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**NATIONAL OPEN UNIVERSITY OF NIGERIA**

**PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA**

**FACULTY OF SCIENCES**

**DEPARTMENT OF PURE AND APPLIED SCIENCE**

 **2018\_2 SEMESTER EXAMINATION**

**COURSE CODE: PHY 307**

**COURSE TITLE: SOLID STATE PHYSICS I**

**CREDIT UNIT 2**

**TIME ALLOWED (2 HRS)**

**INSTRUCTION: *Answer question 1 and any other three questions***

**QUESTION 1**

(a). Define the following :(i). Solid state physics (2marks)

 (ii). Crystal (2marks)

 (iii). A lattice (2marks)

 (iv). A unit cell (2 marks)

 (v). Basis (2 marks)

(b). Briefly explain how Bravais Lattice may be built (5 marks)

(c). Briefly explain Crystal structure of atoms (5 marks)

(d). Briefly explain Lattice cell (5 marks)

**QUESTION 2**

 (a). (i). Define Crystal lattice (2 marks)

 (ii). State the rules to find the direction indices in fundamental types of lattices (3 marks)

 (b). (i). What are miller indices? (3 marks)

 (ii). Mention any two rules for determination of Miller indices (4 marks)

 (c). If x, y and z axes intercept 3, 4, and 2, calculate the Miller indices (3 marks)

**QUESTION 3**

 (a). (i). Define simple lattices (2 marks)

 (ii). Mention any two elementary properties of simple lattices (4 marks)

 (b). In the structure of atoms, briefly explain Closed – packed structures (5 marks)

 (c). (i). In the Hexagonal Close Pack (HCP) structure, give the formula for the vector that separates

two atoms per unit cell (2 marks)

 (ii). Give the formula for the packing fraction in a crystal structure (2 marks)

**QUESTION 4**

 (a). (i). What is diffraction? (2 marks)

 (ii). State the condition for constructive reflection in Braggs formulation of diffraction by a crystal

 (3 marks)

 (b). An X-ray Diffractometer recorder chat for an element, which has a cubic

 crystal structure, shows diffraction peaks at the following 2θ:40, 58, 73, 86.8,100.4 and

 114.7. The wavelength of the incoming X-rays used was 1.540Ȧ

(i) Determine the type of the cubic structure possessed by the element. (5 marks)

(ii)Determine the lattice constant of the element. (5 marks)

**QUESTION 5**

5. (a). (i). Briefly explain the theory of X-ray diffraction (3 marks)

 (ii). Define reciprocal lattice (2marks)

 (b). Mention the properties of reciprocal lattice that make it of importance in the diffraction

 theory (3 marks)

 (c). Prove that the reciprocal lattice vectors as defined in equation of vectors below ( 7 marks)

 $A=2π\frac{b × c}{a.b ×c}$ , $B= 2π\frac{c ×a}{a.b ×c}$ , $C= 2π\frac{a ×b}{a.b ×c}$

 Satisfy,

 $A.B X C= \frac{8π^{3}}{a.b ×c}$