EECS 277C Nanotechnology HW #1

Intro material: (particle in a box)

1. Consider a single electron in a box. Calculate the spacing between the lowest lying energy levels for a box of size a) 1 meter b) 1 micron c) 1 nanometer d) 1 Anstrom. How do these compare to kT at room temperature?
2. Calculate the density of states in a 2d world.

Tunneling:

1. Calculate the probability for an electron to tunnel through a 1 nm barrier that is 10 eV high. This is a good approximation for the tunnel junction shown in class. Use the formula below:



Now calculate the resistance of a tunnel junction based on the geometry of the device shown in class that was made by the professor.

1. Find the relationship between the Fermi energy and the average energy of electrons in a box.
2. Same for the average wavelength.
3. Find the Fermi wavelength of electrons in a typical metal, e.g, Cu.
4. The angle for the first fringe of the diffraction grating was about 45 degrees for 1000 lines/inch. Find the wavelength of the laser.
5. Assume you are trying to diffract matter waves of electrons with the same grid, 1000 lines/inch, and a beam energy of 10 keV. What would the angle be?