1. "Half" square well.

\[ V(x) = \begin{cases} 
V_0 & x > a \\ 
0 & 0 \leq |x| \leq a \\ 
\infty & x < 0 
\end{cases} \]

Consider \( E < V_0 \).

(a) Find equations which determine the energy eigenvalues.

(b) Find the energy eigenstate wave functions.

2. Consider a particle moving in a simple harmonic oscillator potential. The Hamiltonian is

\[ H = \frac{p^2}{2m} + \frac{1}{2} m \omega^2 x^2. \]

(a) Denote the ground state and the first excited state as \( |\psi_0\rangle \) and \( |\psi_1\rangle \), respectively. At \( t = 0 \), the system is prepared in a state

\[ \frac{1}{\sqrt{2}} (|\psi_0\rangle + |\psi_1\rangle). \]

Compute the expectation values \( \langle x \rangle, \langle p \rangle, \langle x^2 \rangle, \langle p^2 \rangle \) at a later time \( t \).

(b) Suppose at \( t = t_0 \), the particle is measured to be at position \( x = 0 \). Derive the time evolution of the wave function of this particle for \( t > t_0 \).