



# MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

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## University Examinations 2023/2024

FIRST YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE FOR MASTER  
OF SCIENCE IN CHEMISTRY

### SCH 7141: SOLID STATE CHEMISTRY

DATE: APRIL 2024

TIME: 2 HOURS

INSTRUCTIONS: Answer question *one* and any other *two* questions

#### QUESTION ONE (30 MARKS)

- Explain why sodium chloride is considered to be crystalline while glass is not (4 Marks)
- X-Ray diffraction studies shows that copper crystallizes in an FCC unit cell with cell edge of  $3.608 \times 10^{-8}$ cm. in a separate experiment, copper is determined to have a density of  $8.92\text{g/cm}^3$ , calculate the atomic mass of copper. (3 marks)
- What is the difference between Crystal Lattice and Unit Cell? (4 marks)
- Explain the Basis of Similarities and Differences Between Metallic and Ionic Crystals. (4 marks)
- Analysis shows that nickel oxide has the formula  $\text{Ni}_{1.098}\text{O}_{1.00}$ . What fractions of nickel exist as  $\text{Ni}^{2+}$  and  $\text{Ni}^{3+}$  ions? (3 marks)
- What is a Semiconductor? Describe the two main types of semiconductors and contrast their conduction mechanism. (6 marks)
- Explain the Following Terms with suitable examples:
  - Schottky Defect: (2 marks)
  - Frenkel Defect: (2 marks)

iii) Interstitial defect: (2 marks)

### QUESTION TWO (20 MARKS)

a) Explain any three advantages of solid state reactions over solution phase reactions (3 marks)

b) In solid state reactions, explain what to consider when

i) Choosing starting materials (1 marks)

ii) Mixing reactants (1 marks)

iii) Choosing reaction vessels (1 marks)

iv) Choosing firing schedule (1 marks)

c) Explain each of the following methods of solid state synthesis

i) Ceramic Method (2 marks)

ii) Sealed tube method (2 marks)

iii) Spray-Drying (2 marks)

iv) Freeze-Drying (2 marks)

### QUESTION THREE (20 MARKS)

a) Explain how each of the following crystal defects influence properties of solids (8 marks)

i) Schottky Defect

ii) metal excess defects

iii) Dislocations

iv) Frenkel defect

b) What is a zeolite? What are they used for? (2 marks)

c) Describe synthesis of zeolites by sol-gel method. (5 marks)

### QUESTION FOUR (20 MARKS)

- a) What information about the properties of solid materials can be obtained by each of the following techniques: (7 marks)
- i) optical microscopy
  - ii) powder x-ray diffraction
  - iii) atomic absorption spectroscopy
  - iv) Nuclear Magnetic resonance
  - v) Infrared spectroscopy
  - vi) Thermogravimetry
  - vii) Single crystal x-ray diffraction

b) Explain the Following With Suitable Examples:

- (i) Ferromagnetism: (2 marks)
- (ii) Paramagnetism: (2 marks)
- (iii) Ferrimagnetism: (2 marks)
- (iv) Antiferromagnetism: (2 marks)