

1. A plane wave is incident from the left on a one dimensional square well potential of width '2a' and height 'V' (use $-a \leq x \leq a$). The energy of the wave is $E > V$. What is the transmission probability of the wave over the potential? What is the reflection coefficient?
2. Consider a particle of mass m moving in the x-y plane under the influence of a potential of infinite value at the edges of a box of dimensions L_1 and L_2 that are not equal and zero inside the box:
 - a. Write the Schrodinger equation for such a particle.
 - b. What are the eigen -functions and eigen- values of energy for this particle.
 - c. What are the lowest three energy state wave functions and their energies?
3. A. Write the wave function of the ground state and the first excited state of a simple harmonic oscillator in one dimension as a function of space x and time t. ✓
 B. Calculate the expectation values for x, x^2 , p and p^2 using raising and lowering operators between all of these two states. ✓

4. A three state system has the following operator representing the Hamiltonian (h_0 is a constant with units of energy):

$$H = h_0 [2 |1\rangle\langle 1| + |2\rangle\langle 2| + |1\rangle\langle 2| + |2\rangle\langle 1| + |3\rangle\langle 3|]$$

What is the 3X3 matrix representing the Hamiltonian in this space of normalized states?

What are the energy eigen-states of the system in terms of the normalized states $|1\rangle$ and $|2\rangle$ and $|3\rangle$?

If at time $t=0$ the state function is written as $|\Psi\rangle = a|1\rangle + 3a|2\rangle + 2a|3\rangle$

Normalize the state $|\Psi\rangle$ and find its development as a function of time.

25% per question.