Physics 472 - 2020

Quantum Mechanics

Quiz 9

Please work for 10 minutes, take a picture, and e-mail it to me at dykmanm@msu.edu

Consider a spin with the wave functions $|\uparrow\rangle$ and $|\downarrow\rangle$ and assume that $\psi(t=0) = |\uparrow\rangle$. The Hamiltonian is $H = H^{(0)} + H^{(1)}$ with

$$H^{(0)} = \frac{1}{2}\hbar\omega\sigma_z; \quad H^{(1)} = \frac{1}{2}\sigma_y V\Theta(t)$$

where $\Theta(t)$ is the step function. Assume that $|V| \ll \hbar\omega$. Find the population of the state $|\downarrow\rangle$ as a function of time.
The Pauli matrices are

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