3 Fig. 3.1 shows, at time t_0, the positions x of the air particles where a progressive sound wave passes through the air towards a reflector.

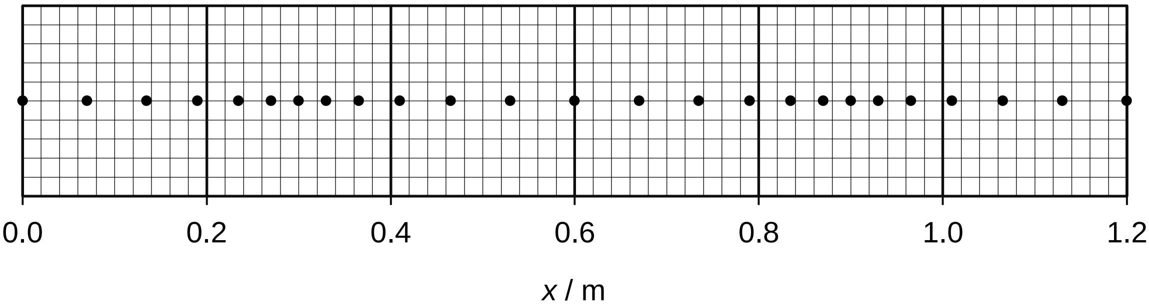

Fig. 3.1

Fig. 3.2 shows, at a later time t_1, the positions x of the same air particles when the reflected sound wave is superposed with the original sound wave to form a stationary wave.

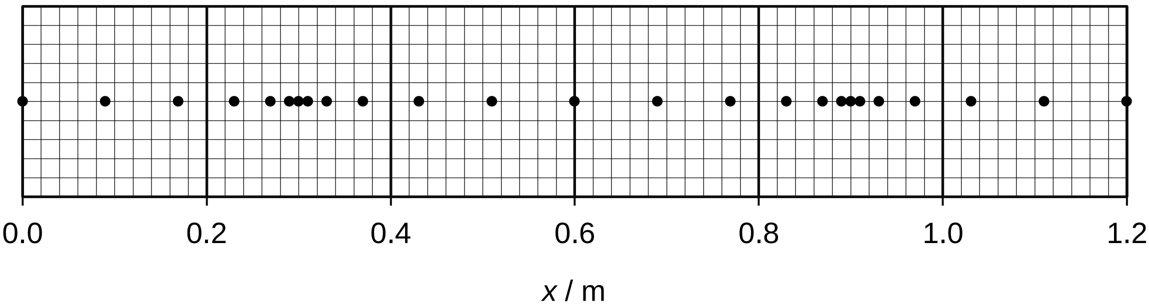

Fig. 3.2

(a) Distinguish between progressive and stationary waves in terms of the amplitudes and the phases of oscillations of the particles.

amplitudes: ....

....

....

....

phases: ....

....

....

.... [2]

(b) Use Fig. 3.1 to deduce, with an explanation,

(i) the wavelength of the sound wave,

wavelength = ... m

....

....

.... [1]

(ii) the amplitude of the oscillations of the particles.

amplitude = ... m

....

....

....

.... [2]

(c) **(i)** On Fig. 3.2, indicate all the positions of the displacement nodes (label as N) and displacement antinodes (label as A). [1]

(ii) By considering the positions of the particles in Fig. 3.2, draw on Fig. 3.3, the variation with position x of the pressure p of the air when a stationary wave is set up

1. at time t_1 (label as Y), [1]

2. at time $t_1 + \frac{T}{8}$ (label as Z), where T is the period of the wave. [1]

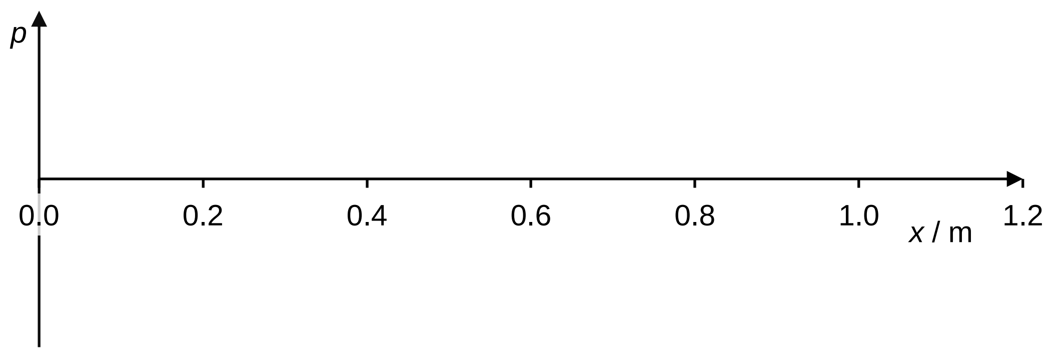

Fig. 3.3

(d) The sound wave represented in Fig. 3.1 is now continuously projected along a vertical tube that is initially fully immersed in water.

As the tube is raised vertically, it was found that the first loud note was heard when the air column has a length of 14.4 cm.

Determine

(i) the end correction of the tube,

end correction = ... m [2]

(ii) the length of the air column when the next loud note is heard.

length = ... m [2]

[Total: 12]