



## **Wave Energy Formulas**

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Examples!

Conversions!

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## **List of 23 Wave Energy Formulas**

## Wave Energy

1) Deepwater Celerity given Wave Power of Deepwater

Open Calculator

$$extbf{K} egin{bmatrix} ext{C}_{
m o} = rac{ ext{P}_{
m d}}{0.5 \cdot ext{E}} \end{bmatrix}$$

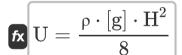
2) Potential Energy given Total Wave Energy

 $f_{\mathbf{x}} PE = TE - KE$ 

Open Calculator

 $= 10.124 \mathrm{J/m} = 20.26 \mathrm{J/m} - 10.136 \mathrm{J}$ 

3) Specific Energy or Energy Density given Wave Height 🗗



Open Calculator G

$$ext{ex} 13.51479 ext{J/m}^3 = rac{1.225 ext{kg/m}^3 \cdot ext{[g]} \cdot ext{(3m)}^2}{8}$$



## 4) Specific Energy or Energy Density given Wavelength and Wave Energy

 $\int U = \frac{TE}{r^2}$ 

Open Calculator

- $\begin{array}{c} \text{ex} \ 13.50667 \text{J/m}^{_3} = \frac{20.26 \text{J/m}}{1.5 \text{m}} \end{array}$
- 5) Total Wave Energy for Wave Power of Deepwater
- $\mathbf{E} = rac{\mathrm{P_d}}{0.5 \cdot \mathrm{C_o}}$

Open Calculator 🖒

- $\boxed{\textbf{ex}} 80 \text{J} = \frac{180 \text{W}}{0.5 \cdot 4.5 \text{m/s}}$
- 6) Total Wave Energy given Kinetic Energy and Potential Energy
- extstyle ext

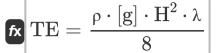
Open Calculator

- $m ex \ 20.266J/m = 10.136J + 10.13J/m$
- 7) Total Wave Energy given Wave Power for Shallow Water
- $\mathbf{E} = rac{\mathrm{P_s}}{\mathrm{C_s}}$

Open Calculator 🗗

 $\boxed{\textbf{ex}}80 J = \frac{224 W}{2.8 m/s}$ 

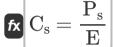
#### 8) Total Wave Energy in one Wavelength per unit Crest Width



Open Calculator

 $\mathbf{ex} = \frac{20.27218 \mathrm{J/m}}{8} = \frac{1.225 \mathrm{kg/m^3 \cdot [g] \cdot (3m)^2 \cdot 1.5m}}{8}$ 

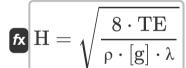
## 9) Wave Celerity given Wave Power for Shallow Water



Open Calculator

 $\boxed{2.8 \text{m/s} = \frac{224 \text{W}}{80 \text{J}}}$ 

# 10) Wave Height given Total Wave Energy in one Wavelength per unit Crest Width



Open Calculator

 $\mathbf{ex} = 2.999098 \mathrm{m} = \sqrt{rac{8 \cdot 20.26 \mathrm{J/m}}{1.225 \mathrm{kg/m^3 \cdot [g] \cdot 1.5 m}}}$ 

#### 11) Wave Power for Deepwater

fx 
$$P_{
m d} = 0.5 \cdot E \cdot C_{
m o}$$

Open Calculator

 $\texttt{ex} \ 180 \text{W} = 0.5 \cdot 80 \text{J} \cdot 4.5 \text{m/s}$ 



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#### 12) Wave Power for Shallow Water

fx  $P_s = E \cdot C_s$ 

Open Calculator 🚰

 $\texttt{ex} \ 224 \text{W} = 80 \text{J} \cdot 2.8 \text{m/s}$ 

# 13) Wavelength for Total Wave Energy in Wavelength per unit Crest Width

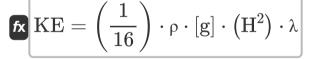
$$\lambda = rac{8 \cdot \mathrm{TE}}{
ho \cdot [\mathrm{g}] \cdot \mathrm{H}^2}$$

Open Calculator

ex  $1.499098m = \frac{8 \cdot 20.26 J/m}{1.225 kg/m^3 \cdot [g] \cdot (3m)^2}$ 

## Kinetic Energy

## 14) Kinetic Energy due to Particle Motion 🗹



Open Calculator 🗗

 $\boxed{10.13609 \mathrm{J} = \left(\frac{1}{16}\right) \cdot 1.225 \mathrm{kg/m^3} \cdot [\mathrm{g}] \cdot \left((3\mathrm{m})^2\right) \cdot 1.5\mathrm{m}}$ 

## 15) Kinetic Energy given Total Wave Energy

$$fx KE = TE - PE$$

Open Calculator

ex  $10.13 \mathrm{J} = 20.26 \mathrm{J/m} - 10.13 \mathrm{J/m}$ 







#### 16) Wave Height given Kinetic Energy due to Particle Motion

 $\mathbf{K} = \sqrt{rac{ ext{KE}}{0.0625 \cdot 
ho \cdot [ ext{g}] \cdot \lambda}}$ 

