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Waves And Sound Formulas

Calculators! Examples! Conversions!

List of 49 Waves And Sound Formulas

Waves And Sound

1) Frequency of Progressive Wave

Open Calculator

fx $$f_w = \frac{\omega_f}{2 \cdot \pi}$$

ex $$1.636113\text{Hz} = \frac{10.28\text{Hz}}{2 \cdot \pi}$$

2) Frequency of Wave using Time Period

Open Calculator

fx $$f_w = \frac{1}{T_w}$$

ex $$0.384615\text{Hz} = \frac{1}{2.6\text{s}}$$

3) Frequency of Wavelength using Velocity

Open Calculator

fx $$f_w = \frac{V_w}{\lambda}$$

ex $$150\text{Hz} = \frac{60\text{m/s}}{0.4\text{m}}$$

4) Intensity of Sound

Open Calculator

fx $$I_s = \frac{P}{A}$$

ex $$20\text{W/m}^2 = \frac{900\text{W}}{45\text{m}^2}$$

5) Length of Closed Organ Pipe

Open Calculator

fx $$L = (2 \cdot n + 1) \cdot \frac{\lambda}{4}$$

ex $$0.5\text{m} = (2 \cdot 2 + 1) \cdot \frac{0.4\text{m}}{4}$$

6) Length of Open Organ Pipe

Open Calculator

fx $$L = \frac{n}{2} \cdot \frac{V_w}{f_w}$$

ex $$0.666667\text{m} = \frac{2}{2} \cdot \frac{60\text{m/s}}{90\text{Hz}}$$

7) Loudness

Open Calculator

fx $$Q = 10 \cdot \log 10 \left(\frac{I_s}{I_{ref}} \right)$$

ex $$48.75061\text{dB} = 10 \cdot \log 10 \left(\frac{75\text{W/m}^2}{0.001\text{W/m}^2} \right)$$

