Important Simple Harmonic Motion(SHM) Formulas PDF

Formulas
Examples
with Units

List of 22
Important Simple Harmonic Motion(SHM) Formulas

1) Basic SHM Equations Formulas

1.1) Amplitude given Position Formula

Evaluate Formula

Formula

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

Example with Units

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

1.2) Angular Frequency given Constant K and Mass Formula

Evaluate Formula

Formula

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

Example with Units

$$10.2851\,\text{rev/s} = \sqrt{\frac{3750}{35.45\,\text{kg}}}$$

1.3) Angular Frequency given Velocity and Distance Formula

Evaluate Formula

Formula

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

Example with Units

$$10.2799\,\text{rev/s} = \sqrt{\frac{60\,\text{m/s}^2}{65.26152\,\text{m}^2 - 65\,\text{m}^2}}$$

1.4) Angular Frequency in SHM Formula

Evaluate Formula

Formula

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

Example with Units

$$10.2834\,\text{rev/s} = \frac{2 \cdot 3.1416}{0.611\,\text{s}}$$

1.5) Frequency of SHM Formula

Evaluate Formula

Formula

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

Example with Units

$$1.6367\,\text{rev/s} = \frac{1}{0.611\,\text{s}}$$

1.6) Mass of Particle given Angular Frequency Formula

Evaluate Formula

Formula

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

Example with Units

$$35.45\,\text{kg} = \frac{3750}{10.28508\,\text{rev/s}^2}$$

1.7) Position of Particle in SHM Formula

Evaluate Formula

Formula

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

Example with Units

$$28.0324 = \frac{\sin\left(10.28508\,\text{rev/s} \cdot 0.611\,\text{s} + 8^\circ\right)}{0.005\,\text{m}}$$

1.8) Time Period of SHM Formula

Evaluate Formula

Formula

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

Example with Units

$$0.6109\,\text{s} = \frac{2 \cdot 3.1416}{10.28508\,\text{rev/s}}$$

2) Forces and Energy in SHM Formulas

2.1) Acceleration given Constant K and Distance Traveled Formula

Evaluate Formula

Formula

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

Example with Units

$$6875.8815\,\text{m/s}^2 = \frac{3750 \cdot 65\,\text{m}}{35.45\,\text{kg}}$$

2.2) Acceleration in SHM given Angular Frequency Formula

Evaluate Formula

Formula

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

Example with Units

$$6875.8866\,\text{m/s}^2 = -10.28508\,\text{rev/s}^2 \cdot 65\,\text{m}$$

2.3) Constant K given Angular Frequency Formula

Evaluate Formula

Formula

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

Example with Units

$$3750.0028 = 10.28508\,\text{rev/s}^2 \cdot 35.45\,\text{kg}$$

2.4) Constant K given Restoring Force Formula

Evaluate Formula

Formula

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

Example with Units

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

2.5) Mass of Body given Distance Traveled and Constant K Formula

Evaluate Formula

Formula

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

Example with Units

$$35.45\,\text{kg} = \frac{3750 \cdot 65\,\text{m}}{6875.88\,\text{m/s}^2}$$

2.6) Restoring Force given Stress Formula

Evaluate Formula

Formula

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

Example with Units

$$660000\,\text{N} = 12000\,\text{Pa} \cdot 55\,\text{m}^2$$

2.7) Restoring Force in SHM Formula

Evaluate Formula

Formula

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

Example with Units

$$-243750\,\text{N} = -(3750) \cdot 65\,\text{m}$$

3) Velocity and Displacement in SHM Formulas

3.1) Distance from Start given Restoring Force and Constant K Formula

Evaluate Formula

Formula

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

Example with Units

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

3.2) Distance Traveled by Particle in SHM until Velocity becomes Zero Formula

Evaluate Formula

Formula

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

Example with Units

$$65.2613\,\text{m} = \sqrt{\frac{60\,\text{m/s}^2}{10.28508\,\text{rev/s}^2} + 65\,\text{m}^2}$$

3.3) Distance Traveled given Velocity Formula

Evaluate Formula

Formula

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

Example with Units

$$65.0003\,\text{m} = \sqrt{65.26152\,\text{m}^2 - \frac{60\,\text{m/s}^2}{10.28508\,\text{rev/s}^2}}$$

3.4) Distance Traveled in SHM given Angular Frequency Formula

Evaluate Formula

Formula

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

Example with Units

$$64.9999\,\text{m} = \frac{6875.88\,\text{m/s}^2}{-10.28508\,\text{rev/s}^2}$$

3.5) Square of Different Distances Traveled in SHM Formula

Evaluate Formula

Formula

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

Example with Units

$$34.066\,\text{m} = 65.26152\,\text{m}^2 - 65\,\text{m}^2$$

3.6) Total Distance Traveled given Velocity and Angular Frequency Formula

Evaluate Formula

Formula

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

Example with Units

$$34.032\,\text{m} = \frac{60\,\text{m/s}^2}{10.28508\,\text{rev/s}^2}$$

3.7) Velocity of Particle in SHM Formula

Evaluate Formula

Formula

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

Example with Units

$$60.03\,\text{m/s} = 10.28508\,\text{rev/s} \cdot \sqrt{65.26152\,\text{m}^2 - 65\,\text{m}^2}$$

Variables used in list of Simple Harmonic Motion(SHM) Formulas above

- **a** Acceleration *(Meter per Square Second)*
- **A** Amplitude *(Meter)*
- A_{shm} Area *(Square Meter)*
- D_{total} Total Distance Traveled *(Meter)*
- **f** Frequency *(Revolution per Second)*
- **F** Force *(Newton)*
- $F_{restoring}$ Restoring Force *(Newton)*
- **K** Spring Constant
- **M** Mass *(Kilogram)*
- **S** Displacement *(Meter)*
- S_{max} Maximum Displacement *(Meter)*
- t_p 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 in list of Simple Harmonic Motion(SHM) Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **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.*
- Functions: **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 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 (m²) *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 (m/s²) *Acceleration Unit Conversion*
- Measurement: **Force** in Newton (N) *Force Unit Conversion*
- Measurement: **Angle** in Degree (°) *Angle Unit Conversion*
- Measurement: **Frequency** in Revolution per Second (rev/s) *Frequency Unit Conversion*

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