

**Phys 402
Spring 2019
Homework 8
Due Friday, April 19, 2019 @ 9 AM**

1. Griffiths, 2nd Edition, Problem 9.9 or Griffiths, 3rd Edition, Problem 11.11
[different derivation of spontaneous emission coefficient]
2. Griffiths, 2nd Edition, Problem 9.11 or Griffiths, 3rd Edition, Problem 11.13
[calculation of half-life of hydrogen n=2 levels – in dipole approximation]
3. Griffiths, 2nd Edition, Problem 9.17 or Griffiths, 3rd Edition, Problem 11.26
[time-dependent perturbation theory]

4. Quadrupole Radiation Matrix Element and Selection Rules

a) Suppose we relax the constraint that the electric field is uniform over the size of an atom. By expanding the traveling wave (see Fig. 9.3, Griffiths, 2nd Edition or Fig. 11.6, Griffiths, 3rd Edition) electric field

$\vec{E}(y, t) = E_0 \hat{z} \cos(ky - \omega t)$, find the potential experienced by the electron in the atom to next order of approximation. {Hint: assume $ky \ll 1$ } This is the electric quadrupole potential. Estimate how big the correction is relative to the original term for visible radiation.

b) What is the form of the quadrupole matrix element? For the hydrogen atom, what selection rules on changes in the quantum number m arise from this type of matrix element?

5 POINT EXTRA (a quick question):

Griffiths, 2nd Edition, Problem 9.19 or Griffiths, 3rd Edition, Problem 11.28
[spontaneous absorption]