# Important Linear Dispersion Relation of Linear Wave Formulas PDF

**Formulas**
**Examples**
**with Units**

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

### 1) Angular Frequency of Wave Formula

Evaluate Formula

Formula

$$\omega_c = \sqrt{[g] \cdot k \cdot \tanh\left(k \cdot d\right)}$$

Example with Units

$$1.3751\,\text{rad/s} = \sqrt{9.8066\,\text{m/s}^2 \cdot 0.2 \cdot \tanh\left(0.2 \cdot 10\,\text{m}\right)}$$

### 2) Dimensionless Wave Speed Formula

Evaluate Formula

Formula

$$v = \frac{v_{p'}}{\sqrt{[g] \cdot d}}$$

Example with Units

$$50.0058\,\text{m/s} = \frac{495.2\,\text{m/s}}{\sqrt{9.8066\,\text{m/s}^2 \cdot 10\,\text{m}}}$$

### 3) Guo Formula of Linear Dispersion Relation Formula

Evaluate Formula

Formula

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

Example with Units

$$14.8776 = \left(6.2\,\text{rad/s}^2 \cdot \frac{10\,\text{m}}{9.8066\,\text{m/s}^2}\right) \cdot \left(1 - \exp\left(-\left(6.2\,\text{rad/s} \cdot \sqrt{\frac{10\,\text{m}}{9.8066\,\text{m/s}^2}}^{\frac{5}{2}}\right)^{-\frac{2}{5}}\right)\right)$$

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

Evaluate Formula

Formula

$$k = \left(\frac{\omega_c^{\,2} \cdot d}{[g]}\right) \cdot \frac{1 - \exp\left(-\left(\omega_c \cdot \sqrt{\frac{d}{[g]}}^{\frac{5}{2}}\right)^{-\frac{2}{5}}\right)}{d}$$

Example with Units

$$0.2228 = \left(\frac{2.04\,\text{rad/s}^{\,2} \cdot 10\,\text{m}}{9.8066\,\text{m/s}^2}\right) \cdot \frac{1 - \exp\left(-\left(2.04\,\text{rad/s} \cdot \sqrt{\frac{10\,\text{m}}{9.8066\,\text{m/s}^2}}^{\frac{5}{2}}\right)^{-\frac{2}{5}}\right)}{10\,\text{m}}$$

## 5) Radian Frequency of Waves Formula

Evaluate Formula

Formula

$$\omega = 2 \cdot \frac{\pi}{T}$$

Example with Units

$$6.2026\,\text{rad/s} = 2 \cdot \frac{3.1416}{1.013}$$

## 6) Relative Wavelength Formula

Evaluate Formula

Formula

$$\lambda_r = \frac{\lambda_o}{d}$$

Example with Units

$$0.7\,\text{m} = \frac{7\,\text{m}}{10\,\text{m}}$$

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

Evaluate Formula

Formula

$$C_v = \sqrt{\frac{[g] \cdot d \cdot \tanh\left(k \cdot d\right)}{k \cdot d}}$$

Example with Units

$$6.8753\,\text{m/s} = \sqrt{\frac{9.8066\,\text{m/s}^2 \cdot 10\,\text{m} \cdot \tanh\left(0.2 \cdot 10\,\text{m}\right)}{0.2 \cdot 10\,\text{m}}}$$

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

Evaluate Formula

Formula

$$C_v = \sqrt{\frac{[g] \cdot d \cdot \tanh\left(2 \cdot \pi \cdot \frac{d}{\lambda''}\right)}{2 \cdot \pi \cdot \frac{d}{\lambda''}}}$$

Example with Units

$$6.8738\,\text{m/s} = \sqrt{\frac{9.8066\,\text{m/s}^2 \cdot 10\,\text{m} \cdot \tanh\left(2 \cdot 3.1416 \cdot \frac{10\,\text{m}}{31.4\,\text{m}}\right)}{2 \cdot 3.1416 \cdot \frac{10\,\text{m}}{31.4\,\text{m}}}}$$

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

Evaluate Formula

Formula

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

Example with Units

$$0.2001 = \frac{2 \cdot 3.1416}{31.4\,\text{m}}$$

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

Evaluate Formula

Formula

$$k = \left(\frac{\omega_c^2}{[g]}\right) \cdot \left(\coth\left(\left(\omega_c \cdot \sqrt{\frac{d}{[g]}}^{\frac{3}{2}}\right)^{\frac{2}{3}}\right)\right)$$

Example with Units

$$0.4587 = \left(\frac{2.04\,\text{rad/s}^2}{9.8066\,\text{m/s}^2}\right) \cdot \left(\coth\left(\left(2.04\,\text{rad/s} \cdot \sqrt{\frac{10\,\text{m}}{9.8066\,\text{m/s}^2}}^{\frac{3}{2}}\right)^{\frac{2}{3}}\right)\right)$$

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

Evaluate Formula

Formula

$$T = 2 \cdot \frac{\pi}{\omega}$$

Example with Units

$$1.0134 = 2 \cdot \frac{3.1416}{6.2\,\text{rad/s}}$$

## 12) Wavelength given Wave Number Formula

Evaluate Formula

| Formula | Example with Units |
| --- | --- |
| $\lambda'' = \frac{2 \cdot \pi}{k}$ | $31.4159\,\text{m} = \frac{2 \cdot 3.1416}{0.2}$ |

## Variables used in list of Linear Dispersion Relation of Linear Wave Formulas above

- $C_v$ 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)*
- $v_{p'}$ Propagation Velocity *(Meter per Second)*
- $\lambda_o$ Deep-Water Wavelength *(Meter)*
- $\lambda_r$ Relative Wavelength *(Meter)*
- $\lambda''$ Deep Water Wavelength of Coast *(Meter)*
- $\omega$ Wave Angular Frequency *(Radian per Second)*
- $\omega_c$ Angular Frequency of Wave *(Radian per Second)*

## Constants, Functions, Measurements used in list of Linear Dispersion Relation of Linear Wave Formulas above

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

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