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Simple Harmonic Motion Formulas

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List of 22 Simple Harmonic Motion Formulas

Simple Harmonic Motion

Basics

1) Frequency of Oscillation for SHM

Open Calculator

fx $$f = \frac{1}{t_p}$$

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

2) Frequency of Particle Moving with Angular Simple Harmonic Motion

Open Calculator

fx $$f = \frac{\sqrt{\frac{\alpha}{\theta}}}{2 \cdot \pi}$$

ex $$0.200266\text{Hz} = \frac{\sqrt{\frac{190\text{rad/s}^2}{120\text{rad}}}}{2 \cdot \pi}$$

3) Periodic Time for SHM

Open Calculator

fx $t_p = 2 \cdot \pi \cdot \sqrt{\frac{d_m}{g}}$

ex $5.000031\text{s} = 2 \cdot \pi \cdot \sqrt{\frac{6206\text{mm}}{9.8\text{m/s}^2}}$

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

Open Calculator

fx $t_p = 2 \cdot \pi \cdot \sqrt{\frac{\theta}{\alpha}}$

ex $4.993369\text{s} = 2 \cdot \pi \cdot \sqrt{\frac{120\text{rad}}{190\text{rad/s}^2}}$

Closely Coiled Helical Spring

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

Open Calculator

fx $\delta = M \cdot \frac{g}{k}$

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

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

Open Calculator

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

ex $$0.200667\text{Hz} = \frac{\sqrt{\frac{20.03\text{N/m}}{12.6\text{kg}}}}{2 \cdot \pi}$$

7) Frequency of Mass Attached to Spring of given Mass

Open Calculator

fx $$f = \frac{\sqrt{\frac{k}{M+\frac{m}{3}}}}{2 \cdot \pi}$$

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

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

Open Calculator

fx $$t_p = 2 \cdot \pi \cdot \sqrt{\frac{M}{k}}$$

ex $$4.983388\text{s} = 2 \cdot \pi \cdot \sqrt{\frac{12.6\text{kg}}{20.03\text{N/m}}}$$

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

Open Calculator

fx $$t_p = 2 \cdot \pi \cdot \sqrt{\frac{M + \frac{m}{3}}{k}}$$

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

10) Restoring Force Due to Spring

Open Calculator

fx $$F = k \cdot x$$

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

Compound Pendulum

11) Frequency of Compound Pendulum in SHM

Open Calculator

fx $$f = \frac{1}{t'_p}$$

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

12) Minimum Periodic Time of SHM for Compound Pendulum

Open Calculator

fx $$t_p = 2 \cdot \pi \cdot \sqrt{2 \cdot \frac{k_G}{g}}$$

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

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

Open Calculator

fx $$t'_p = 2 \cdot \pi \cdot \sqrt{\frac{k_G^2 + h^2}{g \cdot h}}$$

ex $$5.000032\text{s} = 2 \cdot \pi \cdot \sqrt{\frac{(3103\text{mm})^2 + (3100\text{mm})^2}{9.8\text{m/s}^2 \cdot 3100\text{mm}}}$$

Simple Pendulum

14) Angular Acceleration of String

Open Calculator

fx $$\alpha = g \cdot \frac{\theta}{L_s}$$

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

fx $$\omega = \sqrt{\frac{g}{L}}$$

ex $$2.745626\text{rad/s} = \sqrt{\frac{9.8\text{m/s}^2}{1300\text{mm}}}$$

16) Angular Frequency of Spring of given Stiffness Constant

Open Calculator

fx $$\omega = \sqrt{\frac{K_s}{M}}$$

ex $$2.01187\text{rad/s} = \sqrt{\frac{51\text{N/m}}{12.6\text{kg}}}$$

17) Periodic Time for One Beat of SHM

Open Calculator

fx $$t_p = \pi \cdot \sqrt{\frac{L_s}{g}}$$

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

18) Restoring Torque for Simple Pendulum

Open Calculator

fx $$\tau = M \cdot g \cdot \sin(\theta_d) \cdot L_s$$

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

Stiffness

19) Stiffness of Cantilever Beam

Open Calculator

fx $$\kappa = \frac{3 \cdot E \cdot I}{L^3}$$

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

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

Open Calculator

fx $$K = \frac{192 \cdot E \cdot I}{L^3}$$

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

21) Stiffness of Rod under Axial Load

Open Calculator

fx $$K = \frac{E \cdot A_c}{L}$$

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

22) Stiffness of Tapered Rod under Axial Load

Open Calculator

fx $$K = \frac{\pi \cdot E \cdot d_1 \cdot d_2}{4 \cdot L}$$

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

Variables Used

- A_c Rod Cross Sectional Area *(Square Meter)*
- d_1 End Diameter 1 *(Millimeter)*
- d_2 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)*
- **κ** Spring Constant of Cantilever Beam *(Newton per Meter)*
- **τ** Torque Exerted on Wheel *(Newton Meter)*
- **ω** 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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