90

(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY MAIN EXAMINATIONS

2021/2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE (CHEMISTRY) AND BACHELOR OF SCIENCE (INDUSTRIAL CHEMISTRY)

COURSE CODE: SCH 343E

COURSE TITLE: CRYSTALLOGRAPHY

DATE: FRIDAY 22ND APRIL 2022 **TIME:** 8.00 - 10.00 AM

INSTRUCTIONS TO CANDIDATES

Total Marks: 70

Answer all the Questions

TIME: 2 Hours

This Paper Consists of 3 Printed Pages. Please Turn Over.

Question One **(18 Marks)**

a. Differentiate between the following pairs of terms as used in crystallography (8 Marks)

i. Short order range and long range order

ii. London dispersion forces and hydrogen bond.

iii. Space lattice and unit cell

iv. Powder x-ray diffraction and Single crystal X-ray diffraction

b. Briefly describe any THREE types of crystalline solids (6 Marks)

c. State any FOUR properties of amorphous Solids (4 Marks)

Question Two **(17 Marks)**

a. Briefly explain the THREE types of Centred Unit Cells (6 Marks)

b. Calculate the separation of the {123} planes and of the {246} planes of an orthorhombic unit cell with dimensions a= 0.82 nm, b=0.94 nm *and* c=0.75 nm. Compare the separations of the two planes (5 Marks)

c. X-ray diffractometers consist of several basic elements. State the function of each part listed below (4 Marks)

i. Synchrotron

ii. Goniometer

iii. Collimeter

iv. A beam stop

d. State any TWO disadvantages of using capillaries as sample support in mounting of crystals for x-ray diffraction studies (2 Marks)

Question Three **(17 Marks)**

a. Concentration gradient methods are important crystallization methods. Briefly explain any THREE types of concentration gradient methods (6 Marks)

b. A first order reflection from the {111} planes of cubic crystal was observed at a glancing angle of 11.2° when Cu(Kα) X-ray of wavelength 154 pm were used. What is the length of the side of the unit cell? (4 Marks)

c. What do you think are the strengths of single-crystal X-ray diffraction over other methods in structure determination (4 Marks)

d. Outline any THREE deleterious effects of X-rays on human cells (3 Marks)

Question Four **(18 Marks)**

a. State and briefly explain any FOUR classes of absorption correction methods (8 Marks)

b. Calculate the typical wavelength of neutrons that have reached thermal equilibrium with their surroundings at 373 K (Planks constant $=6.626\times10^{-34}$Js, Boltzmann constant = 1.381×10^{-23} m^2 kg s^{-2} K^{-1}, Mass of neutron= 1.675×10^{-27} kg, 1J = 1 m^2 kg s^{-2}) (4 Marks)

c. Proteins are large macromolecules comprising of one or more long chains of amino acid residues. State any FOUR crystallographic methods that can be used in their structural analysis (4 Marks)

d. State any TWO applications of crystallography in real life (2 Marks)