

Q- A flute player hears four beats per second when she compares her note to a 523 Hz tuning fork. She can match the frequency of the tuning fork by pulling out to increase length of her flute slightly. What was her initial frequency?

The beats are produced when the two sound waves of nearly same frequencies are moving in a medium simultaneously. The sources produce sound waves in air of the same frequency as of their oscillation frequency. Because of superposition of such two waves at a point in the medium the Phase difference and hence the intensity of sound varies with time repeatedly between the maximum and minimum. The time interval between two consecutive maximum or two consecutive minimum is called a beat. Number of beats heard per second is called beat frequency and is equal to the difference of the frequencies of the two waves.

Let the frequency of the flute is  $f$  and as it produces four beats per second with the fork of frequency the difference

$$|f - 523| = 4$$

Or  $f - 523 = \pm 4$

Or  $f = 523 \pm 4$

So, the frequency  $f$  of the flute will be 527 or 519 Hz

Now the flute is an open-open pipe and its frequency for a length  $L$  is given by

$$f = \frac{c}{2L}$$

Here  $c$  is the speed of sound and  $L$  is the length of the pipe.

Thus, increasing the length, the frequency decreases.

As lengthening the flute will decrease its frequency and then it matches with 523 Hz means initially it was greater than 523 Hz and hence initial frequency of the flute was **527 Hz**.