

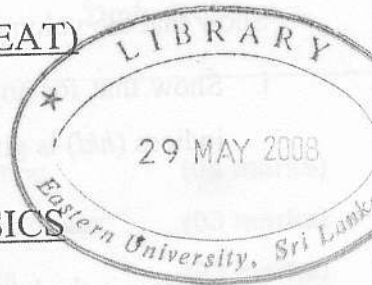
EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE - 2005/2006

SECOND SEMESTER (PROPER/REPEAT)

(MARCH/APRIL 2008)

PH 304 CONDENSED STATE PHYSICS



Time: 01 hour.

Answer ALL Questions

1. Describe what is meant by the terms lattice, basis, conventional unit cell and primitive unit cell. Write down the primitive translational vectors of face centered cubic (*fcc*) lattice in terms of lattice parameter a and the unit vectors of Cartesian coordinate system.

Show that the volume of the primitive cell of the *fcc* lattice is $\frac{a^3}{4}$.

- i. 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.

- ii. Prove that in a cubic crystal a direction $[hkl]$ is perpendicular to a plane (hkl).

2. Describe an experimental method to determine the crystalline structure of a powdered sample.

The element polonium crystallises 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.

- i. Calculate the interplanar spacing corresponding to these angles (assuming that the rings are the first order diffraction peaks).
- ii. 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.