

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

APPLIED PHYSICS DEPARTMENT

SPH2202 – SOLID STATE PHYSICS

BSc HONOURS PART II: JUNE 2004

DURATION: 3 HOURS

ANSWER **ALL** PARTS OF QUESTIONS 1 IN SECTION A AND ANY **THREE** QUESTIONS IN SECTION B. SECTION A CARRIES 40 MARKS AND SECTION B CARRIES 60 MARKS.

Planck's constant, h	=	6.63×10^{-34} Js
Boltzman constant, k	=	1.38×10^{-23} J/K
1 electron – volt, 1 eV	=	1.60×10^{-19} J
Speed of light in vacuo	=	3.00×10^8 m/s
Atomic mass unit 1 a.m.u.	=	1.66×10^{-27} kg
Mass of electron, m_e	=	9.11×10^{-31} kg
Charge on an electron	=	1.60×10^{-19} C
Permeability of free space, μ_0	=	12.57×10^{-7} H/m
Permittivity of free space, ϵ_0	=	8.85×10^{-12} F/m
Bohr magneton, μ_B	=	9.27×10^{-24} J/T

SECTION A

- 1 (a) What is a lattice point? Explain with a mathematical expression. [3]
- (b) Define concisely primitive lattice cell, crystal structure and basis of a crystal. [3]
- (c) (i) Why do you need Miller indices to show important planes in a cubic crystal? Show by drawing planes in a cubic crystal of the indices (200), (01 0) and describe NaCl crystal structure. [6]
- (ii) Show using Fourier analysis $n(\mathbf{r} + \mathbf{T}) = n(\mathbf{r})$ that the Bragg derivation of diffraction condition is satisfied, where \mathbf{T} = period, $n(\mathbf{r})$ = electron density in the directions of three crystal axes. [6]
- (iii) What are Frenkel and Schottky defects, dislocation and colour centers in a crystal? [6]
- (d) Calculate the internal field of iron with atomic number 26 if its Curie temperature is 1043 K with an effective moment of 2.2 Bohr magnetons per ion. [3]