Homework #5
(due Wednesday, May 6, 2020)

1. (15 pts) A hydrogen atom is in the 2p state. Find the transition rate associated with the 2p -> 1s transition and the lifetime of the 2p state.

2. (15 pts) A particle of charge q and mass m is moving in the 1D harmonic oscillator potential of frequency $\omega_0$.
   (a) Find the rate of spontaneous emission for a transition from an excited state $|n\rangle$ to the ground state.
   (b) Estimate the rate calculated in (a) and the lifetime of the state $|n\rangle$ if the particle is an electron and $\omega_0 = 3 \cdot 10^{14}$ rad/s.
   (c) Under what condition is the dipole approximation valid for the particle of (b)? Is it fulfilled?

3. (10 pts) Imagine a situation in which there are three particles and only three states $a,b,$ and $c$ available to them. What is the total number of allowed, distinct configurations for the following systems:

   (a) labeled (i.e. distinguishable) particles
   (b) identical bosons
   (c) identical fermions

4. Reading assignment: Sakurai 5.7, 5.8, 7.6.