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# Simple Harmonic Motion(SHM) Formulas

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# List of 22 Simple Harmonic Motion(SHM) Formulas

## Simple Harmonic Motion(SHM)

### Basic SHM Equations

#### 1) Amplitude given Position

$$\text{fx } A = \frac{\sin(\omega \cdot t_p + \theta)}{X}$$

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2\_img.jpg\)](#)

$$\text{ex } 0.005\text{m} = \frac{\sin(10.28508\text{rev/s} \cdot 0.611\text{s} + 8^\circ)}{28.03238}$$

#### 2) Angular Frequency given Constant K and Mass

$$\text{fx } \omega = \sqrt{\frac{K}{M}}$$

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa\_img.jpg\)](#)

$$\text{ex } 10.28508\text{rev/s} = \sqrt{\frac{3750}{35.45\text{kg}}}$$



### 3) Angular Frequency given Velocity and Distance

$$fx \quad \omega = \sqrt{\frac{V^2}{S_{\max}^2 - S^2}}$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235\_img.jpg\)](#)

$$ex \quad 10.27994 \text{ rev/s} = \sqrt{\frac{(60 \text{ m/s})^2}{(65.26152 \text{ m})^2 - (65 \text{ m})^2}}$$

### 4) Angular Frequency in SHM

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

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0\_img.jpg\)](#)

$$ex \quad 10.28345 \text{ rev/s} = \frac{2 \cdot \pi}{0.611 \text{ s}}$$

### 5) Frequency of SHM

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

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f\_img.jpg\)](#)

$$ex \quad 1.636661 \text{ rev/s} = \frac{1}{0.611 \text{ s}}$$



## 6) Mass of Particle given Angular Frequency

$$fx \quad M = \frac{K}{\omega^2}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95\_img.jpg\)](#)

$$ex \quad 35.44997\text{kg} = \frac{3750}{(10.28508\text{rev/s})^2}$$

## 7) Position of Particle in SHM

$$fx \quad X = \frac{\sin(\omega \cdot t_p + \theta)}{A}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2\_img.jpg\)](#)

$$ex \quad 28.03238 = \frac{\sin(10.28508\text{rev/s} \cdot 0.611\text{s} + 8^\circ)}{0.005\text{m}}$$

## 8) Time Period of SHM

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

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7\_img.jpg\)](#)

$$ex \quad 0.610903\text{s} = \frac{2 \cdot \pi}{10.28508\text{rev/s}}$$



## Forces and Energy in SHM

### 9) Acceleration given Constant K and Distance Traveled

$$fx \quad a = \frac{K \cdot S}{M}$$

[Open Calculator !\[\]\(74d4806277d7e73349d8e8c0897931e9\_img.jpg\)](#)

$$ex \quad 6875.882\text{m/s}^2 = \frac{3750 \cdot 65\text{m}}{35.45\text{kg}}$$

### 10) Acceleration in SHM given Angular Frequency

$$fx \quad a = -\omega^2 \cdot S$$

[Open Calculator !\[\]\(8bba887393ca45b761e5cb49e755e762\_img.jpg\)](#)

$$ex \quad 6875.887\text{m/s}^2 = -(10.28508\text{rev/s})^2 \cdot 65\text{m}$$

### 11) Constant K given Angular Frequency

$$fx \quad K = \omega^2 \cdot M$$

[Open Calculator !\[\]\(0fb13ad0bfa3d86868cdd3883e5665b3\_img.jpg\)](#)

$$ex \quad 3750.003 = (10.28508\text{rev/s})^2 \cdot 35.45\text{kg}$$


### 12) Constant K given Restoring Force

$$fx \quad K = -\left(\frac{F_{\text{restoring}}}{S}\right)$$

[Open Calculator !\[\]\(e50091943b385fe16d3277389202856f\_img.jpg\)](#)

$$ex \quad 3750 = -\left(\frac{-243750\text{N}}{65\text{m}}\right)$$



13) Mass of Body given Distance Traveled and Constant K 

$$fx \quad M = \frac{K \cdot S}{a}$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0\_img.jpg\)](#)

$$ex \quad 35.45001kg = \frac{3750 \cdot 65m}{6875.88m/s^2}$$

14) Restoring Force given Stress 

$$fx \quad F = \sigma \cdot A_{shm}$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5\_img.jpg\)](#)

$$ex \quad 660000N = 12000Pa \cdot 55m^2$$

15) Restoring Force in SHM 

$$fx \quad F_{restoring} = -(K) \cdot S$$

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60\_img.jpg\)](#)

