Air Columns

Monday, May 17, 2010 9:04 AM

Vibrating air columns consist of two types:
1) open at both ends <= toilet paper roll, trumpet,
2) open at one end <= can of soup, glass bottle

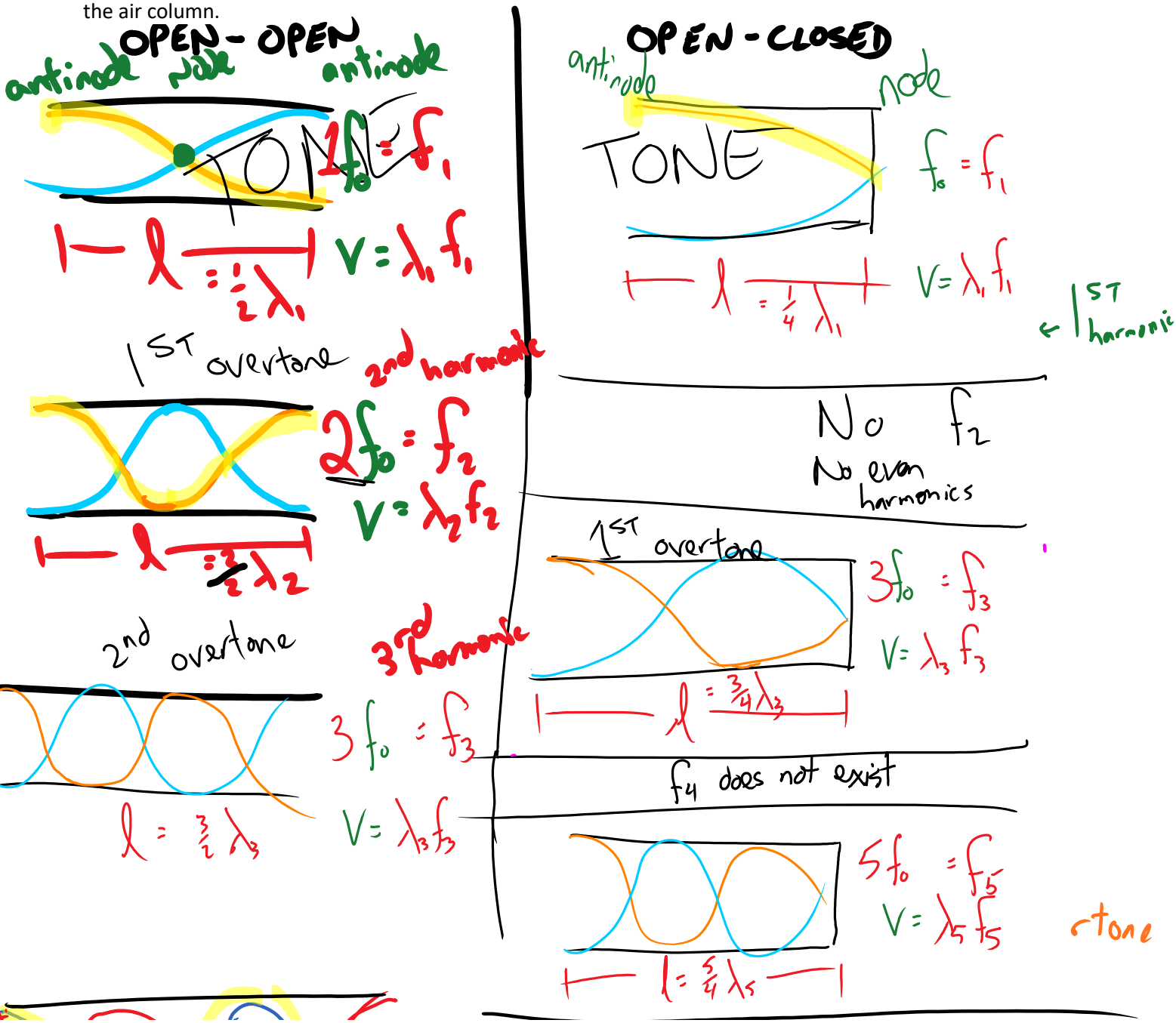
$V_{sound} = 340 \frac{m}{s}$

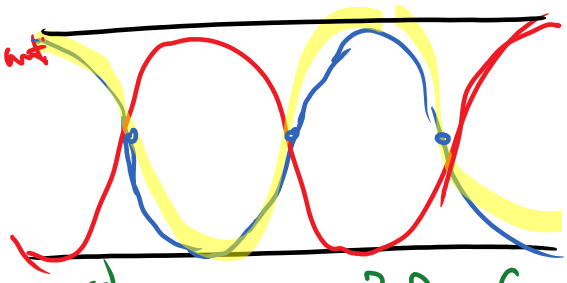
Speed of sound in air at 25°C and 1 atm pressure = 343 m/s

At an open end the air is free to oscillate forth and back. The result is an anti-node at every open end.