Open Calculator

 $= \sqrt{\frac{10.136 J}{0.0625 \cdot 1.225 kg/m^3 \cdot [g] \cdot 1.5m}}$ 

## 17) Wavelength for Kinetic Energy due to Particle Motion

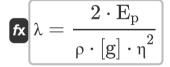


Open Calculator

 $= \frac{10.136 \text{J}}{0.0625 \cdot 1.225 \text{kg/m}^3 \cdot [\text{g}] \cdot (3\text{m})^2}$ 

## Potential Energy 2

## 18) Length given Potential Energy due to Deformation of Free Surface



Open Calculator

 $ext{ex} 1.499977 ext{m} = rac{2 \cdot 324.35 ext{J}}{1.225 ext{kg/m}^3 \cdot [ ext{g}] \cdot (6 ext{m})^2}$ 



#### 19) Potential Energy due to Deformation of Free Surface

 $\mathbf{E}_{\mathrm{p}} = rac{
ho \cdot [\mathrm{g}] \cdot \eta^2 \cdot \lambda}{2}$ 

Open Calculator 🚰

 $ext{ex} \ 324.3549 ext{J} = rac{1.225 ext{kg/m}^3 \cdot [ ext{g}] \cdot (6 ext{m})^2 \cdot 1.5 ext{m}}{2}$ 

### 20) Potential Energy per unit Width in One Wave

 $ag{PE} = \left(rac{1}{16}
ight) \cdot 
ho \cdot [\mathrm{g}] \cdot \left(\mathrm{H}^2
ight) \cdot \lambda$ 

Open Calculator

 $\boxed{ 10.13609 \mathrm{J/m} = \left(\frac{1}{16}\right) \cdot 1.225 \mathrm{kg/m^3} \cdot [\mathrm{g}] \cdot \left(\left(3\mathrm{m}\right)^2\right) \cdot 1.5\mathrm{m} }$ 

# 21) Surface Elevation given Potential Energy due to Deformation of Free Surface

$$\pi = \sqrt{\frac{2 \cdot E_p}{\rho \cdot [g] \cdot \lambda}}$$

Open Calculator

ex 
$$5.999954 \mathrm{m} = \sqrt{rac{2 \cdot 324.35 \mathrm{J}}{1.225 \mathrm{kg/m^3 \cdot [g] \cdot 1.5 m}}}$$



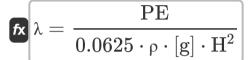
## 22) Wave Height given Potential Energy per Unit Width in One Wave 🛂



Open Calculator 2

$$ext{H} = \sqrt{rac{ ext{PE}}{0.0625 \cdot 
ho \cdot [ ext{g}] \cdot \lambda}}$$

## 23) Wavelength for Potential Energy per unit Width in One Wave



Open Calculator 2

$$= \frac{10.13 \text{J/m}}{0.0625 \cdot 1.225 \text{kg/m}^3 \cdot [\text{g}] \cdot (3\text{m})^2}$$



#### Variables Used

- Co Deepwater Wave Celerity (Meter per Second)
- C<sub>s</sub> Celerity for Shallow Depth (Meter per Second)
- E Total Wave Energy (Joule)
- E<sub>p</sub> Potential Energy of Wave (Joule)
- H Wave Height (Meter)
- **KE** Kinetic Energy of Wave per Unit Width (Joule)
- Pd Wave Power for Deep Water (Watt)
- P<sub>S</sub> Wave Power for Shallow Depth (Watt)
- **PE** Potential Energy per Unit Width (Joule per Meter)
- TE Total Energy of Wave per Width (Joule per Meter)
- **U** Energy Density of Wave (Joule per Cubic Meter)
- η Surface Elevation (Meter)
- **λ** Wavelength (Meter)
- ρ Density of Fluid (Kilogram per Cubic Meter)





## Constants, Functions, Measurements used

- Constant: [g], 9.80665

  Gravitational acceleration on Earth
- 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: Speed in Meter per Second (m/s)
   Speed Unit Conversion
- Measurement: Energy in Joule (J)
   Energy Unit Conversion
- Measurement: Power in Watt (W)
   Power Unit Conversion
- Measurement: Density in Kilogram per Cubic Meter (kg/m³)
   Density Unit Conversion
- Measurement: Energy Density in Joule per Cubic Meter (J/m³)
   Energy Density Unit Conversion
- Measurement: Energy per Unit Length in Joule per Meter (J/m)

  Energy per Unit Length Unit Conversion





#### **Check other formula lists**

- Cnoidal Wave Theory Formulas
- Horizontal and Vertical Semi-Axis of Ellipse Formulas
- Wave Energy Formulas
- Wave Parameters Formulas

- Wave Period Formulas
- Wave Period Distribution and Wave Spectrum Formulas

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