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## Sound Propagation and Resonance Formulas

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## List of 12 Sound Propagation and Resonance Formulas

## Sound Propagation and Resonance ©

## Resonance in Pipes

1) Frequency of 1st Harmonic Closed Organ Pipe
$\mathrm{fx} \mathrm{f}_{1 \text { st }}=\frac{1}{4} \cdot \frac{\mathrm{v}_{\mathrm{w}}}{\mathrm{L}_{\text {closed }}}$
ex $32.5 \mathrm{~Hz}=\frac{1}{4} \cdot \frac{65 \mathrm{~m} / \mathrm{s}}{0.5 \mathrm{~m}}$
2) Frequency of 2nd Harmonic Open Organ Pipe
$f \mathrm{f} \mathrm{f}_{2 \mathrm{nd}}=\frac{\mathrm{v}_{\mathrm{w}}}{L_{\text {open }}}$
ex $90.27778 \mathrm{~Hz}=\frac{65 \mathrm{~m} / \mathrm{s}}{0.72 \mathrm{~m}}$
Open Calculator
3) Frequency of 4th Harmonic Open Organ Pipe
$f \mathrm{fx} \mathrm{f}_{4 \text { th }}=2 \cdot \frac{\mathrm{~V}_{\mathrm{w}}}{\mathrm{L}_{\text {open }}}$
ex $180.5556 \mathrm{~Hz}=2 \cdot \frac{65 \mathrm{~m} / \mathrm{s}}{0.72 \mathrm{~m}}$
4) Frequency of Closed Organ Pipe
$f \times f_{\text {closed pipe }}=\frac{2 \cdot n+1}{4} \cdot \frac{\mathrm{v}_{\mathrm{w}}}{\mathrm{L}_{\text {closed }}}$
Open Calculator
$162.5=\frac{2 \cdot 2+1}{4} \cdot \frac{65 \mathrm{~m} / \mathrm{s}}{0.5 \mathrm{~m}}$
5) Frequency of Open Organ Pipe
$f_{\mathrm{x}} \mathrm{f}_{\text {open pipe }}=\frac{\mathrm{n}}{2} \cdot \frac{\mathrm{v}_{\mathrm{w}}}{\mathrm{L}_{\text {open }}}$
Open Calculator
ex $90.27778=\frac{2}{2} \cdot \frac{65 \mathrm{~m} / \mathrm{s}}{0.72 \mathrm{~m}}$
6) Frequency of Open Organ Pipe for Nth Overtone
$\mathrm{fx}_{\mathrm{x}}^{\mathrm{f}} \mathrm{open} \mathrm{pipe} \mathrm{,Nth} \mathrm{=} \frac{\mathrm{n}-1}{2} \cdot \frac{\mathrm{v}_{\mathrm{w}}}{\mathrm{L}_{\text {open }}}$
Open Calculator
ex $45.13889 \mathrm{~Hz}=\frac{2-1}{2} \cdot \frac{65 \mathrm{~m} / \mathrm{s}}{0.72 \mathrm{~m}}$
7) Length of Closed Organ Pipe

$\mathrm{ex} 0.5 \mathrm{~m}=(2 \cdot 2+1) \cdot \frac{0.4 \mathrm{~m}}{4}$
8) Length of Open Organ Pipe
$\mathrm{fx}_{\mathrm{x}} \mathrm{L}_{\text {open }}=\frac{\mathrm{n}}{2} \cdot \frac{\mathrm{v}_{\mathrm{w}}}{\mathrm{f}}$
ex $0.722222 \mathrm{~m}=\frac{2}{2} \cdot \frac{65 \mathrm{~m} / \mathrm{s}}{90 \mathrm{~Hz}}$

## Sound Propagation

## 10) Intensity of Sound $\sqrt{ }$

$f_{x} I_{s}=\frac{P}{A}$
ex $20 \mathrm{~W} / \mathrm{m}^{2}=\frac{900 \mathrm{~W}}{45 \mathrm{~m}^{2}}$

## 11) Velocity of Sound in Liquid $\sqrt{ }$

$f \mathbf{x} \mathrm{v}_{\text {speed }}=\sqrt{\frac{K}{\rho}}$
ex $1480 \mathrm{~m} / \mathrm{s}=\sqrt{\frac{2183.83 \mathrm{MPa}}{997 \mathrm{~kg} / \mathrm{m}^{3}}}$
12) Velocity of Sound in Solids
$f \times v_{\text {speed }}=\sqrt{\frac{E}{\rho}}$
ex $1480.912 \mathrm{~m} / \mathrm{s}=\sqrt{\frac{2186.52 \mathrm{MPa}}{997 \mathrm{~kg} / \mathrm{m}^{3}}}$

## Variables Used

- A Normal Area (Square Meter)
- E Elasticity (Megapascal)
- f Frequency (Hertz)
- $\mathbf{f}_{1 \mathbf{s t}}$ Frequency of 1st Harmonic Closed Organ Pipe (Hertz)
- $\mathbf{f}_{\mathbf{2 n d}}$ Frequency of 2nd Harmonic Open Organ Pipe (Hertz)
- $\mathbf{f}_{3 r d}$ Frequency of 3rd Harmonic Closed Organ Pipe (Hertz)
- $\mathbf{f}_{4 \text { th }}$ Frequency of 4th Harmonic Open Organ Pipe (Hertz)
- $\mathbf{f}_{\text {closed pipe }}$ Frequency of Closed Organ Pipe
- $f_{\text {open pipe }}$ Frequency of Open Organ Pipe
- $\mathbf{f}_{\text {open }}$ pipe,Nth Frequency of Open Organ Pipe for Nth Overtone (Hertz)
- $\mathbf{I}_{\mathbf{S}}$ Sound Intensity (Watt per Square Meter)
- K Bulk Modulus (Megapascal)
- $L_{\text {closed }}$ Length of Closed Organ Pipe (Meter)
- Lopen Length of Open Organ Pipe (Meter)
- $\mathbf{n}$ Number of Nodes
- P Power (Watt)
- $\mathbf{V}_{\text {speed }}$ Velocity of Sound (Meter per Second)
- $\mathbf{V}_{\mathbf{w}}$ Velocity of Wave (Meter per Second)
- $\boldsymbol{\lambda}$ Wavelength (Meter)
- $\boldsymbol{\rho}$ Density (Kilogram per Cubic Meter)


## Constants, Functions, Measurements used

- Function: sqrt, sqrt(Number)

A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.

- Measurement: Length in Meter (m)

Length Unit Conversion

- Measurement: Area in Square Meter ( $\mathrm{m}^{2}$ )

Area Unit Conversion

- Measurement: Pressure in Megapascal (MPa)

Pressure Unit Conversion

- Measurement: Speed in Meter per Second (m/s)

Speed Unit Conversion

- Measurement: Power in Watt (W)

Power Unit Conversion

- Measurement: Frequency in Hertz (Hz)

Frequency Unit Conversion

- Measurement: Density in Kilogram per Cubic Meter (kg/m³)

Density Unit Conversion

- Measurement: Intensity in Watt per Square Meter (W/m²)

Intensity Unit Conversion

## Check other formula lists

- Sound Propagation and Resonance Formulas $\sqrt{\boxed{Z}}$
- Wave Properties and Equations Formulas

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