Quiz #2

Friday, September 8

PHYSICS 851, FALL 2000

Consider the $\vec{\sigma}$ matrices,

$$\sigma_x = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}, \quad \sigma_y = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}, \quad \sigma_z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}. \tag{1}$$

The spin operator is defined as

$$\vec{S} \equiv \frac{\hbar}{2}\vec{\sigma} \tag{2}$$

1. Write down the 6 vectors describing an electron with spin pointed along the positive/negative directions of each of the three axes.

2. Write the six density matrices describing electrons polarized along the positive/negative directions of each of the three axes.

3. Write the density matrix describing an incoherent mixture of 70% spin-up (along the z axis) and 30 % spin down (along the z axis).

4. Write the density matrix for a state which is incoherent mixture of 50% spin-up (along the x axis) and 50% down (along the x axis).