EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE - 2008/2009

SECOND SEMESTER (PROPER/REPEAT)

(October/November 2010)

PH 304 CONDENSED STATE PHYSICS

Time: 01 hour.

Answer ALL Questions

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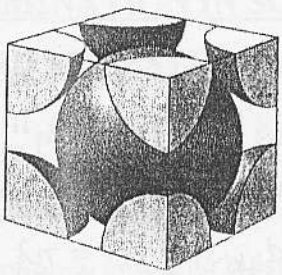
1. Briefly describe the differences between single and poly crystalline materials. What is a space lattice? Demonstrate by suitable diagrams, how a crystal structure can be obtained from a space lattice and basis.

A unit cell of a body centered crystal structure is shown below.



(a) State whether this unit cell is primitive or not. Explain your answer.

(b) Find the packing fraction of a body centered cubic structure.

(c) If the primitive translational vectors of a body centered cube is given by:

$$b_1 = \frac{a}{2}(i + j - k)\,, b_2 = \frac{a}{2}(-i + j + k) \text{ and } b_3 = \frac{a}{2}(i - j + k)$$

where $a_1 = ai, a_2 = aj$ and $a_3 = ak$ are the basis vectors of the unit cell and a is the lattice side, find the volume of the primitive unit cell.

(d) Hence or otherwise find the reciprocal lattice vectors of a body centered crystal structure.

2. Show that for any cubic lattice the separation of the planes corresponding to Miller indices (*hkl*) is given by:

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

Where a is the lattice parameter.

Briefly describe the Bragg's diffraction in crystals and show that the Bragg condition for crystal diffraction on (hkl) planes is given by:

$$2d_{hkl} sin\theta_{hkl} = n\lambda,$$

Where the symbols have their usual meanings.

Determine the Bragg angles for the (111), (220), (311), and (400) reflections of Germanium which has a cubic structure with lattice parameter 5.65 $A°$ using "Copper K_α" X-rays which has a wavelength $\lambda = 0.154$ nm.