Waves

Sound Waves

Velocity

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

Solid	Liquid	Gas
$v = \sqrt{\frac{E}{\rho}}$	$v = \sqrt{\frac{B}{\rho}}$	$v = \sqrt{\frac{\gamma P}{\rho}}$

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

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

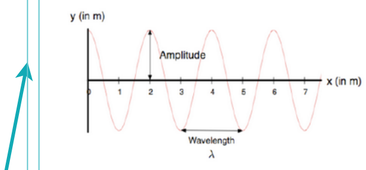
About Waves

Type of Waves

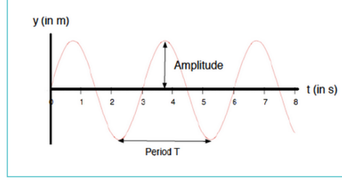
- Transverse waves and longitudinal waves
- Mechanical waves and electromagnetic waves
- Progressive

Graphs

y-x graph



y-t graph



Wave Equations

Progressive Wave:

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

Standing Wave:

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

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

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