> in the range 320 to 345 <math>\text{m s}^{-1}</math> (1)</p> <p><u>Example of calculation</u></p> $v = \frac{0.48 \text{ m} - 0.33 \text{ m}}{1.5 \times 10^{-3} \text{ Hz}^{-1} - 1.05 \times 10^{-3} \text{ Hz}^{-1}} = 333 \text{ m s}^{-1}$                  | 2    |
| (d)                | <p>Use of <math>v = f\lambda</math> (1)</p> <p>Use of <math>\lambda = 4 \times L</math> (1)</p> <p><math>f = 300 \text{ Hz}</math> (1)</p> <p><u>Example of calculation</u></p> $\lambda = 4 \times 0.282 \text{ m} = 1.13 \text{ m}$ $f = \frac{340 \text{ m s}^{-1}}{1.13 \text{ m}} = 301 \text{ Hz}$                                       | 3    |
| Total for question |                                                                                                                                                                                                                                                                                                                                                | 11   |

Q5.

| Question Number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Mark      |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| ai              | Minimum labelled at either rarefaction (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | (1)       |
| aii             | Zero displacement at all compressions and/or all rarefactions. (1)<br>Two complete wave cycles shown. (1)<br><br>(Allow graph inverted in relation to the one shown above)                                                                                                                                                                                                                                                                                                                                                                                                                         | (2)       |
| bi              | Describes an initial situation where the two traces are in antiphase / phase (1)<br>Record the position of the microphone (from the metre rule)<br>Or Measure the distance from the loudspeaker to the microphone (1)<br>Move microphone (gradually) until the two traces are next in antiphase / phase (1)<br>Record the new position of the microphone and calculate the distance moved by the microphone<br>Or Measure the new distance from the loudspeaker to the microphone and calculate the distance moved by the microphone (1)<br>Multiply calculated/measured wavelength by frequency to determine the speed<br>Or Describes a suitable graph to determine the speed (1) | (5)       |
| bii             | Time period read off oscilloscope (from one point to the next in phase point)<br>Or number of waves per second read off oscilloscope (1)<br>Time period (for both traces) is the same (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | (2)       |
| biii            | Use of $v = f\lambda$ (1)<br>Calculates $\lambda$ of 8.5 cm (for 4.0 kHz) and 2.3 cm (for 15.0 kHz) (1)<br>Percentage uncertainty greater for 2.3cm than 8.5cm (so student correct)<br>Or Percentage uncertainty greater for 15.0kHz than 4.0kHz (so student correct)<br>Or Percentage uncertainty is reduced if measurements taken across several wavelengths (so student not necessarily correct) (1)                                                                                                                                                                                                                                                                             | (3)       |
|                 | (Do not allow "uncertainty" for "percentage uncertainty")<br><u>Example of calculation</u><br>$\lambda = v/f = (340 \text{ ms}^{-1}) / (4000 \text{ Hz}) = 0.085 \text{ m}$<br>$\lambda = v/f = (340 \text{ ms}^{-1}) / (15000 \text{ Hz}) = 0.023 \text{ m}$                                                                                                                                                                                                                                                                                                                                                                                                                       |           |
|                 | <b>Total for question</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>13</b> |