



UNIVERSITY OF GHANA

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BSc. MATERIALS SCIENCE & ENGINEERING
SECOND SEMESTER EXAMINATIONS: 2016/2017
SCHOOL OF ENGINEERING SCIENCES
DEPARTMENT OF MATERIALS SCIENCE & ENGINEERING
MTEN 306: MATERIALS LAB II (1 CREDIT)

INSTRUCTIONS: ANSWER ANY TWO (2) QUESTIONS

TIME ALLOWED: ONE (1) HOUR

1. Figure 1 below shows X-ray powder diffraction patterns of Sodium Chloride (NaCl), bottom and Potassium Chloride (KCl) top. Peaks in the KCl diffraction pattern are labeled with Miller indices (h, k, l), indicating the set of lattice planes responsible for that diffraction peak.

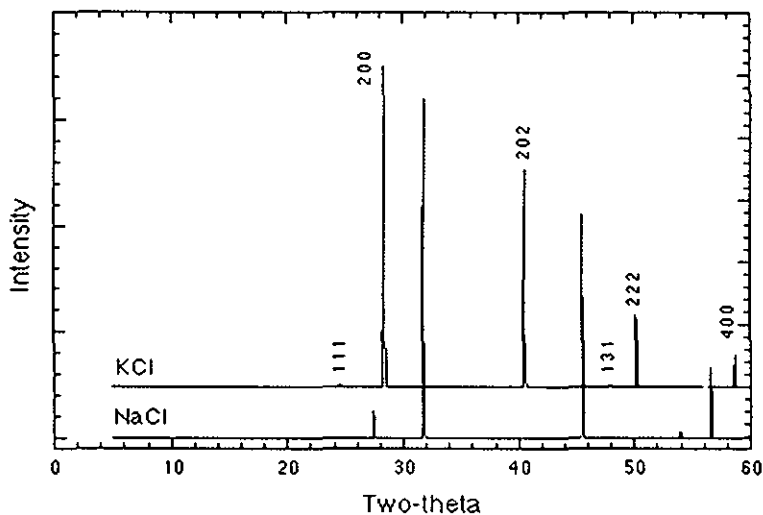


Figure 1. X-ray powder diffraction patterns of NaCl (bottom) and KCl (top).

- a. Mention three (3) features of a diffraction pattern that defines a unique fingerprint X-ray powder pattern for every crystalline material.
- b. Compare X-ray diffraction patterns for the isostructural compounds; NaCl and KCl in Figure 1.
- c. Draw a schematic representation of an X-ray powder diffractometer and explain the principles of powder X-rays diffraction method.

[25 Marks]

2. Silver nanoparticles can be synthesized by reducing Ag^+ ions using fresh Sodium Borohydride.

- a. State and explain four (4) characterization techniques used for studying silver nanoparticles
- b. Name a physical property of silver that changes at the nanoscale.
- c. What effect might a large variance in particle size have on the width of the absorbance peak in the visible spectrum?

[25 Marks]

3. Draw a schematic of the band structures of an insulator, a semiconductor, and a metallic material. Use this to explain why the conductivity of pure metals decreases with increasing temperature, while the opposite is true for semiconductors and insulators.

[25 Marks]