1. Normalize the following wavefunctions
   
   a) \( \psi = \sin \frac{2\pi x}{L} \) on \((0,L)\)
   
   b) \( \psi = C \) on \((-a, a)\), \(C = \) constant
   
   c) \( \psi = e^{-x^2} \) on \((-\infty, \infty)\)
   
   d) \( \psi = e^{-ax} \) in 3-dimensional space

2. Consider the wavefunction \( \psi = \frac{2}{\sqrt{L}} \sin \frac{\pi x}{L} \) for a particle in a box of length \(L\) \((0 \leq x \leq L)\).
   
   What is the probability of finding the particle between \(x = L/4\) and \(3L/4\)? What is the probability of finding it between \(0\) and \(L/2\)?

3. Consider a particle described by the wavefunction \( \psi = e^{ikx} \). What is the momentum? Would multiple measurements of the momentum give the same value? Why or why not?

4. Consider the wavefunction \( \psi = ae^{ikx} + be^{-ikx} \). What is the momentum? Would multiple measurements of the momentum give the same value? Why or why not?

5. If an electron is known to be located between \(x = 0\) and \(10\AA\), what is the uncertainty in its momentum?

6. Consider a conjugated polyene containing 16 C atoms. If you model the \(\pi\) electrons of this system with a one dimensional particle in the box, the ground state would place two electrons in each of the eight lowest energy orbitals. What is the energy gap (in ev) between the 8\textsuperscript{th} and 9\textsuperscript{th} orbitals? What is the frequency of the transition between these two energy levels.