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# Wave Parameters Formulas

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# List of 18 Wave Parameters Formulas

## Wave Parameters

### 1) Angular of Radian Frequency of Wave

$$\text{fx } \omega = 2 \cdot \frac{\pi}{P}$$

[Open Calculator !\[\]\(a870788d6ed9b8fd294b7654a8c8526b\_img.jpg\)](#)

$$\text{ex } 6.10018\text{rad/s} = 2 \cdot \frac{\pi}{1.03}$$

### 2) Eckart's Equation for Wavelength

**fx**
[Open Calculator !\[\]\(c50c8b7b2cc2cf9ff925edec0ee94c0d\_img.jpg\)](#)

$$\lambda = \left( \left( [g] \cdot \frac{P^2}{2} \cdot \pi \right) \cdot \sqrt{\frac{\tanh(4 \cdot \pi^2 \cdot d)}{P^2} \cdot [g]} \right)$$

$$\text{ex } 49.68647\text{m} = \left( \left( [g] \cdot \frac{(1.03)^2}{2} \cdot \pi \right) \cdot \sqrt{\frac{\tanh(4 \cdot \pi^2 \cdot 0.91\text{m})}{(1.03)^2} \cdot [g]} \right)$$

### 3) Elevation of Water Surface Relative to SWL

$$\text{fx } \eta = a \cdot \cos(\theta)$$

[Open Calculator !\[\]\(f1c5da15572e3e09d343161be98f508d\_img.jpg\)](#)

$$\text{ex } 1.351\text{m} = 1.56\text{m} \cdot \cos(30^\circ)$$



#### 4) Major Horizontal Semi-Axis given wavelength, Wave Height and Water Depth

$$\text{fx } A = \left( \frac{H}{2} \right) \cdot \frac{\cosh\left(2 \cdot \pi \cdot \frac{D_{Z+d}}{\lambda}\right)}{\sinh\left(2 \cdot \pi \cdot \frac{d}{\lambda}\right)}$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235\_img.jpg\)](#)

$$\text{ex } 7.758974 = \left( \frac{3\text{m}}{2} \right) \cdot \frac{\cosh\left(2 \cdot \pi \cdot \frac{2\text{m}}{26.8\text{m}}\right)}{\sinh\left(2 \cdot \pi \cdot \frac{0.91\text{m}}{26.8\text{m}}\right)}$$

#### 5) Maximum Wave Steepness for Waves Travelling

$$\text{fx } \varepsilon_s = 0.142 \cdot \tanh\left(2 \cdot \pi \cdot \frac{d}{\lambda}\right)$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0\_img.jpg\)](#)

$$\text{ex } 0.029844 = 0.142 \cdot \tanh\left(2 \cdot \pi \cdot \frac{0.91\text{m}}{26.8\text{m}}\right)$$

#### 6) Minor Vertical Semi-Axis given Wavelength, Wave Height and Water Depth

$$\text{fx } B = \left( \frac{H}{2} \right) \cdot \frac{\sinh\left(2 \cdot \pi \cdot \frac{D_{Z+d}}{\lambda}\right)}{\sinh\left(2 \cdot \pi \cdot \frac{d}{\lambda}\right)}$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f\_img.jpg\)](#)

$$\text{ex } 3.393043 = \left( \frac{3\text{m}}{2} \right) \cdot \frac{\sinh\left(2 \cdot \pi \cdot \frac{2\text{m}}{26.8\text{m}}\right)}{\sinh\left(2 \cdot \pi \cdot \frac{0.91\text{m}}{26.8\text{m}}\right)}$$



## 7) Phase Velocity or Wave Celerity

$$fx \quad C = \frac{\lambda}{P}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95\_img.jpg\)](#)

$$ex \quad 26.01942m/s = \frac{26.8m}{1.03}$$

## 8) Phase Velocity or Wave Celerity given Radian Frequency and Wavenumber

$$fx \quad C = \frac{\omega}{k}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2\_img.jpg\)](#)

$$ex \quad 26.95652m/s = \frac{6.2rad/s}{0.23}$$

## 9) Radian Frequency given Wave Celerity

$$fx \quad \omega = C \cdot k$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7\_img.jpg\)](#)

$$ex \quad 5.5315rad/s = 24.05m/s \cdot 0.23$$

## 10) Water Depth for Maximum Wave Steepness of Waves Travelling

$$fx \quad d = \lambda \cdot a \frac{\tanh\left(\frac{\epsilon_s}{0.142}\right)}{2 \cdot \pi}$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b\_img.jpg\)](#)

$$ex \quad 0.914909m = 26.8m \cdot a \frac{\tanh\left(\frac{0.03}{0.142}\right)}{2 \cdot \pi}$$




