

Mecânica Quântica I - 4302403

Respostas da 7ª lista

3) Um elétron se encontra num estado de spin dado por:

$$|\chi\rangle = A \begin{pmatrix} 3i \\ 4 \end{pmatrix}.$$

a) $A = \frac{1}{5}$

b)

$$\langle S_x \rangle = 0, \quad \langle S_y \rangle = -\frac{24}{25}\hbar, \quad \langle S_z \rangle = -\frac{7}{50}\hbar$$

c) $\text{Prob}(S_y \rightarrow \frac{\hbar}{2}) = 1/50$

d) $\text{Prob}(S_y \rightarrow \frac{\hbar}{2}) = 49/50$

4) b) $\text{Prob}(S_z \rightarrow \frac{\hbar}{2}) = \sin^2(\theta/2)$

c) $\langle S_x \rangle = -\frac{\hbar}{2} \sin \theta \cos \phi$

5) Comece construindo S_z em sua autobase:

$$S_z = \frac{\hbar}{2} \begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & -1 \end{pmatrix}$$

Então construa S_{\pm} partindo de $m = 1$, e daí encontre S_x e S_y :

$$S_x = \frac{\hbar}{2} \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix}, \quad S_y = \frac{\hbar}{2} \begin{pmatrix} 0 & -i & 0 \\ i & 0 & -i \\ 0 & i & 0 \end{pmatrix}$$

6)

$$\langle S_y \rangle = \frac{\hbar}{2} \sin \alpha \sin(\gamma B_0 t), \quad \langle S_z \rangle = \frac{\hbar}{2} \cos \alpha$$

8) a)

$$H = -\frac{\hbar\gamma B_0}{2} \cos(\omega t) \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$

9) a) $H|\pm\rangle = E_{\pm}|\pm\rangle$, onde $E_{\pm} = \mp\hbar\gamma B/2$.

b)

$$|\psi(t)\rangle = \frac{1}{\sqrt{2}} \left(e^{i\gamma B t/2} |+\rangle - e^{-i\gamma B t/2} |-\rangle \right)$$

c)

$$\langle S_x \rangle = -\frac{\hbar}{2} \cos(\gamma B t), \quad \langle S_y \rangle = \frac{\hbar}{2} \sin(\gamma B t), \quad \langle S_z \rangle = 0$$

d)

$$\left| \psi \left(t = \frac{2\pi}{\gamma B} \right) \right\rangle = -|\psi(0)\rangle$$