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Elements of Vibration Formulas

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List of 14 Elements of Vibration Formulas

Elements of Vibration

1) Angular Frequency

$$\text{fx } \omega' = \sqrt{\frac{k'}{m'}}$$

Open Calculator 

$$\text{ex } 2\text{rad/s} = \sqrt{\frac{10.4\text{N/m}}{2.6\text{kg}}}$$

2) Angular Frequency given Time Period of Motion

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

Open Calculator 

$$\text{ex } 1.256637\text{rad/s} = 2 \cdot \frac{\pi}{5\text{s}}$$

3) Damping Force

$$\text{fx } F_d = c \cdot V$$

Open Calculator 

$$\text{ex } 5940\text{N} = 9000\text{Ns/m} \cdot 0.66\text{m/s}$$



4) Displacement of Body in Simple Harmonic Motion

$$fx \quad d = A' \cdot \sin(\omega \cdot t_{\text{sec}})$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235_img.jpg\)](#)

$$ex \quad 12.77654\text{m} = 13.2\text{m} \cdot \sin(0.2\text{rad/s} \cdot 38\text{s})$$

5) Frequency given Spring Constant and Mass

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

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0_img.jpg\)](#)

$$ex \quad 0.31831\text{Hz} = \frac{1}{2 \cdot \pi} \cdot \sqrt{\frac{10.4\text{N/m}}{2.6\text{kg}}}$$

6) Inertia Force

$$fx \quad F_{\text{inertia}} = m' \cdot a$$

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f_img.jpg\)](#)

$$ex \quad 1.326\text{N} = 2.6\text{kg} \cdot 0.51\text{m/s}^2$$

7) Magnitude of Acceleration of Body in Simple Harmonic Motion

$$fx \quad a = A' \cdot \omega^2 \cdot \sin(\omega \cdot t_{\text{sec}})$$

[Open Calculator !\[\]\(b64b40baaee5acddc1eab8538ba84754_img.jpg\)](#)

$$ex \quad 0.511062\text{m/s}^2 = 13.2\text{m} \cdot (0.2\text{rad/s})^2 \cdot \sin(0.2\text{rad/s} \cdot 38\text{s})$$



8) Magnitude of Acceleration of Body in Simple Harmonic Motion given Displacement

$$fx \quad a = \omega^2 \cdot d$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95_img.jpg\)](#)

$$ex \quad 0.5108\text{m/s}^2 = (0.2\text{rad/s})^2 \cdot 12.77\text{m}$$

9) Magnitude of Maximum Acceleration of Body in Simple Harmonic Motion

$$fx \quad a_{\max} = \omega^2 \cdot A'$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2_img.jpg\)](#)

$$ex \quad 0.528\text{m/s}^2 = (0.2\text{rad/s})^2 \cdot 13.2\text{m}$$

10) Maximum Velocity of Body in Simple Harmonic Motion

$$fx \quad V_{\max} = \omega \cdot A'$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7_img.jpg\)](#)

$$ex \quad 2.64\text{m/s} = 0.2\text{rad/s} \cdot 13.2\text{m}$$

11) Period of Motion in Simple Harmonic Motion

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

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b_img.jpg\)](#)

$$ex \quad 31.41593\text{s} = 2 \cdot \frac{\pi}{0.2\text{rad/s}}$$



12) Spring Force

$$fx \quad P_{\text{spring}} = k' \cdot d$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a_img.jpg\)](#)

$$ex \quad 132.808\text{N} = 10.4\text{N/m} \cdot 12.77\text{m}$$

13) Velocity of Body in Simple Harmonic Motion

$$fx \quad V = A' \cdot \omega \cdot \cos(\omega \cdot t_{\text{sec}})$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021_img.jpg\)](#)

$$ex \quad 0.663326\text{m/s} = 13.2\text{m} \cdot 0.2\text{rad/s} \cdot \cos(0.2\text{rad/s} \cdot 38\text{s})$$

14) Work Done by Harmonic Force

$$fx \quad w = \pi \cdot F_h \cdot d \cdot \sin(\Phi)$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd_img.jpg\)](#)

$$ex \quad 0.093479\text{KJ} = \pi \cdot 2.5\text{N} \cdot 12.77\text{m} \cdot \sin(1.2\text{rad})$$












Variables Used





- **a** Acceleration (Meter per Square Second)
- **A'** Vibrational Amplitude (Meter)
- **a_{max}** Maximum Acceleration (Meter per Square Second)
- **c** Damping Coefficient (Newton Second per Meter)
- **d** Displacement of Body (Meter)
- **f** Vibrational Frequency (Hertz)
- **F_d** Damping Force (Newton)
- **F_h** Harmonic Force (Newton)
- **F_{inertia}** Inertia Force (Newton)
- **k'** Spring Stiffness (Newton per Meter)
- **m'** Mass Attached to Spring (Kilogram)
- **P_{spring}** Spring Force (Newton)
- **T** Time Period of Oscillations (Second)
- **t_p** Time Period SHM (Second)
- **t_{sec}** Time in seconds (Second)
- **V** Velocity of Body (Meter per Second)
- **V_{max}** Maximum Velocity (Meter per Second)
- **w** Work Done (Kilojoule)
- **Φ** Phase Difference (Radian)
- **ω** Angular Velocity (Radian per Second)
- **ω'** Angular Frequency (Radian per Second)



Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288
Archimedes' constant
- **Function:** **cos**, $\cos(\text{Angle})$
Trigonometric cosine function
- **Function:** **sin**, $\sin(\text{Angle})$
Trigonometric sine function
- **Function:** **sqrt**, $\sqrt{\text{Number}}$
Square root function
- **Measurement:** **Length** in Meter (m)
Length Unit Conversion 
- **Measurement:** **Weight** in Kilogram (kg)
Weight Unit Conversion 
- **Measurement:** **Time** in Second (s)
Time Unit Conversion 
- **Measurement:** **Speed** in Meter per Second (m/s)
Speed Unit Conversion 
- **Measurement:** **Acceleration** in Meter per Square Second (m/s²)
Acceleration Unit Conversion 
- **Measurement:** **Energy** in Kilojoule (KJ)
Energy Unit Conversion 
- **Measurement:** **Force** in Newton (N)
Force Unit Conversion 
- **Measurement:** **Angle** in Radian (rad)
Angle 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 
- **Measurement: Angular Frequency** in Radian per Second (rad/s)
Angular Frequency Unit Conversion 



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