

Homework #5

Reading

- Kasap 3.2, 3.3, 3.7, 4.5, 4.6, 4.7

Problems

1. Free Electron

Consider the one-dimensional wavefunction for a free electron traveling in a region where $V = 0$.

$$\psi = Ae^{ikx}$$

- Write down the one-dimensional Hamiltonian for the free electron.
- Using the given wavefunction, solve the time-independent Schrödinger equation to determine the energy eigenvalues.
- Using the same wavefunction given above, repeat parts (a) and (b) for a free electron moving in a region where the potential is constant given by V_0 .
- Comparing the two situations, if the total energy E is the same in each case, what does that imply about the wavenumbers for the two situations? Are they the same?

2. Infinite Potential Well

Consider an electron bound within a one-dimensional infinite potential well with a width $a = 0.11$ nm.

- What is the ground state energy ($n = 1$) for the electron?
- What is the energy required to excite the electron to the second energy level?
- What is the wavelength (in nm) of a photon that could transfer enough energy to excite the electron from the ground state to the second energy level?

3. Electronic Materials Project

Submit your chosen material for the Electronic Materials Project.