Quantum Mechanics Summer 2003- Homework Set 3

Due at beginning of class July 28, 2003.

Cohen-Tannoudji Problems - in L_{III}

- 1
- 5 Part a and b only.
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- 12
- 13 (Skip γ)
- 14

Griffith Problems

Problem G1 Calculate the uncertainty relation for the observables $\hat{X}$ and $\hat{H}$, where $H = \frac{p^2}{2m} + V(x)$.

Problem G2 Consider the simple harmonic oscillator potential $V(x) = \frac{1}{2}kx^2$.

(a) Write the hamiltonian of the system.

(b) Compute the time rate of change average of the position, momentum, and kinetic energy.

Problem G3 Consider a system with only two linearly independent states,

$$|1>= \begin{pmatrix} 1 \\ 0 \end{pmatrix}$$

and

$$|2>= \begin{pmatrix} 0 \\ 1 \end{pmatrix}$$

The vectors in the state space are normalized linear combinations of these states

$$|\psi>= a|1> +b|1>= \begin{pmatrix} a \\ b \end{pmatrix}$$

The vectors evolve under the Hamiltonian

$$\hat{H} = \begin{pmatrix} h & g \\ g & h \end{pmatrix}$$

where h and g are real constants.

(a) Verify that $\hat{H}$ is Hermitian.

(b) Find its eigenvalues (note they are real).

(c) Find the normalized eigenvectors.

(d) Solve for $|\psi>$ as a function of time.

Problem G4 A particle of mass m is in the ground state of an infinite square well of length $0 < x < a$. The well suddenly doubles in length to $0 < x < 2a$ leaving the wave function unchanged. The energy of the particle is then measured.

(a) What is the probability of finding the system in its ground state?

(b) What is the probability of finding the system in its first excited state?

(c) What is the expectation value of the energy?