

Dr. Anju Gupta

B.Sc (PS) Chemistry VI Sem
Assignment (Crystal Structure)

Assignment-1

(Crystal structure)

Q1. The primitive translation vectors of a hexagonal space lattice may be taken as

$$\vec{a} = \left(\frac{\sqrt{3}}{2}\right)\hat{i} + \left(\frac{a}{2}\right)\hat{j}, \quad \vec{b} = -\frac{\sqrt{3}a}{2}\hat{i} + \frac{a}{2}\hat{j}, \quad \vec{c} = c\hat{k}$$

show from $V = |\vec{a} \cdot \vec{b} \times \vec{c}|$ that the volume of the primitive cell is $\frac{\sqrt{3}}{2} a^2 c$.

Q2. show that every reciprocal lattice vector \vec{G} is normal to the plane of the crystal lattice (hkl).

Q3. Show that the interplanar spacing d_{hkl} in a real crystal lattice is equal to $\frac{1}{|\vec{G}|}$.

Q4. show that the volume of the unit cell of the reciprocal lattice is inversely proportional to that of corresponding direct lattice.

Q5. Draw the following crystal planes in a cubic cell: (a) $(1\bar{1}0)$ (b) $(\bar{1}02)$ (c) $(11\bar{1})$ (d) $(2\bar{1}0)$ (e) $(\bar{2}\bar{1}\bar{2})$

Q6. Draw the following planes inside the unit cell:
 (i) $(\bar{1}0\bar{1})$ (ii) (111) (iii) $(1\bar{1}\bar{1})$ (iv) $(\bar{1}\bar{1}\bar{1})$ (v) (110)
 (vi) $(\bar{1}\bar{1}\bar{1})$

Q7. Draw (101) and (111) planes in a cubic unit cell. Determine the Miller indices of the directions which are common to both the planes.

Q14. The first maxima for Bragg's diffraction of X-rays from KCl crystal ($d = 0.314 \text{ nm}$) appears at 14° . Calculate the energy of incident X-rays.

classmate

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Q18. In a cubic unit cell, find the angle between normals to the planes (111) and (121).

Q19. Calculate the packing efficiency and density of sodium chloride from the following data:

radius of sodium ion = 0.98 \AA

" " chloride ion = 1.81 \AA

Atomic mass of Na = 22.99 amu

" " " chlorine = 35.45 amu

Q19(a) Calculate the longest wavelength that can be analysed by a rock salt crystal of spacing $d = 2.82 \text{ \AA}$ in the second order.

(b) The first order reflection from the plane of NaCl is obtained at an angle $2\theta = 20^\circ$ with the incident beam. If $d = 2.82 \text{ \AA}$, calculate the wavelength of X-ray used.

Q11. Electrons are accelerated by 344 volts and are reflected from a crystal. The first reflection maximum occurs when glancing angle is 30° . Determine the spacing of the crystal. ($h = 6.62 \times 10^{-34} \text{ Js}$; $e = 1.6 \times 10^{-19} \text{ C}$, $m = 9.1 \times 10^{-31} \text{ kg}$).

Q12. X-rays of wavelength $2 \times 10^{-10} \text{ m}$ suffer first order reflection from (111) crystal plane at an angle of 45° . What is the interatomic spacing of the crystal?

Q13. The primitive translation vectors of a 2-dim. lattice are $\vec{a} = 2\hat{i}$, $\vec{b} = \hat{i} + 2\hat{j}$. Determine the primitive translation vectors of reciprocal lattice.

