7.1: Prelude to Harmonic Oscillators

You may be familiar with several examples of harmonic oscillators form classical mechanics, such as particles on a spring or the pendulum for small deviation from equilibrium, etc.

Figure 7.1.1: The mass on the spring and its equilibrium position

Let me look at the characteristics of one such example, a particle of mass m on a spring. When the particle moves a distance x away from the equilibrium position x_0, there will be a restoring force $-kx$ pushing the particle back ($x > 0$ right of equilibrium, and $x < 0$ on the left). This can be derived from a potential

$$V(x) = \frac{1}{2}kx^2. \tag{7.1.1}$$

Actually we shall write $k = m\omega^2$. The equation of motion

$$m\ddot{x} = -m\omega^2 x \tag{7.1.2}$$

has the solution

$$x(t) = A\cos(\omega t) + B\sin(\omega t). \tag{7.1.3}$$