Homework 5: due on Oct. 13th

1. Textbook 2.10
2. Textbook 2.12

3. One major difference between classical and quantum mechanics on a harmonic oscillator is that in quantum mechanics you may find probability of the particle until \(|x| \to \infty\), while in classical mechanics the particle can only be in so-called “classical range \(-x_c < x < x_c\)” which is defined as: \(\frac{1}{2} m \omega^2 x_c^2 \leq E\). For the ground state, find the total probability of the particle beyond the “classical range”.

4. The Hamiltonian of a coupled harmonic oscillator can be expressed as

\[ H = \frac{1}{2m} (p_1^2 + p_2^2) + \frac{1}{2} m \omega^2 (x_1^2 + x_2^2) + \lambda x_1 x_2 \]

where \( p_1 = -i \hbar \frac{\partial}{\partial x_1} \) and \( p_2 = -i \hbar \frac{\partial}{\partial x_2} \). Assume \( \lambda < m \omega^2 \), find the energy levels of the coupled oscillator.