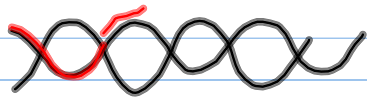
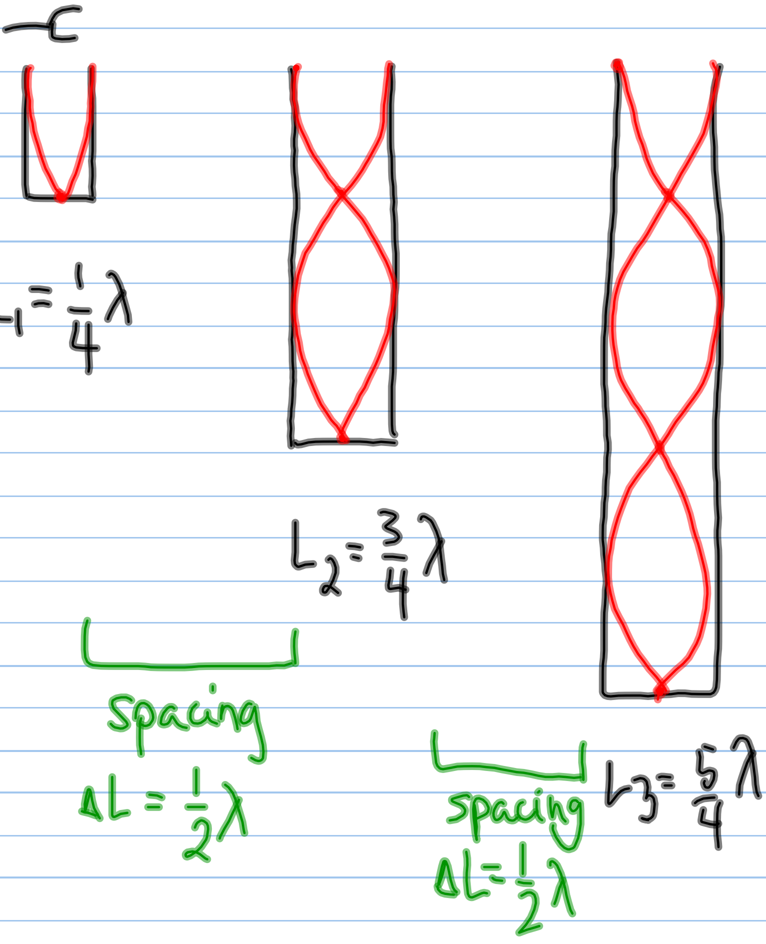
Resonance - Closed Tube

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



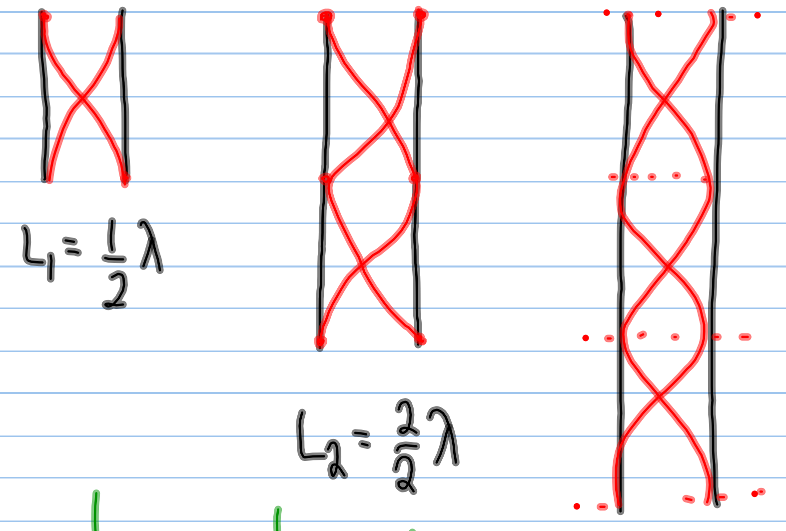


* The shortest tube that can support closed-tube resonance is $\frac{1}{4}\lambda$.

* The spacing between successive resonance lengths is $\frac{1}{2}\lambda$

Open Tube Resonance

- antinodes must be at each end



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

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

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

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

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

* Shortest tube is $\frac{1}{2}\lambda$
* Spaing is $\frac{1}{2}\lambda$

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$L_1 = 9.0\text{ cm}$

$T = 20°C$ (343 m/s)

closed

a) $\lambda = ?$

b) $L_2 = ?$, $L_3 = ?$

c) $f = ?$

a) Shortest tube (i.e. L_1)

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

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

$$\boxed{\lambda = 36\text{ cm}}$$

$L_1 = \frac{1}{4}\lambda$ $\;+\frac{1}{2}\lambda$ or $L_2 = \frac{3}{4}\lambda$

b) $$L_n = (2n-1)\frac{\lambda}{4}$$

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

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

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

$$\boxed{L_2 = 27\text{ cm}}$$

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

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

$$\boxed{L_3 = 45\text{ cm}}$$

c) $$v = \lambda f$$

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

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

$$\boxed{f = 953\text{ Hz}}$$

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open

$f_1 = 330Hz$

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

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

↑ need to find λ

a) $f_n = nf_1$

$f_2 = 2(330Hz)$

$f_2 = 660Hz$

and $f_3 = 990Hz$

b) $v = \lambda f$

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

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

$\lambda = 1.04m$

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

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

$L_1 = 0.521m$

TODO: PP|421
mp|426 + PP|427