Tutorial Sheet – Lecture 12

Band Structure

RA Hogg
r.hogg@shef.ac.uk

1) Visible light spans wavelengths of ~400nm to ~700nm. Calculate;
    a. The span of frequencies
    b. The span of energies in both Joules and eV

2) Calculate the number of photons per second emitted by;
    a. A red laser pointer (Wavelength = 690nm, Power = 1mW)
    b. A microwave oven (Frequency =2.45 GHz, Power = 750W)

3) Providing details of assumptions, estimate the de Broglie wavelength of;
    a. An electron at the Brillouin-Zone edge of GaAs
    b. A photon with an energy equal to the band-gap of GaAs
    c. Professor Hogg running (or more realistically fired from a canon….) at $10ms^{-1}$.

4) An electron tunnelling through a resonant tunnelling diode has a lifetime of 1ps in the resonant state. Calculate the energy broadening of this state in eV.

5) Describe, in your own words, how the Bloch theorem may be applied to Schroedinger's equation to describe the wavefunctions of particles in a periodic potential.

6) Describe, in your own words, the essence of the simplification of the solution to Schroedinger's equation using the Kroenig-Penney model.

7) Describe, in your own words, the essence of the simplification of the solution to Schroedinger's equation using the Nearly Free Electron approximation.

8) Describe, in your own words, what is meant by the Tight Binding Approximation with regards to electron band-structure in solids.