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# Frequency of Free Damped Vibrations Formulas

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# List of 19 Frequency of Free Damped Vibrations Formulas

## Frequency of Free Damped Vibrations

### 1) Amplitude Reduction Factor

Open Calculator

fx $$A_{reduction} = e^{a \cdot t_p}$$

ex $$1.822119 = e^{0.2Hz \cdot 3s}$$

### 2) Circular Damped Frequency

Open Calculator

fx $$\omega_d = \sqrt{\frac{k}{m} - \left(\frac{c}{2 \cdot m}\right)^2}$$

ex $$6.920809 = \sqrt{\frac{60N/m}{1.25kg} - \left(\frac{0.8Ns/m}{2 \cdot 1.25kg}\right)^2}$$

### 3) Circular Damped Frequency given Natural Frequency

Open Calculator

fx $$\omega_d = \sqrt{\omega_n^2 - a^2}$$

ex $$20.99905 = \sqrt{(21rad/s)^2 - (0.2Hz)^2}$$

## 4) Condition for Critical Damping

Open Calculator

fx $$c_c = 2 \cdot m \cdot \sqrt{\frac{k}{m}}$$

ex $$17.32051\text{Ns/m} = 2 \cdot 1.25\text{kg} \cdot \sqrt{\frac{60\text{N/m}}{1.25\text{kg}}}$$

## 5) Critical Damping Coefficient

Open Calculator

fx $$c_c = 2 \cdot m \cdot \omega_n$$

ex $$52.5\text{Ns/m} = 2 \cdot 1.25\text{kg} \cdot 21\text{rad/s}$$

## 6) Damping Factor

Open Calculator

fx $$\zeta = \frac{c}{c_c}$$

ex $$0.1 = \frac{0.8\text{Ns/m}}{8\text{Ns/m}}$$

## 7) Damping Factor given Natural Frequency

Open Calculator

fx $$\zeta = \frac{c}{2 \cdot m \cdot \omega_n}$$

ex $$0.015238 = \frac{0.8\text{Ns/m}}{2 \cdot 1.25\text{kg} \cdot 21\text{rad/s}}$$

## 8) Displacement of Mass from Mean Position

Open Calculator

$$d_{mass} = A \cdot \cos(\omega_d \cdot t_p)$$

$$6.603167\text{mm} = 10\text{mm} \cdot \cos(6 \cdot 3\text{s})$$

## 9) Frequency Constant for Damped Vibrations

Open Calculator

$$a = \frac{c}{m}$$

$$0.64\text{Hz} = \frac{0.8\text{Ns/m}}{1.25\text{kg}}$$

## 10) Frequency Constant for Damped Vibrations given Circular Frequency

Open Calculator

$$a = \sqrt{\omega_n^2 - \omega_d^2}$$

$$20.12461\text{Hz} = \sqrt{(21\text{rad/s})^2 - (6)^2}$$

## 11) Frequency of Damped Vibration

Open Calculator

$$f = \frac{1}{2 \cdot \pi} \cdot \sqrt{\frac{k}{m} - \left(\frac{c}{2 \cdot m}\right)^2}$$

$$1.101481\text{Hz} = \frac{1}{2 \cdot \pi} \cdot \sqrt{\frac{60\text{N/m}}{1.25\text{kg}} - \left(\frac{0.8\text{Ns/m}}{2 \cdot 1.25\text{kg}}\right)^2}$$

## 12) Frequency of Damped Vibration using Natural Frequency

Open Calculator

fx $$f = \frac{1}{2 \cdot \pi} \cdot \sqrt{\omega_n^2 - a^2}$$

ex $$3.342102\text{Hz} = \frac{1}{2 \cdot \pi} \cdot \sqrt{(21\text{rad/s})^2 - (0.2\text{Hz})^2}$$

## 13) Frequency of Undamped Vibration

Open Calculator

fx $$f = \frac{1}{2 \cdot \pi} \cdot \sqrt{\frac{k}{m}}$$

ex $$1.102658\text{Hz} = \frac{1}{2 \cdot \pi} \cdot \sqrt{\frac{60\text{N/m}}{1.25\text{kg}}}$$

