

A level Physics B

H557/02 Scientific literacy in physics

Question Set 1

1

This question is about notes produced by a flute.

A flute is an instrument that produces standing waves with displacement antinodes (A) at both ends.

The nodes (N) and antinodes for the lowest note possible for a flute of length L are shown in **Fig. 1.1**.

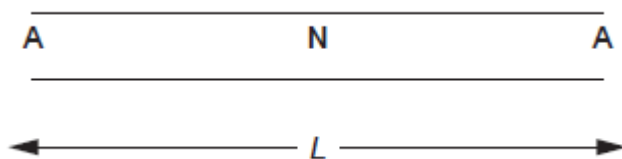


Fig. 1.1

(a) Explain how standing waves are formed in air.

[3]

(b) Mark the antinodes and nodes on **Fig. 1.2** for a note of **twice** the frequency of the note indicated in **Fig. 1.1**. Explain your answer.

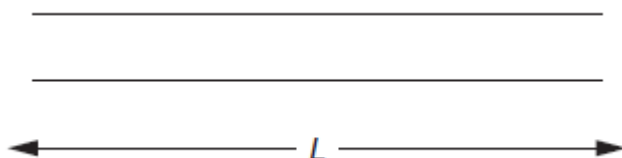


Fig. 1.2

[2]

(c) The velocity of sound in air v is given by the equation $v = \sqrt{\frac{kp}{\rho}}$ where p is the pressure of the gas, ρ is the density of the gas and k is a constant.

Use the expression $pV = nRT$ and the expression for density, $\rho = \frac{m}{V}$, to show that

$$v = \sqrt{\frac{kRT}{M}} \text{ where } M = \frac{m}{n} \text{ is the mass of one mole of air.}$$

[2]

(d) A flute of length L sounds a note of 262 Hz at a temperature of 293 K. Calculate the frequency of the note from the same length flute when the temperature of the air in the flute has increased to 303 K. The change in length of the flute caused by this temperature rise is negligible.

frequency at 303 K =Hz [3]

Total Marks for Question Set 1: 10

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