



Simple Harmonic Motion Formulas

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Examples!

Conversions!

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Open Calculator 2

Open Calculator

List of 22 Simple Harmonic Motion Formulas

Simple Harmonic Motion &

Basics 🗗

1) Frequency of Oscillation for SHM

$$f$$
 $f = rac{1}{t_{
m p}}$

 $\boxed{0.2 \text{Hz} = \frac{1}{5\text{s}}}$



$$\mathbf{f}$$
 $\mathbf{f}=rac{\sqrt{rac{lpha}{ heta}}}{2\cdot\pi}$

 $extbf{ex} 0.200266 ext{Hz} = rac{\sqrt{rac{190 ext{rad/s}^2}{120 ext{rad}}}}{2 \cdot \pi}$



3) Periodic Time for SHM

Open Calculator

 $\left|\mathbf{t}_{\mathrm{p}}=2\cdot\pi\cdot\sqrt{rac{\mathrm{d}_{\mathrm{m}}}{\mathrm{g}}}
ight|$

 $extbf{ex} 5.000031 ext{s} = 2 \cdot \pi \cdot \sqrt{rac{6206 ext{mm}}{9.8 ext{m/s}^2}}$

4) Periodic Time of Particle Moving with Angular Simple Harmonic Motion

 $\left|\mathbf{f}_{\mathrm{p}}
ight|\mathbf{t}_{\mathrm{p}}=2\cdot\pi\cdot\sqrt{rac{ heta}{lpha}}
ight|$

Open Calculator 2

 $4.993369 ext{s} = 2 \cdot \pi \cdot \sqrt{rac{120 ext{rad}}{190 ext{rad/s}^2}}$

Closely Coiled Helical Spring G

5) Deflection of Spring when Mass m is Attached to it

 $\delta = \mathbf{M} \cdot rac{\mathbf{g}}{\mathbf{k}}$

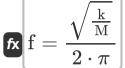
Open Calculator

 $ext{ex} \ 6164.753 ext{mm} = 12.6 ext{kg} \cdot rac{9.8 ext{m/s}^2}{20.03 ext{N/m}}$





6) Frequency of Mass Attached to Closely Coiled Helical Spring which is Hanged Vertically



Open Calculator

$$egin{aligned} {f ex} \ 0.200667{
m Hz} = rac{\sqrt{rac{20.03{
m N/m}}{12.6{
m kg}}}}{2\cdot\pi} \end{aligned}$$

7) Frequency of Mass Attached to Spring of given Mass

$$\mathbf{f}$$
 $\mathbf{f}=rac{\sqrt{rac{k}{\mathrm{M}+rac{m}{3}}}}{2\cdot\pi}$

Open Calculator

$$ext{ex} 0.200402 ext{Hz} = rac{\sqrt{rac{20.03 ext{N/m}}{12.6 ext{kg} + rac{0.1 ext{kg}}{3}}}}{2 \cdot \pi}$$

8) Periodic Time of Mass Attached to Closely Coiled Helical Spring which is Hanged Vertically

$$au_{
m p} = 2 \cdot \pi \cdot \sqrt{rac{
m M}{
m k}}$$

Open Calculator

$$ag{4.983388} = 2 \cdot \pi \cdot \sqrt{rac{12.6 ext{kg}}{20.03 ext{N/m}}}$$





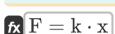
9) Periodic Time of Mass Attached to Spring of given Mass 🗗

Open Calculator

$$\mathbf{f}$$
 $\mathbf{t}_{\mathrm{p}} = 2 \cdot \pi \cdot \sqrt{rac{\mathrm{M} + rac{\mathrm{m}}{3}}{\mathrm{k}}}$

ex
$$4.989975 \mathrm{s} = 2 \cdot \pi \cdot \sqrt{rac{12.6 \mathrm{kg} + rac{0.1 \mathrm{kg}}{3}}{20.03 \mathrm{N/m}}}$$

10) Restoring Force Due to Spring

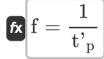


Open Calculator 2

$$\mathbf{ex} \ 2.50375 \mathrm{N} = 20.03 \mathrm{N/m} \cdot 125 \mathrm{mm}$$

Compound Pendulum 🗗

11) Frequency of Compound Pendulum in SHM



$$\boxed{\textbf{ex}} \ 0.2 \text{Hz} = \frac{1}{5.00 \text{s}}$$



12) Minimum Periodic Time of SHM for Compound Pendulum

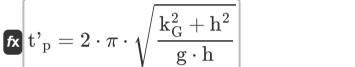


Open Calculator

$$\left|\mathbf{f}\mathbf{x}
ight| \mathrm{t_p} = 2 \cdot \pi \cdot \sqrt{2 \cdot rac{\mathrm{k_G}}{\mathrm{g}}}$$

$$ext{ex} 5.000031 ext{s} = 2 \cdot \pi \cdot \sqrt{2 \cdot rac{3103 ext{mm}}{9.8 ext{m/s}^2}}$$

13) Periodic Time of SHM for Compound Pendulum given Radius of Gyration 🛂



Open Calculator

Open Calculator

$$\mathbf{ex} \ 5.000032 \mathrm{s} = 2 \cdot \pi \cdot \sqrt{rac{\left(3103 \mathrm{mm}
ight)^2 + \left(3100 \mathrm{mm}
ight)^2}{9.8 \mathrm{m/s^2} \cdot 3100 \mathrm{mm}}}$$

