

List of Formula.

1. Eq of SHM:

$$\frac{d^2x}{dt^2} + \omega^2 x = 0.$$

2. Soln of eqn of SHM

$$x(t) = A \sin \omega t + B \cos \omega t$$

3. Kinetic energy for SHM

$$K.E = \frac{1}{2} m v^2 = \frac{1}{2} m \omega^2 A^2 \cos^2(\omega t + \phi)$$

4. Potential energy of SHM

$$P.E = \frac{1}{2} m \omega^2 x^2 = \frac{1}{2} m \omega^2 A^2 \sin^2(\omega t + \phi)$$

5.

Total energy of SHM

$$E = K.E + P.E$$

$$E = \frac{1}{2} m \omega^2 A^2$$

6. Frequency for SHM

$$f = \frac{1}{T} = \frac{\omega}{2\pi}$$

7. Time period for SHM

$$T = \frac{2\pi}{\omega}$$

8. Time period for simple pendulum

$$T = 2\pi \sqrt{\frac{l}{g}}$$

9. Time period for mass spring

$$T = 2\pi \sqrt{\frac{m}{k}}$$

10. Eq of damped harmonic oscillator.

$$\frac{d^2x}{dt^2} + 2 \frac{dx}{dt} + \omega^2 x = 0$$

where $\gamma = \frac{2b}{m}$

11. Soln of DHO

$$x(t) = A \cdot e^{(-b + \sqrt{b^2 - \omega^2})t} + B \cdot e^{(-b - \sqrt{b^2 - \omega^2})t}$$

12. over damping.

$$b^2 > \omega^2$$

$$x(t) = e^{-bt} [c \cosh qt + d \sinh qt].$$

13. critical damping.

$$b^2 = \omega^2$$

$$x(t) = e^{-bt} [c + dt].$$

14. Under damping.

$$b^2 < \omega^2$$

$$x(t) = A \cdot e^{-bt} [\sin(\sqrt{\omega^2 - b^2})t + \theta].$$

15. Relaxation time.

$$\tau = \frac{2m}{b}$$

or

$$\tau = \frac{1}{b}$$

16. Q factor.

$$Q = \frac{m\omega}{b}$$

17. Energy loss in α factor

$$E = E_0 e^{-bt/m \cdot t}$$

$$\frac{E}{\Delta E} = \frac{1}{2\pi} \cdot \frac{m\omega}{b}$$

18. SPL \rightarrow Sound pressure level

$$SPL = 20 \log \frac{P_i}{P_0}$$

19. SIL \rightarrow sound Intensity level

$$SIL = 10 \log \frac{I_s}{I_0}$$

20. Value of b (damping constant)

$$b = \frac{\beta}{2m}$$

21. Value of $\omega \rightarrow$ angular frequency of DHM

$$\omega = \sqrt{b^2 - \omega^2}$$

in case of α factor only.

22. Amplitude (in case of Q factor & relaxation time).

$$A = A_0 e^{-bt}$$

$$\frac{A_0}{A} = e^{bt}$$