Homework assignment

Chapter 2

turn in complete assignment electronically in pdf format:

Problem #1 – Ch2, part 1 lecture, spin ½ in general direction (show all your work!)
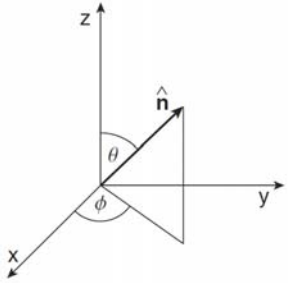
$$0 \leq \theta < \pi \text{ and } 0 \leq \phi < 2\pi$$

$$\hat{\mathbf{n}} = \hat{\mathbf{i}} \sin\theta \cos\phi + \hat{\mathbf{j}} \sin\theta \sin\phi + \hat{\mathbf{k}} \cos\theta$$

$$S_n = \mathbf{S} \cdot \hat{\mathbf{n}}$$
$$= S_x \sin\theta \cos\phi + S_y \sin\theta \sin\phi + S_z \cos\theta.$$

Prove that these expressions are correct

$$S_n \doteq \frac{\hbar}{2} \begin{pmatrix} \cos\theta & \sin\theta \, e^{-i\phi} \\ \sin\theta \, e^{i\phi} & -\cos\theta \end{pmatrix}$$

$$|+\rangle_n = \cos\frac{\theta}{2}|+\rangle + \sin\frac{\theta}{2}e^{i\phi}|-\rangle$$

$$|-\rangle_n = \sin\frac{\theta}{2}|+\rangle - \cos\frac{\theta}{2}e^{i\phi}|-\rangle$$

Problem #2 (<mark>show all your work!</mark>)   spin ½

For the state $|+\rangle_y$, calculate the expectation values and uncertainties for measurements of S_x, S_y, and S_z

Problem #3 (<mark>show all your work!</mark>)

Find the matrix representation of the $\mathbf{S}^2$ operator for a spin-1 system. Do this once by explicit matrix calculation

Problem #4 (<mark>show all your work!</mark>)

A beam of spin-1 particles is prepared in the state

$$|\psi\rangle = \frac{2}{\sqrt{29}}|1\rangle_y + i\frac{3}{\sqrt{29}}|0\rangle_y - \frac{4}{\sqrt{29}}|-1\rangle_y.$$

a) What are the possible results of a measurement of the spin component S_z, and with what probabilities would they occur?

b) What are the possible results of a measurement of the spin component S_y, and with what probabilities would they occur?