Physics 852   **Problem Set 5**   **Spring 2023**

NOTE: All problem numbers from Sakurai correspond to the 3rd Edition.

1. Calculate the wavelength, in centimeters of the photon emitted under a hyperfine transition in the ground state ($n = 1$) of **deuterium**. Deuterium is "heavy" hydrogen, with an extra neutron in the nucleus; the proton and neutron bind together to form a **deuteron**, with spin 1 and magnetic moment

$$\vec{\mu}_d = \frac{-g_d e}{2 m_d c} \vec{S}_d$$

   where the deuteron g-factor is $g_d = 1.71$.

2. A hydrogen atom is placed in a time-dependent electric field (which is nonzero only for $t > 0$) pointing in the z-direction. The magnitude is $\mathcal{E}(t) = \mathcal{E}_0 e^{-\gamma t}$. What is the probability that as $t \to \infty$, the hydrogen atom makes a transition to the $2p$ state if it is initially in the ground state?

3. Sakurai 5.29

4. Sakurai 5.33