

PHYSICS 232 – CHAPTER 13: PERIODIC MOTION

Frequency and angular frequency:

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

where T is the period.

Simple Harmonic Motion (SHM). Force on a spring:

$$F = -kx$$

Angular Frequency:

$$\omega = \sqrt{\frac{k}{m}}$$

Acceleration:

$$a = \frac{F}{m} = -\frac{k}{m}x = -\omega^2 x$$

Frequency and Period:

$$f = \frac{\omega}{2\pi} = \frac{1}{2\pi} \sqrt{\frac{k}{m}}, \quad T = \frac{1}{f} = 2\pi \sqrt{\frac{m}{k}}$$

Displacement x as a function of t :

$$x = A \sin(\omega t + \phi)$$

Conservation of Energy:

$$E = \frac{1}{2}mv^2 + \frac{1}{2}m\omega^2 x^2 = \frac{1}{2}m\omega^2 A^2 = \text{constant.}$$

Simple Pendulum consists of a point mass m at the end of a massless string of length L . Its motion is SHM for a small amplitude. Angular frequency, frequency and period:

$$\omega = \sqrt{\frac{g}{L}}, \quad f = \frac{\omega}{2\pi} = \frac{1}{2\pi} \sqrt{\frac{g}{L}}, \quad T = \frac{2\pi}{\omega} = \frac{1}{f} = 2\pi \sqrt{\frac{L}{g}}$$

Damping force $F = -bv$, damped oscillation

$$x = Ae^{-bt/(2m)} \cos \sqrt{\frac{k}{m} - \frac{b^2}{4m^2}} t$$

Driving force of frequency ω_0 , resonance:

$$A = \frac{F_{max}}{\sqrt{(k - m\omega_0^2)^2 + b^2\omega_0^2}}$$