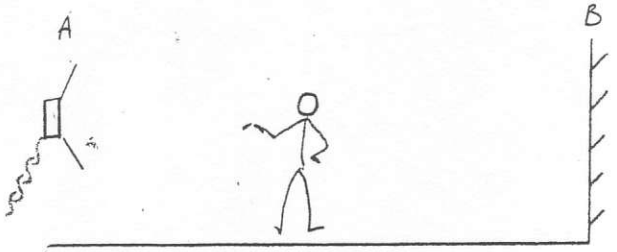
Waves – Standing waves – 1

A Physics

1. Describe 2 key differences between a progressive wave and a standing wave (you can use a diagram to help) – (4)

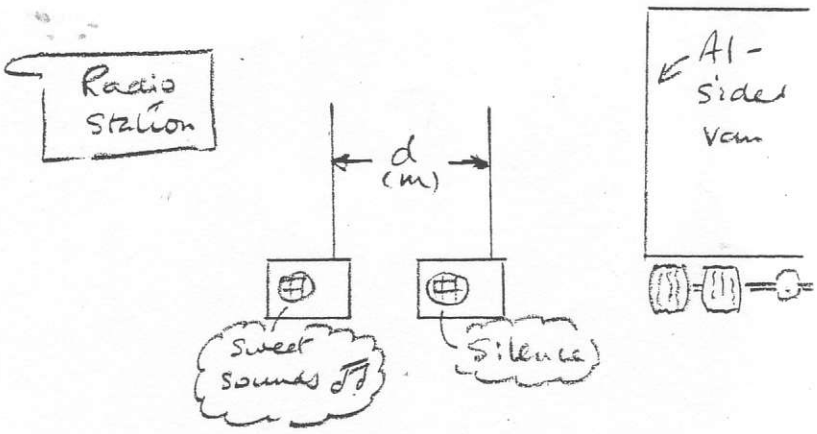
V sound in air = 330 m/s
V sound in water = 1500 m/s
V EM waves = 3×10^8 m/s
1 MHz = 1×10^6 Hz.

2. A loudspeaker at A emits a pure sound with a frequency of 500 Hz towards the wall at B.



(a) Explain how the resulting standing wave is produced (3)
(b) Calculate the distance between 2 adjacent nodes (3)
(c) Draw a labelled diagram of the standing wave, showing the first two nodes in relation to the wall (5)
(d) If the person's head is 1.65 m from the wall, what does (s)he hear? Explain your answer. (3)
(e) What does the person experience as (s)he walks from A to B? Explain your answer. (2) [16]

3. A workman has his radio by the side of his van, tuned to Classic FM, frequency 100.5 MHz. He notices that in one position, the radio plays properly, but if it is moved to another position it makes no sound.



(a) Draw a labelled diagram to show the standing wave produced, calculating & showing distance between adjacent nodes (5)
(b) Explain the situation described above, and calculate distance d (4)
(c) What is the closest position to the van that the radio will play properly? Explain your answer. (2)
(d) With the radio in this position the worker tunes to a new station, and the radio goes silent. What is the frequency of this new station? (3) [14]

Standing waves ① Answers A Phys...

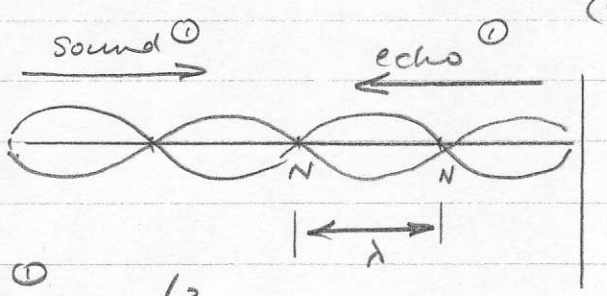
1. | Progressive | Standing |
(a) all parts have same amplitude | – amplitude varies, Nodes have 0 ; Antinodes ; max.
(b) at any 1 time different parts of the wave are at different phases (stages of oscillation) | – all parts in phase (at same part of cycle)

(4)

2 (a) 2 progressive waves have same f (or λ) ① /3

(b) $\lambda = v/f$ ① $= 330/500 = 0.66$ ① m

node separation $= \lambda/2 = 0.33$ ① m /3

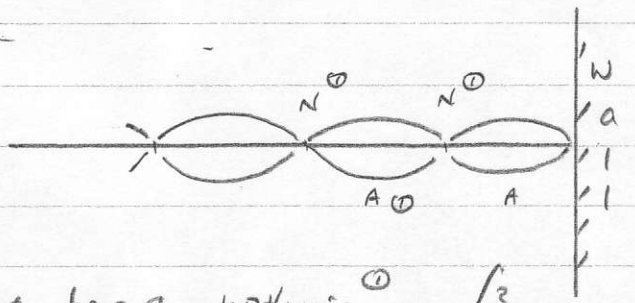


(c) Shape ∞ ①

2 nodes 2

antinode 1

node at wall 1/5



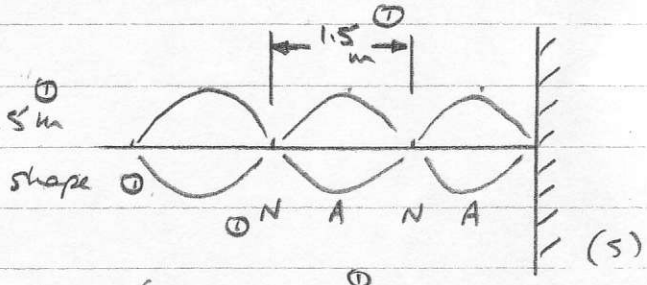
(d) 1.65 m = 5 × 0.33 m ①

So the person is at a node ① and hears nothing ① /3

(e) from A → B, the person hears sound of constant frequency change in loudness ①, as they walk through nodes + antinodes ① /4 [16]

3. a) $v = f\lambda \rightarrow \lambda = v/f = 2.99$ m $= \underline{3.0}$ m ①

Distance between nodes NN $= \lambda/2 = 1.5$ m ①



(5)

(b) The radio wave passes through the reflected wave ①, coming from the van. The 2 waves have identical amplitudes + wavelength, so a standing wave is formed. If the aerial is at an antinode then ... signal ①; if at node then ... silence. ①

Distance d = distance AN $= \lambda/4 = 0.75$ m ①

(4)

(c) Closest distance to van = AN $= 0.75$ m ① – the first antinode ①

(2)

MN (d) Radio now at node ① so $\lambda_{new}/2 = 0.75$ m $\rightarrow \lambda_{new} = 1.5$ m ①

1.99 + 2.99

So $f_{new} = v/\lambda_{new} = 2 \times 10^8$ Hz $= 200$ MHz ①

(3) [14]

① ... 1/4 2/16 3/14