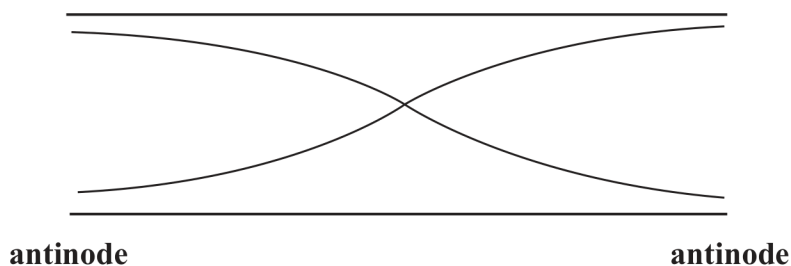


21 A recorder is a musical instrument with a mouthpiece at one end, as shown.



- (a) When a musician blows into the mouthpiece, a stationary wave is produced in the air column inside the recorder.
- (i) The stationary wave has antinodes at both ends of the air column as shown.



Calculate the frequency of the sound produced by this stationary wave.

speed of sound in air =  $330 \text{ m s}^{-1}$

length of recorder =  $23.6 \text{ cm}$

(3)

Frequency = .....



(ii) The recorder is made from three separate sections that slide together as shown.



A musician plays the recorder and produces the same frequency sound as in (i). The temperature of the air increases. As the temperature of the air increases, the speed of sound also increases.

Explain how the musician can adjust the recorder to produce the same frequency sound as in (i).

(3)

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- (b) On a violin, a stationary wave is created when a string is plucked. A violin string has a fixed length but the tension can be adjusted.

When a string is plucked, it produces a sound with a frequency of 432 Hz. This string is adjusted to produce a sound of frequency 440 Hz.

Calculate the percentage increase in the tension in the string.

(3)

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Percentage increase = .....

**(Total for Question 21 = 9 marks)**