University of Kentucky
Department of Physics and Astronomy

PHY 525. Introduction to Solid State Physics II

Test 1.

Date: Oct 8, 2001
Time: 9:00-9:50
Answer all questions.

1. (25 points)
The crystal structure of copper is face-centered cubic (fcc) of lattice parameter *a* to be determined by X-ray diffraction (λ = 17.89 nm) at room temperature (T=293K). Distance between (hkl) planes of simple cubic is given as:

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

(i) Determine the conditions on Miller indices of the diffraction peaks. What are the Miller indices of the first peak (i.e. smallest Bragg's angle θ) ?

(ii) The θ of the first peak is measured to be 25.38^o. What is the lattice parameter of copper?

(iii) The coefficient of linear thermal expansion is 1.91×10^{-5} K^{-1}. Where will be the first peek at T=1200K?

2. (25 points)
The relation between frequency ν and wavelength λ for surface tension waves on a liquid of density ρ and surface tension σ is

$$\nu^2 = \frac{2\pi\sigma}{\rho\lambda^3}$$

(i) What is the density of state $D(\omega)$? Note that it is a two dimensional system. Assume the area of the surface to be A.

(ii) Obtain the analogue of the Debye T^3 law for the surface contribution to the heat capacity of liquid helium very near to absolute zero. You can assume a cutoff frequency ω_D, similar to the Debye frequency we used in 3D crystal.