## 14) Logarithmic Decrement

Open Calculator

fx $$\delta = a \cdot t_p$$

ex $$0.6 = 0.2\text{Hz} \cdot 3\text{s}$$

## 15) Logarithmic Decrement using Circular Damped Frequency

Open Calculator

fx $$\delta = a \cdot \frac{2 \cdot \pi}{\omega_d}$$

ex $$0.20944 = 0.2\text{Hz} \cdot \frac{2 \cdot \pi}{6}$$

## 16) Logarithmic Decrement using Circular Damping Coefficient

Open Calculator

fx $$\delta = \frac{2 \cdot \pi \cdot c}{\sqrt{c_c^2 - c^2}}$$

ex $$0.631484 = \frac{2 \cdot \pi \cdot 0.8\text{Ns/m}}{\sqrt{(8\text{Ns/m})^2 - (0.8\text{Ns/m})^2}}$$

## 17) Logarithmic Decrement using Natural Frequency

Open Calculator

fx $$\delta = \frac{a \cdot 2 \cdot \pi}{\sqrt{\omega_n^2 - a^2}}$$

ex $$0.059843 = \frac{0.2\text{Hz} \cdot 2 \cdot \pi}{\sqrt{(21\text{rad/s})^2 - (0.2\text{Hz})^2}}$$

## 18) Periodic Time of Vibration

Open Calculator

fx $$t_p = \frac{2 \cdot \pi}{\sqrt{\frac{k}{m} - \left(\frac{c}{2 \cdot m}\right)^2}}$$

ex $$0.907869\text{s} = \frac{2 \cdot \pi}{\sqrt{\frac{60\text{N/m}}{1.25\text{kg}} - \left(\frac{0.8\text{Ns/m}}{2 \cdot 1.25\text{kg}}\right)^2}}$$

## 19) Periodic Time of Vibration using Natural Frequency

Open Calculator

fx $$t_p = \frac{2 \cdot \pi}{\sqrt{\omega_n^2 - a^2}}$$

ex $$0.299213\text{s} = \frac{2 \cdot \pi}{\sqrt{(21\text{rad/s})^2 - (0.2\text{Hz})^2}}$$

## Variables Used

- **a** Frequency Constant for Calculation *(Hertz)*
- **A** Amplitude of Vibration *(Millimeter)*
- $A_{reduction}$ Amplitude Reduction Factor
- **c** Damping Coefficient *(Newton Second per Meter)*
- $c_c$ Critical Damping Coefficient *(Newton Second per Meter)*
- $d_{mass}$ Total Displacement *(Millimeter)*
- **f** Frequency *(Hertz)*
- **k** Stiffness of Spring *(Newton per Meter)*
- **m** Mass Suspended from Spring *(Kilogram)*
- $t_p$ Time Period *(Second)*
- **δ** Logarithmic Decrement
- **ζ** Damping Ratio
- $\omega_d$ Circular Damped Frequency
- $\omega_n$ Natural Circular Frequency *(Radian per Second)*

## Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  *Archimedes' constant*
- Constant: **e**, 2.71828182845904523536028747135266249
  *Napier's constant*
- 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: **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 Millimeter (mm)
  *Length Unit Conversion*
- Measurement: **Weight** in Kilogram (kg)
  *Weight Unit Conversion*
- Measurement: **Time** in Second (s)
  *Time Unit Conversion*
- Measurement: **Frequency** in Hertz (Hz)
  *Frequency Unit Conversion*
- Measurement: **Surface Tension** in Newton per Meter (N/m)
  *Surface Tension Unit Conversion*
- Measurement: **Angular Velocity** in Radian per Second (rad/s)
  *Angular Velocity Unit Conversion*
- Measurement: **Damping Coefficient** in Newton Second per Meter (Ns/m)
  *Damping Coefficient Unit Conversion*

## Check other formula lists

- Load for Various Types of Beams and Load Conditions Formulas
- Critical or Whirling Speed of Shaft Formulas
- Effect of Inertia of Constraint in Longitudinal and Transverse Vibrations Formulas
- Frequency of Free Damped Vibrations Formulas
- Frequency of Under Damped Forced Vibrations Formulas
- Natural Frequency of Free Transverse Vibrations Formulas
- Values of length of beam for the various types of beams and under various load conditions Formulas
- Values of static deflection for the various types of beams and under various load conditions Formulas
- Vibration Isolation and Transmissibility Formulas

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