Simple Pendulum 🛂

14) Angular Acceleration of String

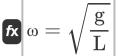
$$lpha = \mathbf{g} \cdot rac{\mathbf{ heta}}{\mathrm{L_s}}$$

ex
$$190.2913 \text{rad/s}^2 = 9.8 \text{m/s}^2 \cdot \frac{120 \text{rad}}{6180 \text{mm}}$$





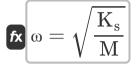
15) Angular Frequency of Simple Pendulum



Open Calculator

= 2.745626rad/s $=\sqrt{rac{9.8 ext{m/s}^2}{1300 ext{mm}}}$

16) Angular Frequency of Spring of given Stiffness Constant

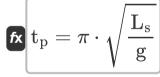


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Open Calculator

 $oxed{ex} 2.01187 \mathrm{rad/s} = \sqrt{rac{51 \mathrm{N/m}}{12.6 \mathrm{kg}}}$

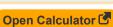
17) Periodic Time for One Beat of SHM



 $ext{ex} \ 2.494773 ext{s} = \pi \cdot \sqrt{rac{6180 ext{mm}}{9.8 ext{m/s}^2}}$

18) Restoring Torque for Simple Pendulum

 $au = M \cdot g \cdot \sin(heta_{
m d}) \cdot L_{
m s}$



 $= 547.419 \text{N*m} = 12.6 \text{kg} \cdot 9.8 \text{m/s}^2 \cdot \sin(0.8 \text{rad}) \cdot 6180 \text{mm}$



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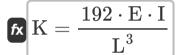
Stiffness 🚰

19) Stiffness of Cantilever Beam

$$\kappa = rac{3 \cdot \mathrm{E} \cdot \mathrm{I}}{\mathrm{L}^3}$$

 $= \frac{993.4001 \text{N/m} = \frac{3 \cdot 15 \text{N/m} \cdot 48.5 \text{kg} \cdot \text{m}^2}{(1300 \text{mm})^3}$

20) Stiffness of Fixed-Fixed Beam with Load at Middle



Open Calculator

ex $17.3036 \mathrm{N/m} = \frac{192 \cdot 15 \mathrm{N/m} \cdot 0.0132 \mathrm{kg \cdot m^2}}{(1300 \mathrm{mm})^3}$

21) Stiffness of Rod under Axial Load 🚰



 $ext{ex} 17.30769 ext{N/m} = rac{15 ext{N/m} \cdot 1.5 ext{m}^2}{1300 ext{mm}}$



22) Stiffness of Tapered Rod under Axial Load 🛂



Open Calculator

$$\mathbf{K} = rac{\pi \cdot \mathrm{E} \cdot \mathrm{d}_1 \cdot \mathrm{d}_2}{4 \cdot \mathrm{L}}$$

ex
$$17.31441 \mathrm{N/m} = \frac{\pi \cdot 15 \mathrm{N/m} \cdot 466000.2 \mathrm{mm} \cdot 4.1 \mathrm{mm}}{4 \cdot 1300 \mathrm{mm}}$$



Variables Used

- A_c Rod Cross Sectional Area (Square Meter)
- d₁ End Diameter 1 (Millimeter)
- d₂ End Diameter 2 (Millimeter)
- d_m Total Displacement (Millimeter)
- E Young's Modulus (Newton per Meter)
- f Frequency (Hertz)
- F Force (Newton)
- g Acceleration Due to Gravity (Meter per Square Second)
- **h** Distance of PT of Suspension of Pendulum From CG (Millimeter)
- I Moment of Inertia (Kilogram Square Meter)
- k Stiffness of Spring (Newton per Meter)
- K Stiffness Constant (Newton per Meter)
- **k**_G Radius of Gyration (Millimeter)
- K_s Spring Constant (Newton per Meter)
- L Total Length (Millimeter)
- L_s Length of String (Millimeter)
- m Mass of Spring (Kilogram)
- M Mass of Body (Kilogram)
- t_p Time Period SHM (Second)
- t'p Periodic Time for Compound Pendulum (Second)
- X Displacement of Load Below Equilibrium Position (Millimeter)
- α Angular Acceleration (Radian per Square Second)





- δ Deflection of Spring (Millimeter)
- **θ** Angular Displacement (Radian)
- θ_d Angle through which the String is Displaced (Radian)
- I Moment of Inertia of Beam About Bending Axis (Kilogram Square Meter)
- K Spring Constant of Cantilever Beam (Newton per Meter)
- T Torque Exerted on Wheel (Newton Meter)
- **w** Angular Frequency (Radian per Second)





Constants, Functions, Measurements used

- Constant: pi, 3.14159265358979323846264338327950288
 Archimedes' constant
- 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 Millimeter (mm)
 Length Unit Conversion
- Measurement: Weight in Kilogram (kg)
 Weight Unit Conversion
- Measurement: Time in Second (s)
 Time Unit Conversion
- Measurement: Area in Square Meter (m²)
 Area Unit Conversion
- Measurement: Acceleration in Meter per Square Second (m/s²)
 Acceleration 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: Torque in Newton Meter (N*m)

 Torque Unit Conversion
- Measurement: Moment of Inertia in Kilogram Square Meter (kg·m²)

 Moment of Inertia Unit Conversion
- Measurement: Angular Acceleration in Radian per Square Second (rad/s²)
 - Angular Acceleration Unit Conversion
- Measurement: Angular Frequency in Radian per Second (rad/s)
 Angular Frequency Unit Conversion
- Measurement: Stiffness Constant in Newton per Meter (N/m)
 Stiffness Constant Unit Conversion





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