11) Wave Amplitude 

$$fx \quad a = \frac{H}{2}$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a\_img.jpg\)](#)

$$ex \quad 1.5m = \frac{3m}{2}$$

12) Wave Amplitude given Elevation of Water Surface Relative to SWL 

$$fx \quad a = \frac{\eta}{\cos(\theta)}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021\_img.jpg\)](#)


$$ex \quad 0.207846m = \frac{0.18m}{\cos(30^\circ)}$$

13) Wave Height given Maximum Wave Steepness Limit by Michell 

$$fx \quad H = \lambda \cdot 0.142$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd\_img.jpg\)](#)

$$ex \quad 3.8056m = 26.8m \cdot 0.142$$


14) Wave Number given Wave Celerity 

$$fx \quad k = \frac{\omega}{C}$$

[Open Calculator !\[\]\(7bc43b319a082987e20f7bf78f4bab80\_img.jpg\)](#)

$$ex \quad 0.257796 = \frac{6.2rad/s}{24.05m/s}$$



15) Wave number given wavelength 

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

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0\_img.jpg\)](#)


$$ex \quad 0.234447 = 2 \cdot \frac{\pi}{26.8m}$$

16) Wave Steepness 

$$fx \quad \epsilon_s = \frac{H}{\lambda}$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5\_img.jpg\)](#)

$$ex \quad 0.11194 = \frac{3m}{26.8m}$$

17) Wavelength for Maximum Wave Steepness 

$$fx \quad \lambda = 2 \cdot \pi \cdot \frac{d}{a} \tanh\left(\frac{\epsilon_s}{0.142}\right)$$

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60\_img.jpg\)](#)

$$ex \quad 26.65621m = 2 \cdot \pi \cdot \frac{0.91m}{a} \tanh\left(\frac{0.03}{0.142}\right)$$

18) Wavelength given Maximum Wave Steepness Limit by Michell 

$$fx \quad \lambda = \frac{H}{0.142}$$

[Open Calculator !\[\]\(5abce1a84a655b073239ab33e1199487\_img.jpg\)](#)

$$ex \quad 21.12676m = \frac{3m}{0.142}$$




## Variables Used

- **a** Wave Amplitude (Meter)
- **A** Horizontal Semi-axis of Water Particle
- **B** Vertical Semi-Axis
- **C** Celerity of the Wave (Meter per Second)
- **d** Water Depth (Meter)
- **D<sub>Z+d</sub>** Distance above the Bottom (Meter)
- **H** Wave Height (Meter)
- **k** Wave Number
- **P** Wave Period
- **$\epsilon_s$**  Wave Steepness
- **$\eta$**  Elevation of Water Surface (Meter)
- **$\theta$**  Theta (Degree)
- **$\lambda$**  Wavelength (Meter)
- **$\omega$**  Wave Angular Frequency (Radian per Second)






## Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288  
*Archimedes' constant*
- **Constant:** **[g]**, 9.80665  
*Gravitational acceleration on Earth*
- **Function:** **atanh**, atanh(Number)  
*The inverse hyperbolic tangent function returns the value whose hyperbolic tangent is a number.*
- **Function:** **cos**, cos(Angle)  
*Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.*
- **Function:** **cosh**, cosh(Number)  
*The hyperbolic cosine function is a mathematical function that is defined as the ratio of the sum of the exponential functions of  $x$  and negative  $x$  to 2.*
- **Function:** **sinh**, sinh(Number)  
*The hyperbolic sine function, also known as the sinh function, is a mathematical function that is defined as the hyperbolic analogue of the sine 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.*
- **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: Angle** in Degree ( $^{\circ}$ )  
*Angle Unit Conversion* 
- **Measurement: Angular Frequency** in Radian per Second (rad/s)  
*Angular Frequency Unit Conversion* 



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