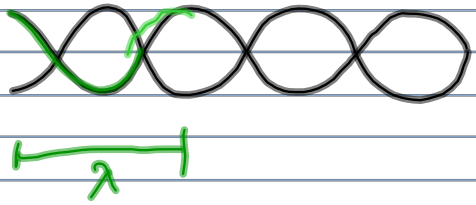
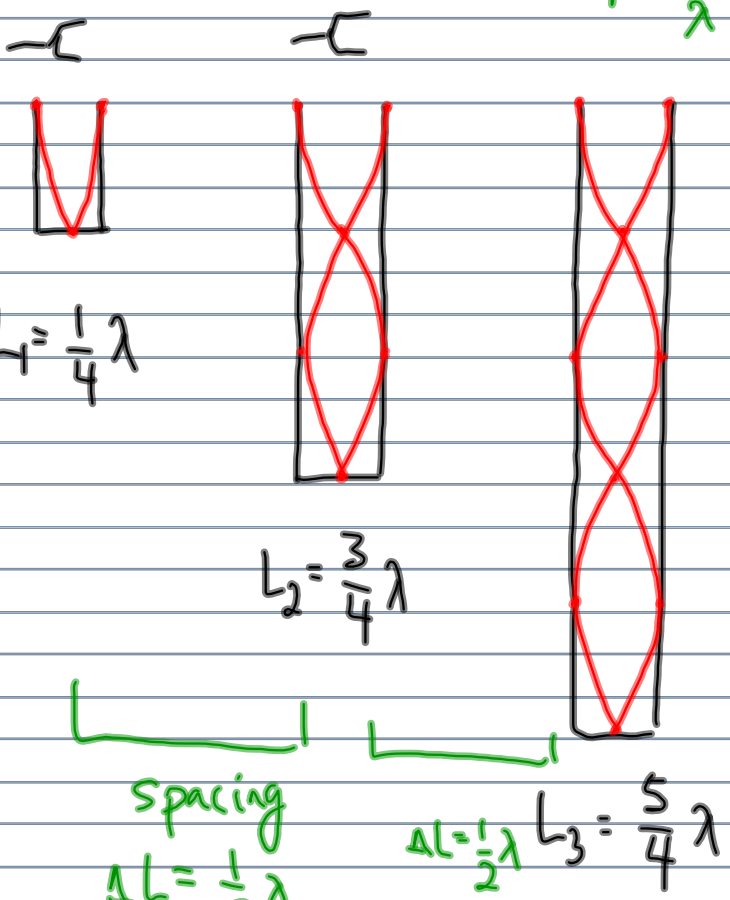
Closed-Tube Resonance

- antinode at the open end
- node at the closed end



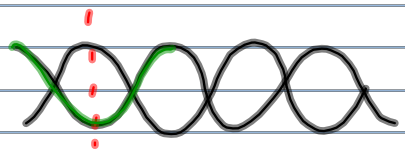


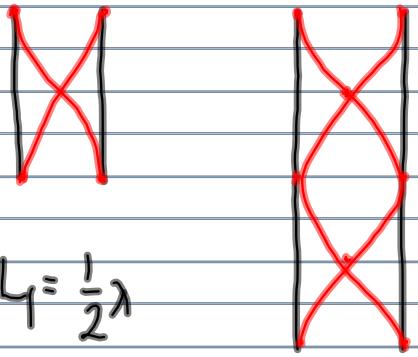
* shortest tube => $\frac{1}{4}\lambda$

* spacing => $\frac{1}{2}\lambda$

Open Tube Resonance

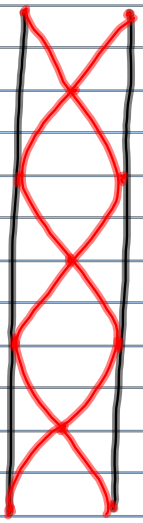
- antinode at both ends





$L_1 = \frac{1}{2}\lambda$

$L_2 = \frac{2}{2}\lambda$



$L_3 = \frac{3}{2}\lambda$

spacing

$\Delta L = \frac{1}{2}\lambda$

spacing

$\Delta L = \frac{1}{2}\lambda$

* shortest tube is $\frac{1}{2}\lambda$
* spacing is $\frac{1}{2}\lambda$

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$L_1 = 9.0\,cm$

$T = 20^\circ C$ $(v = 343\,m/s)$

closed

a) $\lambda = ?$

b) L_2 and $L_3 = ?$

c) $f = ?$

a) Shortest tube: $\frac{1}{4}\lambda$ (closed)

$L_1 = \frac{1}{4}\lambda$

$9.0\,cm = \frac{1}{4}\lambda$

$\lambda = 4(9.0\,cm)$

$\lambda = 36\,cm$

b) $L_2 = \frac{3}{4}\lambda$ ⇐ you could use $L_n = (2n-1)\frac{\lambda}{4}$ OR just look at a diagram of a standing wave.

$L_2 = \frac{3}{4}(36\,cm)$

$L_2 = 27\,cm$

$L_2 = (2(2)-1)\frac{\lambda}{4}$

$L_2 = \frac{3}{4}\lambda$

$L_3 = \frac{5}{4}\lambda$

$L_3 = \frac{5}{4}(36\,cm)$

$L_3 = 45\,cm$

c) $v = \lambda f$

$f = \frac{v}{\lambda}$

$f = \frac{343\,m/s}{0.36\,m}$

$f = 953\,Hz$

$9.5 \times 10^2\,Hz$

L → λ → f or v

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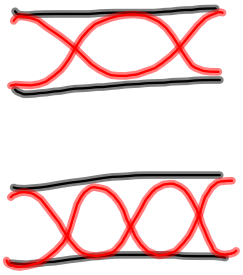
open

$f_1 = 330\,Hz$



a) $f_2 = ?$ $f_3 = ?$

b) $L_1 = ?$ $(v = 344\,m/s)$

↑ need to find λ

a) $f_n = n f_1$

$f_2 = 2(330\,Hz)$

$f_2 = 660\,Hz$

b) $v = \lambda f$

$\lambda = \frac{v}{f}$

$\lambda = \frac{344\,m/s}{330\,Hz}$

$\lambda = 1.04\,m$

$f_3 = 3(330\,Hz)$

$f_3 = 990\,Hz$

$L_1 = \frac{1}{2}\lambda$

$L_1 = \frac{1}{2}(1.04\,m)$

$L_1 = 0.521\,m$

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