<table>
<thead>
<tr>
<th>Question number</th>
<th>Answer</th>
<th>Marks</th>
<th>Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 a</td>
<td>wavelength from the point on one wave to the same point on the adjacent wave amplitude: from the centre point to the top of the peak/bottom of the trough</td>
<td>1</td>
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<tr>
<td>1 b</td>
<td>transverse: particles oscillate at right angles to direction wave travels longitudinal: particles oscillate along direction wave travels</td>
<td>1</td>
<td></td>
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<tr>
<td>1 c i</td>
<td>water waves/S-wave/electromagnetic waves</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1 c ii</td>
<td>sound/P-wave</td>
<td>1</td>
<td></td>
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<tr>
<td>2 a</td>
<td>3 oscillations in 60 s so $T = 20, s$ $\therefore f = \frac{1}{20}, s = 0.05, \text{Hz}$</td>
<td>1</td>
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<tr>
<td>2 b</td>
<td>24 m/60 s $=$ 0.40 m/s</td>
<td>1</td>
<td></td>
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<tr>
<td>2 c</td>
<td>0.40 m/s $\frac{0.05, \text{Hz}}{0.05, \text{Hz}} = 8.0, \text{m}$</td>
<td>1</td>
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<tr>
<td>3 a</td>
<td>the ripples travel across the surface but the water does not travel across the ripple tank</td>
<td>1</td>
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<tr>
<td>3 b</td>
<td>see P12.3, Figure 3: correct refraction and direction, refracted wave at small angle to boundary as incident wave</td>
<td>1</td>
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<tr>
<td>3 c</td>
<td>as the wave crosses the boundary from deep water to shallow water, it will change direction to a smaller angle from the boundary the wave slows down in the shallow water and changes direction</td>
<td>1</td>
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<tr>
<td>4 a i</td>
<td>as surface vibrates it pushes air particles away then allows them to return. Air particles pushed away push other air particles then retreat with them. These in turn alternately push and pull particles further away so waves of compressions and rarefactions pass through air</td>
<td>1</td>
<td>1</td>
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<tr>
<td>4 a ii</td>
<td>sound waves spread out so their amplitude becomes smaller.</td>
<td>1</td>
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<tr>
<td>4 b i</td>
<td>same number of waves but taller (higher amplitude)</td>
<td>1</td>
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<tr>
<td>4 b ii</td>
<td>same height of waves but stretched so fewer waves on screen</td>
<td>1</td>
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<tr>
<td>4 c</td>
<td>adjust signal generator so sound heard comfortably gradually increase frequency without changing amplitude, until no longer hear the sound measure time period on oscilloscope screen to determine frequency at this point upper limit frequency = 1 ÷ measured time period</td>
<td>1</td>
<td>1</td>
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<tr>
<td>5 a</td>
<td>sound of clapping travels through air to wall then reflected. Some reflected waves travel back to person who hears echo</td>
<td>1</td>
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<tr>
<td>5 b</td>
<td>total distance = 340 m/s × 0.30 s = 102 m distance to wall = 0.5 × 102 m = 51 m</td>
<td>1</td>
<td>1</td>
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<tr>
<td>6 a</td>
<td>rearranging the equation: speed = frequency × wavelength gives wavelength = ( \frac{\text{speed}}{\text{frequency}} ) = ( \frac{340 \text{ m/s}}{256 \text{ Hz}} ) = 1.33 m</td>
<td>1</td>
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<tr>
<td>6 b</td>
<td>similarity: both travel in or across a substance difference: sound waves are longitudinal whereas water waves are transverse (or not longitudinal)</td>
<td>1</td>
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