



## **Oceanography Formulas**

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## List of 36 Oceanography Formulas

## Oceanography 🕑

## Dynamics of Ocean Currents 🕑

1) Angular Velocity given Pressure Gradient Normal to Current 🕑

fx 
$$\Omega_{
m E} = rac{\left(rac{1}{
ho_{
m water}}
ight)\cdot\left(\delta {
m p}_{/\delta n}
ight)}{2\cdot \sin({
m L})\cdot{
m V}}$$

ex 7.3E<sup>-5</sup>rad/s = 
$$\frac{\left(\frac{1}{1000 \text{kg/m}^3}\right) \cdot (4000)}{2 \cdot \sin(20^\circ) \cdot 49.8 \text{mi/s}}$$

### 2) Coriolis Acceleration

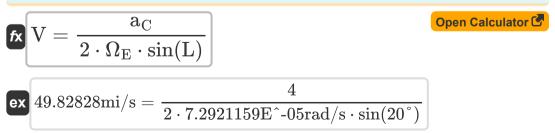
fx 
$$\mathbf{a}_{\mathrm{C}} = 2 \cdot \Omega_{\mathrm{E}} \cdot \sin(\mathrm{L}) \cdot \mathrm{V}$$

Open Calculator 🕑

Open Calculator

```
ex 3.99773 = 2 \cdot 7.2921159 \text{E}^{-05 \text{rad}/\text{s}} \cdot \sin(20^{\circ}) \cdot 49.8 \text{mi/s}
```

#### 3) Current Velocity given Coriolis Acceleration





4) Current Velocity given Pressure Gradient Normal to Current

$$\mathbf{fx} = \frac{\left(\frac{1}{\rho_{water}}\right) \cdot \left(\delta p_{/\delta n}\right)}{2 \cdot \Omega_{E} \cdot \sin(L)}$$

$$\mathbf{fx} = \frac{\left(\frac{1}{1000 \text{ kg/m}^{2}}\right) \cdot (4000)}{2 \cdot 7.2921159 \text{ E}^{*} - 05 \text{ rad/s} \cdot \sin(20^{\circ})}$$

$$\mathbf{fx} = a \sin\left(\frac{a_{C}}{2 \cdot \Omega_{E} \cdot V}\right)$$

$$\mathbf{fx} = a \sin\left(\frac{a_{C}}{2 \cdot \Omega_{E} \cdot V}\right)$$

$$\mathbf{fx} = a \sin\left(\frac{4}{2 \cdot 7.2921159 \text{ E}^{*} - 05 \text{ rad/s} \cdot 49.8 \text{ mi/s}}\right)$$

$$\mathbf{fx} = a \sin\left(\frac{\left(\frac{1}{\rho_{water}}\right) \cdot \delta p_{/\delta n}}{2 \cdot \Omega_{E} \cdot V}\right)$$

$$\mathbf{fx} = a \sin\left(\frac{\left(\frac{1}{\rho_{water}}\right) \cdot \delta p_{/\delta n}}{2 \cdot \Omega_{E} \cdot V}\right)$$

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$$\mathbf{fx} = a \sin\left(\frac{\left(\frac{1}{\rho_{water}}\right) \cdot \delta p_{/\delta n}}{2 \cdot \Omega_{E} \cdot V}\right)$$



7) Pressure Gradient Normal to Current

### Eckman Wind Drift 🕑

fx 
$$heta=45+\left(\pi\cdotrac{\mathrm{z}}{\mathrm{D}_{\mathrm{F}}}
ight)$$

ex 
$$49.18879 = 45 + \left(\pi \cdot \frac{160}{120 \mathrm{m}}\right)$$

### 9) Atmospheric Pressure as function of Salinity and Temperature

fx 
$$\sigma_{
m t} = 0.75 \cdot {
m S}$$

ex 
$$24.9975 = 0.75 \cdot 33.33 \mathrm{mg/L}$$

10) Density given Atmospheric Pressure whose value of Thousand is reduced from Density Value

fx 
$$ho_{
m s}=\sigma_{
m t}+1000$$
 Open Calculator P  $m v$   $m 1025 kg/m^3=25+1000$ 

