

QUANTUM MECHANICS

Homework Set 8

April 10, 2014

1. (a) Construct the matrix S_r representing the component of spin angular momentum along the radial unit vector \hat{r} . Use spherical coordinates, for which

$$\hat{r} = \sin \theta \cos \phi \hat{x} + \sin \theta \sin \phi \hat{y} + \cos \theta \hat{z} .$$

- (b) Find the eigenvalues of S_r .
 - (c) Find the normalized eigenspinors of S_r .
2. An electron is at rest in an oscillating magnetic field

$$\mathbf{B} = B_0 \cos \omega t \hat{x} ,$$

where B_0 and ω are constants.

- (a) Construct the Hamiltonian matrix for this system.
- (b) The electron starts out (at $t = 0$) in the spin-up state with respect to the z -axis. Determine $\chi(t)$ at any subsequent time by directly solving the Schrödinger equation. (*Note:* This is a time-dependent Hamiltonian, so you cannot get $\chi(t)$ in the usual way from stationary states.)
- (c) Find the probability $P_-(t)$ of getting $-\hbar/2$, if you measure S_z .