ESTERN UNIVERSITY, SRI LANKA

THIRD YEAR EXAMINATION IN SCIENCE – 2004/05 – 2ND SEMESTER

PH 304 – Condensed State Physics

Answer all question **Time allowed: One hour**

1. Explain the concept of "Bravias Lattice" and "basis" in describing the crystal structure of a crystalline solid. Hence identify the Bravias lattice and the basis that would generate the hexagonal close-packed (*hcp*) structure.

   Show that the *c*/*a* ratio of the unit cell dimensions of an *hcp* lattice is $\sqrt{8/3}$.

   Zinc has an *hcp* structure with lattice parameters *a* and *c* as 2.66 Å and 4.95 Å respectively. If the atomic radius and the atomic mass of zinc are 1.31 Å and 65.37 a.m.u. respectively, find the packing fraction and density of zinc.

2. Show that for a unit cell having lattice parameters (*a*, *b*, *c*), the separation of two successive planes corresponding to the Miller indices (*h k l*) is given by

$$d_{hkl} = \left[\left(\frac{h}{a}\right)^2 + \left(\frac{k}{b}\right)^2 + \left(\frac{l}{c}\right)^2\right]^{-\frac{1}{2}}.$$

   Describe Bragg's Law in crystallography.

   Potassium chloride (KCl) has a similar structure to sodium chloride (NaCl) possessing a face-centered cubic Bravias Lattice. An x-rays of wavelength 0.71 Å is incident on a KCl single crystal and a diffracted beam from (200) planes is observed at Bragg angle 27.5°. If the edge of KCl unit cell is less than 6.5 Å, find,

   (a) the order of diffraction and the exact length of the edge of the unit cell of KCl;
   (b) the density of KCl.

   Take the atomic weight of potassium (K) and chlorine (Cl) as 39.1 a.m.u. and 35.5 a.m.u. respectively. (1 a.m.u.=1.66 x 10^{-27} kg)