

1. The edge of a unit cell in a cubic crystal is $a = 2.62 \text{ \AA}$. Find the Bragg angle corresponding to reflection from the planes (100), (110), (111), (200) and (211), given the wavelength of the monochromatic x-ray beam is 1.54 \AA .
2. The Bragg reflection angle from the (110) planes in bcc iron is 22° for x-ray beam with $\lambda = 1.54 \text{ \AA}$. Calculate the edge of a cubic unit cell a .
3. Show that the volume of the first Brillouin zone is $8\pi^3/V_c$, where V_c is the volume of a crystal primitive cell. (Hint: remember that Wigner-Seitz cell has the same volume as parallelepiped formed by three basis vectors of a primitive cell)

4. For a hydrogen atom in its ground state, the electron density is

$$n(r) = \frac{1}{\pi a_0^3} e^{\frac{-2r}{a_0}}$$

where a_0 is the Bohr radius (0.53 \AA). Show that the atomic scattering factor for hydrogen is

$$f_a = 16/(4 + G^2 a_0^2)^2$$

5. a) Calculate the structure factor F_{hkl} for fcc lattice. Find the condition for h, k, l numbers for which the factor is non-zero.
- b) Calculate the structure factor for diamond lattice.