$$ex \quad -243750N = -(3750) \cdot 65m$$


Velocity and Displacement in SHM 16) Distance from Start given Restoring Force and Constant K 

$$fx \quad S_{max} = -\left(\frac{F_{restoring}}{K}\right)$$

[Open Calculator !\[\]\(21226b58c700e5231ab98d27101bac58\_img.jpg\)](#)

$$ex \quad 65m = -\left(\frac{-243750N}{3750}\right)$$



17) Distance Traveled by Particle in SHM until Velocity becomes Zero 

$$fx \quad S_{\max} = \sqrt{\frac{V^2}{\omega^2} + S^2}$$

Open Calculator 

$$ex \quad 65.26126m = \sqrt{\frac{(60m/s)^2}{(10.28508rev/s)^2} + (65m)^2}$$

18) Distance Traveled given Velocity 

$$fx \quad S = \sqrt{S_{\max}^2 - \frac{V^2}{\omega^2}}$$

Open Calculator 

$$ex \quad 65.00026m = \sqrt{(65.26152m)^2 - \frac{(60m/s)^2}{(10.28508rev/s)^2}}$$

19) Distance Traveled in SHM given Angular Frequency 

$$fx \quad S = \frac{a}{-\omega^2}$$

Open Calculator 

$$ex \quad 64.99994m = \frac{6875.88m/s^2}{-(10.28508rev/s)^2}$$



## 20) Square of Different Distances Traveled in SHM

$$\text{fx } D_{\text{total}} = S_{\text{max}}^2 - S^2$$

[Open Calculator !\[\]\(6605b201d6f14d9b3bcb8ab5f274d107\_img.jpg\)](#)

$$\text{ex } 34.06599\text{m} = (65.26152\text{m})^2 - (65\text{m})^2$$

## 21) Total Distance Traveled given Velocity and Angular Frequency

$$\text{fx } D_{\text{total}} = \frac{V^2}{\omega^2}$$

[Open Calculator !\[\]\(e8fb589d58dad1692debababa5e928b6\_img.jpg\)](#)

$$\text{ex } 34.03197\text{m} = \frac{(60\text{m/s})^2}{(10.28508\text{rev/s})^2}$$

## 22) Velocity of Particle in SHM

$$\text{fx } V = \omega \cdot \sqrt{S_{\text{max}}^2 - S^2}$$

[Open Calculator !\[\]\(4688aadfd656ded00cd6bdfae55089a9\_img.jpg\)](#)

$$\text{ex } 60.02998\text{m/s} = 10.28508\text{rev/s} \cdot \sqrt{(65.26152\text{m})^2 - (65\text{m})^2}$$














## Variables Used

- **a** Acceleration (Meter per Square Second)
- **A** Amplitude (Meter)
- **A<sub>shm</sub>** Area (Square Meter)
- **D<sub>total</sub>** Total Distance Traveled (Meter)
- **f** Frequency (Revolution per Second)
- **F** Force (Newton)
- **F<sub>restoring</sub>** Restoring Force (Newton)
- **K** Spring Constant
- **M** Mass (Kilogram)
- **S** Displacement (Meter)
- **S<sub>max</sub>** Maximum Displacement (Meter)
- **t<sub>p</sub>** Time Period SHM (Second)
- **V** Velocity (Meter per Second)
- **X** Position of a Particle
- **θ** Phase Angle (Degree)
- **σ** Stress (Pascal)
- **ω** Angular Frequency (Revolution per Second)



## Constants, Functions, Measurements used

- **Constant:** **pi**, 3.14159265358979323846264338327950288  
*Archimedes' constant*
- **Function:** **sin**,  $\sin(\text{Angle})$   
*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**,  $\text{sqrt}(\text{Number})$   
*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:** **Weight** in Kilogram (kg)  
*Weight Unit Conversion* 
- **Measurement:** **Time** in Second (s)  
*Time Unit Conversion* 
- **Measurement:** **Area** in Square Meter ( $\text{m}^2$ )  
*Area Unit Conversion* 
- **Measurement:** **Pressure** in Pascal (Pa)  
*Pressure Unit Conversion* 
- **Measurement:** **Speed** in Meter per Second (m/s)  
*Speed Unit Conversion* 
- **Measurement:** **Acceleration** in Meter per Square Second ( $\text{m/s}^2$ )  
*Acceleration Unit Conversion* 
- **Measurement:** **Force** in Newton (N)  
*Force Unit Conversion* 
- **Measurement:** **Angle** in Degree ( $^\circ$ )  
*Angle Unit Conversion* 



- **Measurement: Frequency** in Revolution per Second (rev/s)  
*Frequency Unit Conversion* 



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