8) Mass per Unit Length of String

Open Calculator

$$m = \frac{T}{V_w^2}$$

$$0.027778\text{kg/m} = \frac{100\text{N}}{(60\text{m/s})^2}$$

9) Tension in String

Open Calculator

$$T = V_w^2 \cdot m$$

$$43200\text{N} = (60\text{m/s})^2 \cdot 12\text{kg/m}$$

10) Time Period given Velocity

Open Calculator

$$T_w = \frac{\lambda}{V_w}$$

$$0.006667\text{s} = \frac{0.4\text{m}}{60\text{m/s}}$$

11) Time Period using Angular Frequency

Open Calculator

$$T_w = \frac{2 \cdot \pi}{\omega_f}$$

$$0.611205\text{s} = \frac{2 \cdot \pi}{10.28\text{Hz}}$$

12) Time Period using Frequency

Open Calculator

fx $$T_w = \frac{1}{f_w}$$

ex $$0.011111\text{s} = \frac{1}{90\text{Hz}}$$

13) Velocity of Sound in Liquid

Open Calculator

fx $$V_w = \sqrt{\frac{K}{\rho}}$$

ex $$1.41634\text{m/s} = \sqrt{\frac{2000\text{Pa}}{997\text{kg/m}^3}}$$

14) Velocity of Sound in Solids

Open Calculator

fx $$V_w = \sqrt{\frac{E}{\rho}}$$

ex $$0.10015\text{m/s} = \sqrt{\frac{10\text{Pa}}{997\text{kg/m}^3}}$$

15) Wave Number

Open Calculator

fx $$k = \frac{2 \cdot \pi}{\lambda}$$

ex $$15.70796 = \frac{2 \cdot \pi}{0.4\text{m}}$$

16) Wave Number using Angular Frequency

Open Calculator

fx $$k = \frac{\omega_f}{V_w}$$

ex $$0.171333 = \frac{10.28\text{Hz}}{60\text{m/s}}$$

Angular Frequency

17) Angular Frequency given Velocity

Open Calculator

fx $$\omega_f = \frac{2 \cdot \pi \cdot V_w}{\lambda}$$

ex $$942.4778\text{Hz} = \frac{2 \cdot \pi \cdot 60\text{m/s}}{0.4\text{m}}$$

18) Angular Frequency using Frequency

Open Calculator

fx $$\omega_f = 2 \cdot \pi \cdot f_w$$

ex $$565.4867\text{Hz} = 2 \cdot \pi \cdot 90\text{Hz}$$

19) Angular Frequency using Time Period

Open Calculator

fx $$\omega_f = \frac{2 \cdot \pi}{T_w}$$

ex $$2.41661\text{Hz} = \frac{2 \cdot \pi}{2.6\text{s}}$$

20) Angular Frequency using Wave Number

Open Calculator

fx $$\omega_f = k \cdot V_w$$

ex $$13.8\text{Hz} = 0.23 \cdot 60\text{m/s}$$

Frequency of Organ Pipe

21) Frequency of 1st Harmonic Closed Organ Pipe

Open Calculator

fx $$f_w = \frac{1}{4} \cdot \frac{V_w}{L}$$

ex $$20\text{Hz} = \frac{1}{4} \cdot \frac{60\text{m/s}}{0.75\text{m}}$$

22) Frequency of 2nd Harmonic Open Organ Pipe

Open Calculator

fx $$f_w = \frac{V_w}{L}$$

ex $$80\text{Hz} = \frac{60\text{m/s}}{0.75\text{m}}$$

23) Frequency of 3rd Harmonic Closed Organ Pipe

Open Calculator

fx $$f_w = \frac{3}{4} \cdot \frac{V_w}{L}$$

ex $$60\text{Hz} = \frac{3}{4} \cdot \frac{60\text{m/s}}{0.75\text{m}}$$

24) Frequency of 4th Harmonic Open Organ Pipe

Open Calculator

fx $$f_w = 2 \cdot \frac{V_w}{L}$$

ex $$160\text{Hz} = 2 \cdot \frac{60\text{m/s}}{0.75\text{m}}$$

25) Frequency of Closed Organ Pipe

Open Calculator

fx $$f_w = \frac{2 \cdot n + 1}{4} \cdot \frac{V_w}{L}$$

ex $$100\text{Hz} = \frac{2 \cdot 2 + 1}{4} \cdot \frac{60\text{m/s}}{0.75\text{m}}$$

26) Frequency of Open Organ Pipe

Open Calculator

fx $$f_w = \frac{n}{2} \cdot \frac{V_w}{L}$$

ex $$80\text{Hz} = \frac{2}{2} \cdot \frac{60\text{m/s}}{0.75\text{m}}$$

27) Frequency of Open Organ Pipe for Nth Overtone

Open Calculator

$$f_w = \frac{n-1}{2} \cdot \frac{V_w}{L}$$

$$40\text{Hz} = \frac{2-1}{2} \cdot \frac{60\text{m/s}}{0.75\text{m}}$$

Observed Frequency

28) Observed Frequency when Observer and Source Move Away from Each Other

Open Calculator

$$F_o = \left(\frac{c - V_o}{c + V_{source}}\right) \cdot f_w$$

$$41.06383\text{Hz} = \left(\frac{343\text{m/s} - 150\text{m/s}}{343\text{m/s} + 80\text{m/s}}\right) \cdot 90\text{Hz}$$

29) Observed Frequency when Observer and Source Move towards Each Other

Open Calculator

$$F_o = \left(\frac{c + V_o}{c - V_{source}}\right) \cdot f_w$$

$$168.7072\text{Hz} = \left(\frac{343\text{m/s} + 150\text{m/s}}{343\text{m/s} - 80\text{m/s}}\right) \cdot 90\text{Hz}$$

30) Observed Frequency when Observer Moves Away from Source

Open Calculator

fx $$F_o = c - V_o$$

ex $$193\text{Hz} = 343\text{m/s} - 150\text{m/s}$$

31) Observed Frequency when Observer Moves Away from Source using Wavelength

Open Calculator

fx $$F_o = \frac{c - V_o}{\lambda}$$

ex $$482.5\text{Hz} = \frac{343\text{m/s} - 150\text{m/s}}{0.4\text{m}}$$

32) Observed Frequency when Observer Moves towards Source

Open Calculator

fx $$F_o = \left(\frac{c + V_{obj}}{c}\right) \cdot f_w$$

ex $$103.1195\text{Hz} = \left(\frac{343\text{m/s} + 50\text{m/s}}{343\text{m/s}}\right) \cdot 90\text{Hz}$$

33) Observed Frequency when Observer Moves towards Source and Source Moves Away

Open Calculator

fx $$F_o = \left(\frac{c + V_o}{c + V_{source}}\right) \cdot f_w$$

ex $$104.8936\text{Hz} = \left(\frac{343\text{m/s} + 150\text{m/s}}{343\text{m/s} + 80\text{m/s}}\right) \cdot 90\text{Hz}$$

34) Observed Frequency when Observer Moves towards Source using Wavelength

Open Calculator

fx $$F_o = \frac{c + V_{obj}}{\lambda}$$

ex $$982.5\text{Hz} = \frac{343\text{m/s} + 50\text{m/s}}{0.4\text{m}}$$

35) Observed Frequency when Source Moves Away from Observer

Open Calculator

fx $$F_o = \frac{c \cdot f_w}{c + V_{source}}$$

ex $$72.97872\text{Hz} = \frac{343\text{m/s} \cdot 90\text{Hz}}{343\text{m/s} + 80\text{m/s}}$$

36) Observed Frequency when Source Moves towards Observer

Open Calculator

fx $$F_o = \frac{c \cdot f_w}{c - V_{source}}$$

ex $$117.3764\text{Hz} = \frac{343\text{m/s} \cdot 90\text{Hz}}{343\text{m/s} - 80\text{m/s}}$$

37) Observed Frequency when Source Moves towards Observer and Observer Moves Away

Open Calculator

fx $$F_o = \left(\frac{c - V_o}{c - V_{source}} \right) \cdot f_w$$

ex $$66.04563\text{Hz} = \left(\frac{343\text{m/s} - 150\text{m/s}}{343\text{m/s} - 80\text{m/s}} \right) \cdot 90\text{Hz}$$

