1 Spin Three Halves Time Dependence

A spin-3/2 particle initially is in the state $|\psi(0)\rangle = |\frac{1}{2}\rangle$. This particle is placed in an external magnetic field so that the Hamiltonian is proportional to the $\hat{S}_x$ operator, $\hat{H} = \alpha \hat{S}_x \doteq \frac{\alpha\hbar}{2} \begin{pmatrix} 0 & \sqrt{3} & 0 & 0 \\ \sqrt{3} & 0 & 2 & 0 \\ 0 & 2 & 0 & \sqrt{3} \\ 0 & 0 & \sqrt{3} & 0 \end{pmatrix}$

(a) Find the energy eigenvalues and energy eigenstates for the system.

(b) Find $|\psi(t)\rangle$.

(c) List the outcomes of all possible measurements of S_x and find their probabilities. Explicitly identify any probabilities that depend on time.

(d) List the outcomes of all possible measurements of S_z and find their probabilities. Explicitly identify any probabilities that depend on time.