Open Calculator

Open Calculator 🕑

11) Depth given Angle between Wind and Current Direction

$$\begin{array}{l} \text{fx} \ D_{\rm F} = \pi \cdot \frac{{\rm Z}}{\theta - 45} & \text{Open Calculator } \end{tabular} \\ \text{ex} \ 119.9654{\rm m} = \pi \cdot \frac{160}{49.19 - 45} & \text{I2) Depth given Volume Flow rate per unit of Ocean Width } \end{tabular} \\ \text{fx} \ D_{\rm F} = \frac{{\rm q}_{\rm x} \cdot \pi \cdot \sqrt{2}}{{\rm V}_{\rm s}} & \text{Open Calculator } \end{tabular} \end{array}$$

ex 
$$119.9578m = \frac{13.5m^3/s \cdot \pi \cdot \sqrt{2}}{0.5m/s}$$

### 13) Depth of Frictional Influence by Eckman 子

$$\textbf{fx} D_{Eddy} = \pi \cdot \sqrt{\frac{\epsilon_v}{\rho_{water} \cdot \Omega_E \cdot sin(L)}}$$
 Open Calculator

ex 
$$15.40894 \text{m} = \pi \cdot \sqrt{\frac{0.6}{1000 \text{kg/m}^3 \cdot 7.2921159 \text{E}^{-05 \text{rad/s} \cdot \sin(20^\circ)}}}$$



14) Latitude given Depth of Frictional Influence by Eckman 🕑

$$\mathbf{k} \mathbf{L} = a \sin \left( \frac{\varepsilon_{\mathrm{v}}}{\rho_{\mathrm{water}} \cdot \Omega_{\mathrm{E}} \cdot \left( \frac{\mathrm{D}_{\mathrm{Eddy}}}{\pi} \right)^2} \right)$$

$$\mathbf{ex} 21.12738^{\circ} = a \sin \left( \frac{0.6}{1000 \mathrm{kg/m^3} \cdot 7.2921159 \mathrm{E}^{\circ} - 05 \mathrm{rad/s} \cdot \left( \frac{15.01 \mathrm{m}}{\pi} \right)^2} \right)$$

$$\mathbf{15} \text{ Salinity given Atmospheric Pressure } \mathbf{C}$$

$$\mathbf{fx} \mathbf{S} = \frac{\sigma_{\mathrm{t}}}{0.75}$$

$$\mathbf{Open Calculator } \mathbf{C}$$

$$\mathbf{ex} 33.3333 \mathrm{mg/L} = \frac{25}{0.75}$$

$$\mathbf{16} \text{ Velocity at Surface given Velocity Component along Horizontal x Axis}$$

$$\mathbf{fx} \mathbf{V}_{\mathrm{s}} = \frac{\mathrm{u}_{\mathrm{x}}}{e^{\pi \cdot \frac{z}{\mathrm{D}_{\mathrm{F}}} \cdot \cos\left(45 + \left(\pi \cdot \frac{z}{\mathrm{D}_{\mathrm{F}}}\right)\right)}$$

$$\mathbf{Den Calculator } \mathbf{fx}$$

ex 
$$0.479647 \text{m/s} = rac{15 \text{m/s}}{e^{\pi \cdot rac{160}{120 \text{m}}} \cdot \cos \left( 45 + \left( \pi \cdot rac{160}{120 \text{m}} \right) 
ight)}$$





# 17) Velocity at Surface given Velocity detail of Current Profile in Three Dimensions

fx 
$$V_{
m s}=rac{
m V}{e^{\pi\cdotrac{
m z}{
m D_{
m F}}}}$$
 Open Calculator IP

ex 
$$0.909877 \mathrm{m/s} = rac{60 \mathrm{m/s}}{e^{\pi \cdot rac{160}{120 \mathrm{m}}}}$$

### 18) Velocity Component along Horizontal x Axis 🖸

fx 
$$\mathbf{u}_{\mathrm{x}} = \mathrm{V}_{\mathrm{s}} \cdot e^{\pi \cdot rac{\mathrm{z}}{\mathrm{D}_{\mathrm{F}}}} \cdot \cos igg( 45 + igg( \pi \cdot rac{\mathrm{z}}{\mathrm{D}_{\mathrm{F}}} igg) igg)$$