Velocity of Wave

38) Velocity of Progressive Wave

Open Calculator

fx $$V_w = \frac{\lambda}{T_w}$$

ex $$0.153846\text{m/s} = \frac{0.4\text{m}}{2.6\text{s}}$$

39) Velocity of Progressive Wave given Angular Frequency

Open Calculator

fx $$V_w = \frac{\lambda \cdot \omega_f}{4 \cdot \pi}$$

ex $$0.327223\text{m/s} = \frac{0.4\text{m} \cdot 10.28\text{Hz}}{4 \cdot \pi}$$

40) Velocity of Progressive Wave using Frequency

Open Calculator

fx $$V_w = \lambda \cdot f_w$$

ex $$36\text{m/s} = 0.4\text{m} \cdot 90\text{Hz}$$

41) Velocity of Wave given Wave Number

Open Calculator

fx $V_w = \frac{\omega_f}{k}$

ex $44.69565\text{m/s} = \frac{10.28\text{Hz}}{0.23}$

42) Velocity of Wave in String

Open Calculator

fx $V_w = \sqrt{\frac{T}{m}}$

ex $2.886751\text{m/s} = \sqrt{\frac{100\text{N}}{12\text{kg/m}}}$

Wavelength

43) Change in Wavelength due to Movement of Source

Open Calculator

fx $\lambda = V_{source} \cdot T_w$

ex $208\text{m} = 80\text{m/s} \cdot 2.6\text{s}$

44) Change in Wavelength given Angular Frequency

Open Calculator

fx $\lambda = 2 \cdot \pi \cdot V_{source} \cdot \omega_f$

ex $5167.292\text{m} = 2 \cdot \pi \cdot 80\text{m/s} \cdot 10.28\text{Hz}$

45) Change in Wavelength given Frequency

Open Calculator

fx $$\lambda = \frac{V_{source}}{f_w}$$

ex $$0.888889\text{m} = \frac{80\text{m/s}}{90\text{Hz}}$$

46) Effective Wavelength when Source Moves Away from Observer

Open Calculator

fx $$\lambda = \frac{c + V_{source}}{f_w}$$

ex $$4.7\text{m} = \frac{343\text{m/s} + 80\text{m/s}}{90\text{Hz}}$$

47) Effective Wavelength when Source Moves towards Observer

Open Calculator

fx $$\lambda = \frac{c - V_{source}}{f_w}$$

ex $$2.922222\text{m} = \frac{343\text{m/s} - 80\text{m/s}}{90\text{Hz}}$$

48) Wavelength given Frequency

Open Calculator

fx $$\lambda = \frac{V_w}{f_w}$$

ex $$0.666667\text{m} = \frac{60\text{m/s}}{90\text{Hz}}$$

49) Wavelength of Wave using Velocity

Open Calculator

fx $\lambda = V_w \cdot T_w$

ex $156\text{m} = 60\text{m/s} \cdot 2.6\text{s}$

Variables Used

- **A** Normal Area *(Square Meter)*
- **c** Velocity of Sound *(Meter per Second)*
- **E** Elasticity *(Pascal)*
- F_o Frequency Observed *(Hertz)*
- f_w Wave Frequency *(Hertz)*
- I_{ref} Reference Intensity *(Watt per Square Meter)*
- I_s Sound Intensity *(Watt per Square Meter)*
- **k** Wave Number
- **K** Bulk Modulus *(Pascal)*
- **L** Length of Organ Pipe *(Meter)*
- **m** Mass per Unit Length *(Kilogram per Meter)*
- **n** Number of Nodes
- **P** Power *(Watt)*
- **Q** Loudness *(Decibel)*
- **T** Tension of String *(Newton)*
- T_w Time Period of Progressive Wave *(Second)*
- V_o Velocity Observed *(Meter per Second)*
- V_{obj} Velocity of Object *(Meter per Second)*
- V_{source} Velocity of Source *(Meter per Second)*
- V_w Velocity of Wave *(Meter per Second)*
- **λ** Wavelength *(Meter)*
- **ρ** Density *(Kilogram per Cubic Meter)*

- ω_f Angular Frequency *(Hertz)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **log10**, log10(Number)
  The common logarithm, also known as the base-10 logarithm or the decimal logarithm, is a mathematical function that is the inverse of the exponential function.
- 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: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Area** in Square Meter (m^2)
  Area Unit Conversion
- Measurement: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Power** in Watt (W)
  Power Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Frequency** in Hertz (Hz)
  Frequency Unit Conversion

- Measurement: **Density** in Kilogram per Cubic Meter (kg/m^3)
  Density Unit Conversion
- Measurement: **Sound** in Decibel (dB)
  Sound Unit Conversion
- Measurement: **Linear Mass Density** in Kilogram per Meter (kg/m)
  Linear Mass Density Unit Conversion
- Measurement: **Intensity** in Watt per Square Meter (W/m^2)
  Intensity Unit Conversion

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