Example 12:
An organ pipe is 112 cm in length and assume the speed of sound in air to be 343 m/s. Find the fundamental along with the second and third **audible** harmonics for this pipe if it is considered a..

A. ...Pipe open at both ends
B. ...Pipe open at one end

A.) Pipes open at Both ends
All harmonics are heard

$f_1 = \frac{1 \cdot v}{2L} = \frac{1 \cdot 343}{2(1.12)}$

$f_1 = 153$ Hz

$f_2 = 2 \cdot 153 = 306$ Hz

$f_3 = 3 \cdot 153 = 459$ Hz

B.) Pipes open at One End
Only odd harmonics can be heard

$f_1 = \frac{1 \cdot v}{4L} = \frac{(1)(343)}{4(1.12)}$

$f_1 = 76.6$ Hz

$f_3 = 3 \cdot 76.6 = 230$ Hz

$f_5 = 5 \cdot 76.6 = 383$ Hz

Example 13:
A flute (considered to be a pipe open at both ends) is designed to play middle C (f = 262 Hz) as a fundamental frequency when all the holes are covered. Assume the velocity of sound in air as 343 m/s.

A. What is the length needed for this column of air?
B. How far does the flute need to be uncovered to play the D above middle C as the fundamental at 294 Hz?

A.) $f_1 = 1 \cdot \frac{v}{2L}$

$262 = \frac{343}{2 \cdot L}$

$262 \cdot 2 \cdot L = 343$

$L = 0.655$ m

B.) Length needed for 294 Hz

$f_1 = 1 \cdot \frac{v}{2L}$

$294 = \frac{343}{2 \cdot L}$

$294 \cdot 2L = 343$

$L = 0.583$ m

So $0.655 - 0.583 = 0.072$ m
Needs to be uncovered.

Example 14:
A pipe in regular, room-temperature air produces two successive harmonics at frequencies of 240 and 280 Hz.

A. Is this a pipe open at both ends or only one end?
B. What is the length of this pipe

A) 240 Hz, 280 Hz

40

$\frac{240}{40} = 6$

$\frac{280}{40} = 7$

* The separation between the two harmonics is 40 Hz. This divides into the two frequencies evenly to give the 6th and 7th harmonics.
* Because both odd and even harmonics are produced, this must be a pipe open at both ends.

B.) $f_1 = 1 \cdot \frac{v}{2L}$

$40 = \frac{1 \cdot 343}{2 \cdot L}$

$80 \cdot L = 343$

$L = 4.29$ m