Open Calculator

Open Calculator

$$\mathbf{x} \ 15.6365 \mathrm{m/s} = 0.5 \mathrm{m/s} \cdot e^{\pi \cdot \frac{160}{120 \mathrm{m}}} \cdot \cos \biggl( 45 + \biggl( \pi \cdot \frac{160}{120 \mathrm{m}} \biggr) \biggr)$$

# 19) Velocity in Current Profile in Three Dimensions by introducing Polar Coordinates

fx 
$$\mathrm{V}_{\mathrm{Current}} = \mathrm{V}_{\mathrm{s}} \cdot e^{\pi \cdot rac{\mathrm{z}}{\mathrm{D}_{\mathrm{F}}}}$$

ex  $32.97148 \mathrm{m/s} = 0.5 \mathrm{m/s} \cdot e^{\pi \cdot rac{160}{120 \mathrm{m}}}$ 

# 20) Vertical Coordinate from Ocean Surface given Angle between Wind and Current Direction

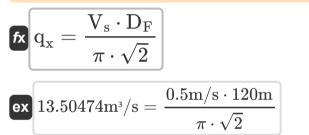
fx 
$$z = D_F \cdot \frac{\theta - 45}{\pi}$$
  
ex  $160.0462 = 120m \cdot \frac{49.19 - 45}{\pi}$   
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# 21) Vertical Eddy Viscosity Coefficient given Depth of Frictional Influence by Eckman

fx 
$$\epsilon_{
m v} = rac{{
m D}_{
m Eddy}^2 \cdot 
ho_{
m water} \cdot \Omega_{
m E} \cdot \sin({
m L})}{\pi^2}$$

$$0.569334 = rac{(15.01 {
m m})^2 \cdot 1000 {
m kg/m^3} \cdot 7.2921159 {
m E^-} - 05 {
m rad/s} \cdot \sin(20^\circ)}{\pi^2}$$

### 22) Volume Flow Rates per unit of Ocean Width 🕑



## Forces Driving Ocean Currents 🕑

### 23) Angular Speed of Earth for given Coriolis Frequency 🕑



Open Calculator

Open Calculator

9/17 Oceanography Formulas... 24) Coriolis Frequency 💪 Open Calculator fx  ${
m f}=2\cdot\Omega_{
m E}\cdot\sin(\lambda_{
m e})$ ex  $0.0001 = 2 \cdot 7.2921159 \text{E}^{-05 \text{rad}/\text{s}} \cdot \sin(43.29^{\circ})$ 25) Coriolis Frequency given Horizontal Component of Coriolis Acceleration Open Calculator  $f = \frac{a_C}{U}$ ex  $0.0001 = \frac{4}{24.85 \text{mi/s}}$ 26) Drag Coefficient fx  $\mathrm{C_{D}} = 0.00075 + (0.000067 \cdot \mathrm{V_{10}})$ Open Calculator ex  $0.002224 = 0.00075 + (0.000067 \cdot 22 \text{m/s})$ 27) Drag Coefficient given Wind Stress 🖌 Open Calculator fx  $C_D = rac{ au_o}{
ho \cdot V_{10}^2}$ ex  $0.002397 = {1.5 {
m Pa} \over 1.293 {
m kg/m^3} \cdot (22 {
m m/s})^2}$ 





### 28) Horizontal Component of Coriolis Acceleration 💪

4

$$f_{X}a_{C}=f\cdot U$$

ex 
$$3.99922 = 0.0001 \cdot 24.85 \mathrm{mi/s}$$

#### 29) Horizontal Speed across Earth's Surface given Coriolis Frequency

fx 
$$\mathbf{U}=rac{\mathbf{a}_{\mathrm{C}}}{\mathrm{f}}$$
ex  $24.85485\mathrm{mi/s}=rac{4}{0.0001}$ 

