EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE - 2007/2008

SECOND SEMESTER (SPECIAL REPEAT)

(FEBRUARY 2010)

PH 304 CONDENSED STATE PHYSICS

Time: 01 hour.

Answer ALL Questions

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1. Define the terms Bravais lattice, primitive unit cell, conventional unit cell, lattice constant and basis. Identify the Bravais lattice and 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 *amu* respectively, find the packing fraction and density of zinc.

2. Derive Bragg's law for the diffraction of radiation by a three dimensional crystal.

   Explain how Miller indices can uniquely define a set of crystalline planes.

   For the case of a cubic crystalline structure, the spacing d between planes labeled by Miller indices h, k and l is related to the lattice parameter a by the equation

$$d = \frac{a}{\sqrt{h^2 + k^2 + l^2}}$$

   The element polonium crystallizes in a simple cubic structure. If a powder sample is illuminated by radiation with wavelength 0.154 nm, a series of scattering rings is seen. The measured Bragg angles θ for some of the rings are 13.29, 18.97, 23.46, 27.37 and 30.93 degrees. Calculate the interplanar spacings corresponding to these angles (assuming that the rings are the first order diffraction peaks).

   By considering the ratios of the squares of the interplanar spacings, or otherwise, determine the Miller indices for the planes corresponding to these angles, and hence determine the lattice parameter for polonium.