12.5: Quantum Mechanical Harmonic Oscillator

The quantum mechanical harmonic oscillator shares the characteristic of other quantum mechanical bound state problems in that the total energy can take on only discrete values. Calculation of these values is too difficult for this book, but the problem is sufficiently important to warrant reporting the results here. The energies accessible to a quantum mechanical mass-spring system are given by the formula

$$E_n = (n+1/2)\hbar(k/M)^{1/2}, \quad n = 0, 1, 2, \ldots \tag{12.5.1}$$

In other words, the energy difference between successive quantum mechanical energy levels in this case is constant and equals the classical resonant frequency for the oscillator, $\omega = (\mathrm{kM})^{1/2},\ \text{times}\ \hbar$.