



# Linear Dispersion Relation of Linear Wave Formulas

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## List of 12 Linear Dispersion Relation of Linear Wave Formulas

### Linear Dispersion Relation of Linear Wave 🗗

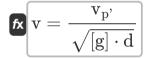
1) Angular Frequency of Wave

 $\omega_{\mathrm{c}} = \sqrt{[\mathrm{g}] \cdot \mathbf{k} \cdot \mathrm{tanh}(\mathbf{k} \cdot \mathbf{d})}$ 

Open Calculator

 $extbf{ex} \left| 1.375055 ext{rad/s} = \sqrt{[ ext{g}] \cdot 0.2 \cdot ext{tanh}(0.2 \cdot 10 ext{m})} \right|$ 

2) Dimensionless Wave Speed



Open Calculator

$$\mathbf{ex} = 50.00579 \, \text{m/s} = \frac{495.2 \, \text{m/s}}{\sqrt{[\text{g}] \cdot 10 \, \text{m}}}$$



### 3) Guo Formula of Linear Dispersion Relation

Open Calculator

$$\mathrm{kd} = \left(\omega^2 \cdot rac{\mathrm{d}}{[\mathrm{g}]}
ight) \cdot \left(1 - \exp\left(-\left(\omega \cdot \sqrt{rac{\mathrm{d}}{[\mathrm{g}]}}^{rac{5}{2}}
ight)^{-rac{2}{5}}
ight)
ight)$$

ex

$$14.87764 = \left(\left(6.2 \mathrm{rad/s}\right)^2 \cdot \frac{10 \mathrm{m}}{[\mathrm{g}]}\right) \cdot \left(1 - \mathrm{exp}\left(-\left(6.2 \mathrm{rad/s} \cdot \sqrt{\frac{10 \mathrm{m}}{[\mathrm{g}]}}^{\frac{5}{2}}\right)^{-\frac{2}{5}}\right)\right)$$

### 4) Guo Formula of Linear Dispersion Relation for Wave Number 🗗

 $\mathbf{k} = \left( rac{\omega_{\mathrm{c}}^2 \cdot d}{[\mathrm{g}]} 
ight) \cdot rac{1 - \exp\left( -\left(\omega_{\mathrm{c}} \cdot \sqrt{rac{\mathrm{d}}{[\mathrm{g}]}}^{rac{5}{2}}
ight)^{-rac{5}{5}}
ight)}{\mathrm{d}}$ 

Open Calculator

ex

$$0.222819 = \left(\frac{\left(2.04 \text{rad/s}\right)^2 \cdot 10 \text{m}}{[\text{g}]}\right) \cdot \frac{1 - \exp\left(-\left(2.04 \text{rad/s} \cdot \sqrt{\frac{10 \text{m}}{[\text{g}]}}^{\frac{5}{2}}\right)^{-\frac{2}{5}}\right)}{10 \text{m}}$$

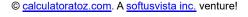
### 5) Radian Frequency of Waves

$$\omega = 2 \cdot rac{\pi}{\mathrm{T}}$$

Open Calculator

 $\mathbf{ex} \left[ 6.202552 \text{rad/s} = 2 \cdot \frac{\pi}{1.013} \right]$ 







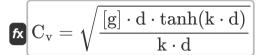
### 6) Relative Wavelength



Open Calculator 🗗

$$\boxed{\textbf{ex}} \ 0.7 \text{m} = \frac{7 \text{m}}{10 \text{m}}$$

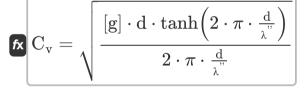
### 7) Velocity of Propagation in Linear Dispersion Relation



Open Calculator

ex 
$$6.875275 \text{m/s} = \sqrt{\frac{[\text{g}] \cdot 10 \text{m} \cdot \tanh(0.2 \cdot 10 \text{m})}{0.2 \cdot 10 \text{m}}}$$

### 8) Velocity of Propagation in Linear Dispersion Relation given Wavelength



Open Calculator

### 9) Wave Number for Steady Two-dimensional Waves

$$\mathbf{f}\mathbf{k} = rac{2 \cdot \pi}{\lambda^{"}}$$

Open Calculator

$$\boxed{ 0.200101 = \frac{2 \cdot \pi}{31.4 \mathrm{m}} }$$





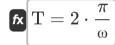
### 10) Wave Number of Convenient Empirical Explicit Approximation



Open Calculator 🗗

 $\mathbf{k} = \left(rac{\omega_{\mathrm{c}}^2}{[\mathrm{g}]}
ight) \cdot \left( \mathrm{coth} \left( \left(\omega_{\mathrm{c}} \cdot \sqrt{rac{\mathrm{d}}{[\mathrm{g}]}}^{rac{3}{2}}
ight)^{rac{2}{3}}
ight) 
ight)$ 

### 11) Wave Period given Radian Frequency of Waves



$$1.013417 = 2 \cdot \frac{\pi}{6.2 \text{rad/s}}$$

### 12) Wavelength given Wave Number

$$\lambda = rac{2 \cdot \pi}{\mathrm{k}}$$

$$\mathbf{ex} \ 31.41593 \mathbf{m} = \frac{2 \cdot \pi}{0.2}$$



### Variables Used

- C<sub>v</sub> Velocity of Propagation (Meter per Second)
- **d** Coastal Mean Depth (Meter)
- k Wave Number for Water Wave
- kd Linear Dispersion Relation
- T Wave Period
- V Wave Speed (Meter per Second)
- V<sub>p'</sub> Propagation Velocity (Meter per Second)
- λ<sub>o</sub> Deep-Water Wavelength (Meter)
- λ<sub>r</sub> Relative Wavelength (Meter)
- λ" Deep Water Wavelength of Coast (Meter)
- **W** Wave Angular Frequency (Radian per Second)
- ω<sub>c</sub> Angular Frequency of Wave (Radian per Second)





### Constants, Functions, Measurements used

- Constant: pi, 3.14159265358979323846264338327950288
   Archimedes' constant
- Constant: [g], 9.80665 Gravitational acceleration on Earth
- Function: coth, coth(Number)
   The hyperbolic cotangent function, denoted as coth(x), is defined as the ratio of the hyperbolic cosine to the hyperbolic sine.
- Function: exp, exp(Number)

  n an exponential function, the value of the function changes by a constant factor for every unit change in the independent variable.
- 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.
- Function: tanh, tanh(Number)

  The hyperbolic tangent function (tanh) is a function that is defined as the ratio of the hyperbolic sine function (sinh) to the hyperbolic cosine function (cosh).
- Measurement: Length in Meter (m)
  Length Unit Conversion
- Measurement: Speed in Meter per Second (m/s)
   Speed Unit Conversion
- Measurement: Angular Frequency in Radian per Second (rad/s)

  Angular Frequency Unit Conversion





### **Check other formula lists**

- Group Velocity, Beats, Energy
   Transport Formulas
- Linear Dispersion Relation of Linear Wave Formulas
- Non-Linear Wave Theory Formulas
- Shoaling, Refraction and Breaking Formulas

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