At a closed end the air is not free to oscillate and a node occurs.

Only certain wavelengths may exist in air columns based on the length of the air column.



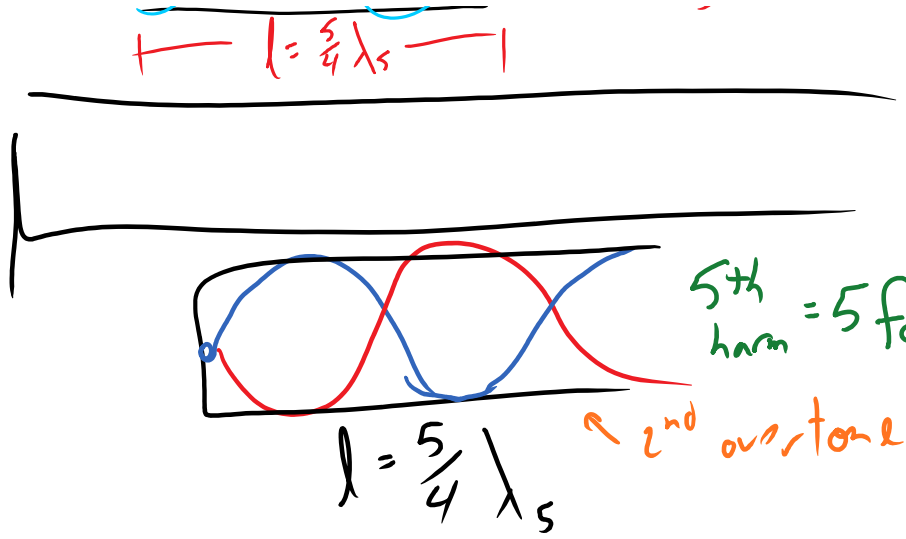


3rd harmonic $3f_0 = f_3$

$l = \frac{3}{2}\lambda_3$ ← 2nd overtone

$l = \frac{3}{2}\lambda_3$ $\quad V = \lambda_3 f_3$

2nd overtone $\quad = \frac{3}{3} l f_3$



$l = \frac{5}{4}\lambda_5$

5th harm $= 5f_0$

$l = \frac{5}{4}\lambda_5$ ← 2nd overtone

general form

$f_n = n f_0$

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$\lambda_n = \frac{n}{2}\lambda_1$

$l = \frac{n}{2}\lambda_n$

As long V stays constant

$V = \lambda f$

$V = \lambda_0 f_0 = \lambda_3 f_3$

A-F

general form

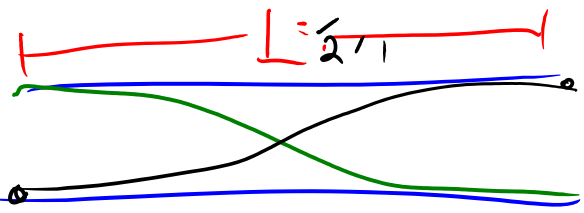
$f_n = n f_0$

$n \neq 2, 4, 6 \ldots\ldots$

$\lambda_n = \frac{n}{4}\lambda_1$

$l = \frac{n}{4}\lambda_n$

$\frac{f_0}{f_3} = \frac{\lambda_3}{\lambda_0}$



$L = \frac{1}{2}\lambda_1$

$L = \frac{1}{2}\ 1.3\ m$

$= 0.65m$

$f_1 = 264\ Hz$

$V = \lambda_1 f_1$

$\frac{343}{264} = \lambda_1 = 1.3$

$f_0 = 264\ Hz$

$\frac{343}{264} = \lambda_0 = 1.299\ m$

$L = \frac{1}{2}(1.3) = 0.65\ m$

Do A → F