6.12

(a) from $\psi(\vec{r},t) = e^{\frac{-i\hat{H}t}{\hbar}} \psi(\vec{r},0)$ and knowing that ϕ_{nlm} are eigen states of hamiltonian with eigen value E_n, we have:

$$\psi(\vec{r},t) = e^{\frac{-i\hat{H}t}{\hbar}} \psi(\vec{r},0) = e^{\frac{iE_3 t}{\hbar}} \psi(\vec{r},0)$$

(b)

wave function of the system is eigen function of energy with eigen value of E_3 thus by measuring energy only the value of E_3 with probability of one will apear.

(c) by measuring $\hat{\vec{L}}^2$ the value of $l(l+1)\hbar^2$ with probability of P_l will obtain. here l can be $0, 1, 2$

$P_0 = |\langle \phi_{300} | \psi \rangle|^2 = \left(\frac{1}{\sqrt{2}}\right)^2 = \frac{1}{2}$ (the value of $0(0+1)\hbar^2 = 0$ will happen with probability $\frac{1}{2}$)

$P_1 = |\langle \phi_{311} | \psi \rangle|^2 = \left(\frac{1}{\sqrt{3}}\right)^2 = \frac{1}{3}$ (" " " $2\hbar^2$ " " " " $\frac{1}{3}$)

$P_2 = |\langle \phi_{322} | \psi \rangle|^2 = \left(\frac{1}{\sqrt{6}}\right)^2 = \frac{1}{6}$ (" " " $6\hbar^2$ " " " " $\frac{1}{6}$)

by measuring $\hat{L}_z$ the value of $m\hbar$ with probability of P'_m will obtain. here m can be 0, 1, 2

$P'_0 = |\langle \varphi_{300}|\psi\rangle|^2 = \frac{1}{2}$ (the value of $0\hbar = 0$ will happen with probability $\frac{1}{2}$)

$P'_1 = |\langle \varphi_{311}|\psi\rangle|^2 = \frac{1}{3}$ (" " " $\hbar$ " " " " $\frac{1}{3}$)

$P'_2 = |\langle \varphi_{322}|\psi\rangle|^2 = \frac{1}{6}$ (" " " $2\hbar$ " " " " $\frac{1}{6}$)

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