

# Quantum Mechanics PHYS 212B

## Problem Set 6

Due Tuesday, February 23, 2016

**Exercise 6.1** Bound-Free absorption. Linearly polarized (direction  $\hat{\epsilon}$  light with frequency  $\omega$  falls on a hydrogen atom in state  $|i\rangle$ . Find the differential cross section for ejection of the electron into a plane wave state with momentum  $\hbar\mathbf{k}_f$ . Take the rest mass of the electron to be  $m_e$ , and the plane wave final state for the electron to be normalized to square root of volume  $L^{3/2}$  (i.e. in the denominator)

**Exercise 6.2** Use the time-domain-to-energy-domain Fourier transform technique discussed in class to give an argument for the Lorentzian, *Breit-Wigner*, shape for the energy probability distribution for a state or particle with lifetime  $\tau$  and width  $\Gamma = \hbar/\tau$ . This is a quantum mechanically “sketchy” argument because it uses linearity and completeness, hallmarks of the evolution in time of isolated unitary systems, to treat the *non-unitary* time evolution of a decaying system. Comments?