30) Horizontal Speed across Earth's Surface given Horizontal Component of Coriolis Acceleration

$$f \times U = \frac{a_C}{2 \cdot \Omega_E \cdot \sin(\lambda_e)}$$
Open Calculator (\*)
$$U = \frac{a_C}{2 \cdot \Omega_E \cdot \sin(\lambda_e)}$$

$$e \times 24.85415 \text{mi/s} = \frac{4}{2 \cdot 7.2921159 \text{E}^{\circ} - 05 \text{rad/s} \cdot \sin(43.29^{\circ})}$$
31) Latitude given Coriolis Frequency (\*)
$$f \times \lambda_e = a \sin\left(\frac{f}{2 \cdot \Omega_E}\right)$$
Open Calculator (\*)
$$\lambda_e = a \sin\left(\frac{f}{2 \cdot \Omega_E}\right)$$





Open Calculator

Open Calculator

# 32) Latitude given Magnitude of Horizontal Component of Coriolis Acceleration





fx 
$$au_{\mathrm{o}} = \mathrm{C}_{\mathrm{D}} \cdot \rho \cdot \mathrm{V}_{10}^2$$

 $\begin{array}{c} \mathsf{ex} \left[ 1.56453 \mathrm{Pa} = 0.0025 \cdot 1.293 \mathrm{kg} / \mathrm{m^{_3}} \cdot \left( 22 \mathrm{m/s} \right)^2 \right] \end{array}$ 







Open Calculator 🕑



## Variables Used

- **a**<sub>C</sub> Horizontal Component of Coriolis Acceleration
- C<sub>D</sub> Drag Coefficient
- **D<sub>Eddy</sub>** Depth of Frictional Influence by Eckman (*Meter*)
- **D**<sub>F</sub> Depth of Frictional Influence (Meter)
- f Coriolis Frequency
- L Latitude of a Position on Earth Surface (Degree)
- **q<sub>x</sub>** Volume Flow Rates per unit of Ocean Width (*Cubic Meter per Second*)
- S Salinity of Water (Milligram per Liter)
- U Horizontal Speed across the Earth's Surface (Mile per Second)
- **U**<sub>X</sub> Velocity Component along a Horizontal x Axis (Meter per Second)
- V Current Profile Velocity (Meter per Second)
- V Current Velocity (Mile per Second)
- V<sub>10</sub> Wind Speed at Height of 10 m (Meter per Second)
- V<sub>Current</sub> Velocity in the Current Profile (Meter per Second)
- V<sub>s</sub> Velocity at the Surface (Meter per Second)
- Z Vertical Coordinate
- δp<sub>/δn</sub> Pressure Gradient
- ε<sub>v</sub> Vertical Eddy Viscosity Coefficient
- **θ** Angle between the Wind and Current Direction
- λ<sub>e</sub> Earth Station Latitude (Degree)
- **p** Density of Air (Kilogram per Cubic Meter)
- **ρ**<sub>s</sub> Density of Salt Water (Kilogram per Cubic Meter)



- **P**water Water Density (Kilogram per Cubic Meter)
- $\sigma_t$  Difference of Density Values
- To Wind Stress (Pascal)
- Ω<sub>E</sub> Angular Speed of the Earth (*Radian per Second*)





## **Constants, Functions, Measurements used**

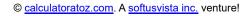
- Constant: pi, 3.14159265358979323846264338327950288 Archimedes' constant
- Constant: e, 2.71828182845904523536028747135266249 Napier's constant
- Function: **asin**, asin(Number) The inverse sine function, is a trigonometric function that takes a ratio of two sides of a right triangle and outputs the angle opposite the side with the given ratio.
- 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: sin, sin(Angle) Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.
- 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: Pressure in Pascal (Pa) Pressure Unit Conversion
- Measurement: Speed in Mile per Second (mi/s), Meter per Second (m/s)
   Speed Unit Conversion
- Measurement: Angle in Degree (°) Angle Unit Conversion
- Measurement: Volumetric Flow Rate in Cubic Meter per Second (m<sup>3</sup>/s) Volumetric Flow Rate Unit Conversion





 Measurement: Density in Kilogram per Cubic Meter (kg/m³), Milligram per Liter (mg/L)

Density Unit Conversion 🖸





## Check other formula lists

- Calculation of Forces on Ocean Structures Formulas
- Density Currents in Harbors Formulas 🕅
- Density Currents in Rivers Formulas
- Dredging Equipment Formulas C. Wave Prediction Formulas C.
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