
Open and Closed Tube Resonance (SwiftStudy Printable)

Closed Tube

$\lambda = 4(l + 0.4d)$	λ	resonant wavelength	m
	l	length of tube	m
	d	inner diameter of tube	m

Open Tube

$\lambda = 2(l + 0.8d)$	λ	resonant wavelength	m
	l	length of tube	m
	d	inner diameter of tube	m

Simpler Versions

$$\lambda = 4l \text{ (closed)} \qquad \lambda = 2l \text{ (open)}$$

Tips to Remember

- ▶ An open tube is one in which **both** ends of the tube are open, and a closed tube is one with **one** closed end. For example, in a common lab activity to measure the speed of sound, you place one end of a tube underwater while the top end is in the air. You would use the closed tube formula for the calculation because the water blocks one end of the tube.
- ▶ Wondering why two versions of the formulas are given? The formulas that include inner diameter give more accurate results because they take into account that a real wave will not be reflected from **exactly** the end of the tube. The simpler version results from neglecting the real world end effects, which make it easier to derive the formula.
- ▶ The equations listed are for the fundamental resonant wavelengths, or the longest wavelengths which will be observed in each tube. There are other shorter resonant wavelengths too, but you would need modified formulas to calculate them.

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