## Stationary waves Mark Scheme 2

| Level | International A Level |
| :--- | :--- |
| Subject | Physics |
| Exam Board | CIE |
| Topic | Superposition |
| Sub Topic | Stationary Waves |
| Paper Type | Theory |
| Booklet | Mark Scheme 2 |



1 (a waves (travels along tube) reflect at closed end / end of tube
incident and reflected waves or these two waves are in opposite directions interfere or stationary wave formed if tube length equivalent to $\lambda / 4,3 \lambda / 4$, etc.

A1 [3]
(b) (i) 1. no motion (as node) / zero amplitude

B1
2. vibration backwards and forwards / maximum amplitude along length
(ii) $\lambda=330 / 880(=0.375 \mathrm{~m})$

$$
L=3 \lambda / 4
$$

$L=3 / 4 \times(0.375)=0.28(0.281) m$
A
(b) apparatus: source of sound + detector + reflection system adjustment to apparatus to set up standing waves - how recognised B1 measurements made to obtain wavelength B1
(c) (i) at least two nodes and two antinodes A1
(ii) $\begin{aligned} & \text { node to node }=\lambda / 2=34 \mathrm{~cm} \text { (allow } 33 \text { to } 35 \mathrm{~cm} \text { ) } \mathrm{C} 1\end{aligned}$
$c=f \lambda$ C1
$f=340 / 0.68=500 \quad(490$ to 520$) \mathrm{Hz}$ A1
$\begin{array}{ll}\text { (a) two waves travelling (along the same line) in opposite directions overlap/meet } & \text { M1 } \\ \text { same frequency / wavelength } & \text { A1 }\end{array}$ resultant displacement is the sum of displacements of each wave / produces nodes and antinodes
(a) waves overlap B
(resultant) displacement is the sum of the displacements of each of the waves
(b) waves travelling in opposite directions overlap / incident and reflected waves overlap
(allow superpose or interfere for overlap here)
waves have the same speed and frequency
B1
(c) (i) time period $=4 \times 0.1$ (ms)

C1
$f=1 / T=1 / 4 \times 10^{-4}=2500 \mathrm{~Hz}$
(ii) 1. the microphone is at an antinode and goes to a node and then an antinode / maximum amplitude at antinode and minimum amplitude at node
2. $\lambda / 2=6.7$ (cm)

C1
$v=f \lambda$
$v=2500 \times 13.4 \times 10^{-2}=335 \mathrm{~m} \mathrm{~s}^{-1}$
C1
A1
incorrect $\lambda$ then can only score second mark
4 (a e.g. no energy transfer amplitude varies along its length/nodes and antinodes neighbouring points (in inter-nodal loop) vibrate in phase, etc. (any two, 1 mark each to max 2 ..... B2
(b) $\quad\left(\quad \lambda=\left(330 \times 10^{2}\right) / 550\right.$ ..... M1
$\lambda=60 \mathrm{~cm}$ ..... A0
(ii) node labelled at piston ..... B1
antinode labelled at open end of tube ..... B1
additional node and antinode in correct positions along tube ..... B1
(c) at lowest frequency, length $=\lambda / 4$ ..... C1
$\lambda=1.8 \mathrm{~m}$
frequency = 330/1.8 ..... C1
$=180 \mathrm{~Hz}$ ..... A1A
5 (a) ( frequency $f$ ..... B1
[1]
(ii) amplitude $A$ ..... B1
(b) $\pi \mathrm{rad}$ or $180^{\circ}$ (unit necessary)B1
(c) (i) speed $=f \times L$ ..... B1
(ii) wave is reflected at end / at $P$ ..... B1
either incident and reflected waves interfere
or two waves travelling in opposite directions interfere ..... M1
speed is the speed of incident or reflected wave / one of these waves ..... A1

