

Velocity

$$v_{\theta} = v_0 + 0.6\theta \quad \text{when } P = 1\text{atm}, v_0 = 331.1\text{ms}^{-1}$$

Solid

$$v = \sqrt{\frac{E}{\rho}}$$

Liquid

$$v = \sqrt{\frac{B}{\rho}}$$

Gas

$$v = \sqrt{\frac{\gamma P}{\rho}}$$

Resonance Tube Experiment

$$\ell = \frac{v}{4} \times \frac{1}{f} - c$$

$$\ell + c = \frac{1}{4}\lambda$$

$$\ell_1 + c = \frac{3}{4}\lambda$$

Pipes

$$f \propto \frac{1}{\ell}$$

Closed Pipes

$$f_0 = \frac{v}{\lambda_0} = \frac{v}{4\ell}$$

$$f_1 = \frac{v}{\lambda_1} = \frac{3v}{4\ell} = 3f_0$$

$$f_n = (2n + 1)f_0$$

End correction: $f_0 = \frac{v}{\lambda_0} = \frac{v}{4(\ell + c)}$

Open Pipes

$$f_0 = \frac{v}{\lambda_0} = \frac{v}{2\ell}$$

$$f_1 = \frac{v}{\lambda_1} = \frac{v}{\ell} = 2f_0$$

$$f_n = (n + 1)f_0$$

End correction: $f_0 = \frac{v}{\lambda_0} = \frac{v}{2(\ell + c)}$

Tubes

$$v = \sqrt{\frac{T}{\mu}} \quad \mu = \frac{m}{\ell}$$

Plucked at middle

$$f_0 = \frac{v}{\lambda_0} = \frac{1}{2\ell} \sqrt{\frac{T}{\mu}}$$

$$f_1 = \frac{v}{\lambda_1} = \frac{3}{2\ell} \sqrt{\frac{T}{\mu}} = 3f_0$$

$$f_n = (2n + 1)f_0$$

Plucked at other places

$$f_0 = \frac{v}{\lambda_0} = \frac{1}{2\ell} \sqrt{\frac{T}{\mu}}$$

$$f_1 = \frac{v}{\lambda_1} = \frac{2}{2\ell} \sqrt{\frac{T}{\mu}} = 3f_0$$

$$f_n = (n + 1)f_0$$

Doppler Effect

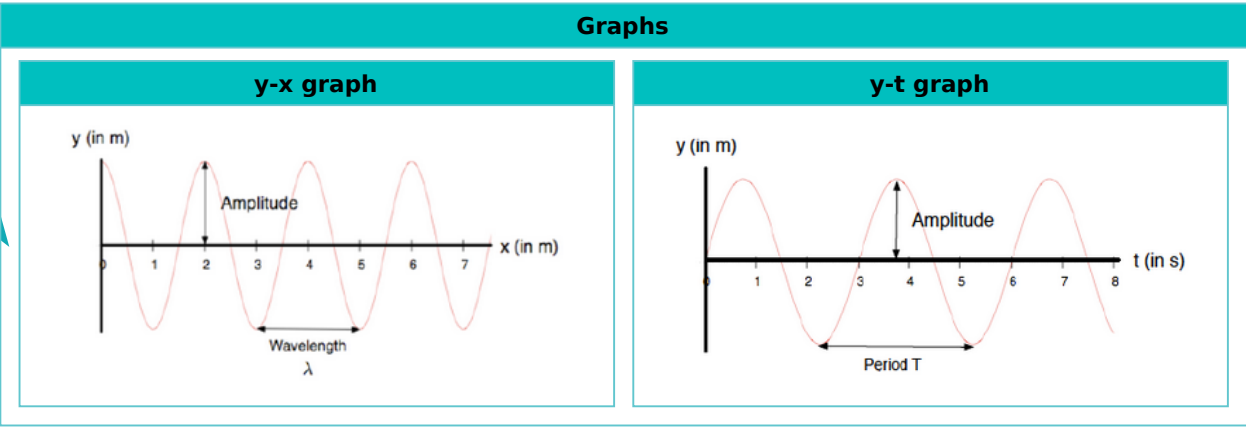
$$f' = \frac{v'}{\lambda'} = \frac{v + u_o}{v + u_s} f$$

Type of Waves

Transverse waves and longitudinal waves

Mechanical waves and electromagnetic waves

Progressive



Wave Equations

Progressive Wave:

$$y = a \sin(\omega t - kx) = a \sin\left(\frac{2\pi t}{T} - \frac{2\pi}{\lambda}x\right)$$

Standing Wave:

$$y = a \cos kx \sin \omega t$$

$$kx = n\pi \rightarrow \text{antinodes} \quad kx = \left(n + \frac{1}{2}\right)\pi \rightarrow \text{nodes}$$

Comparison	
Progressive Wave	Standing Wave
Energy transferred along direction of propogation	No energy transferred along direction of propogation
Wave profile move in direction of propogation	Wave profile does not move in direction of propogation
Every point along direction of propogation is displaced but at different instant	Points known as nodes where no displacement occur
Every point has same amplitude and frequency	Points between two successive nodes have different amplitude
Neighbouring points are not in phase	All points between two successive nodes vibrate in phase with each other

