

UNIVERSITY OF GHANA

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SCHOOL OF ENGINEERING SCIENCES

BSc. (Eng) MATERIALS SCIENCE AND ENGINEERING

SECOND SEMESTER EXAMINATIONS 2014/2015

MTEN 306-MATERIALS LABORATORY II (1 CREDIT)

TIME- 1Hr 30min

ANSWER ALL QUESTIONS

SECTION A

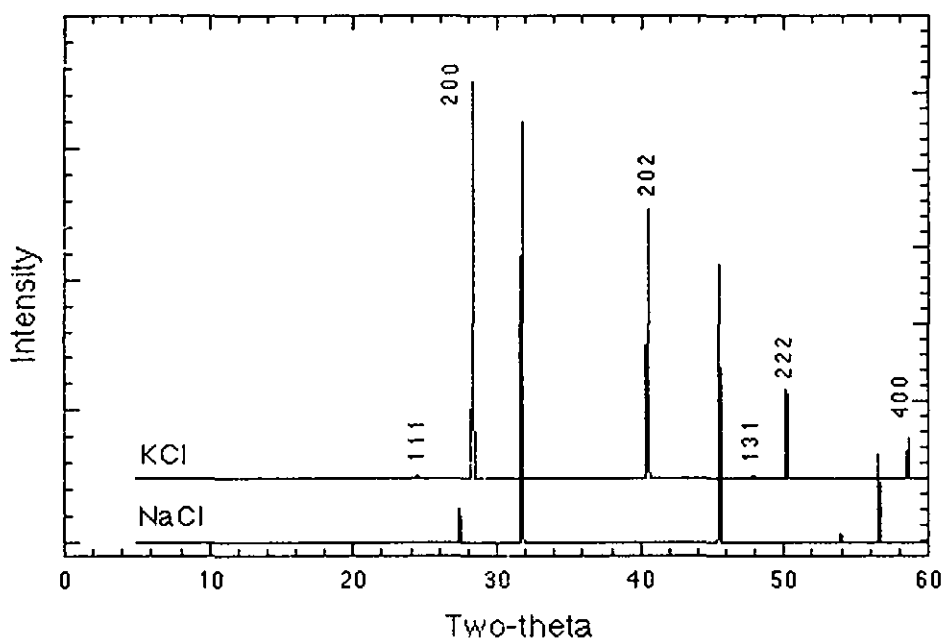
1.
  - a. Briefly describe the principle of operation of the metallurgical microscope. (5 marks)
  - b. Briefly describe the steps involved in the preparation of a sample to be viewed under the metallurgical microscope. (5 marks)
  - c. Name two (2) equipment used in the preparation of a biological specimen for transmission electron microscopic analysis. (2 marks)
  - d. Why is it necessary to prepare a specimen before examination with the microscope? (3 marks)
2.
  - a. During a Materials laboratory experimental class, you are given a piece of silicon to analyse, briefly explain the reasons why you will use an X-Ray diffraction technique instead of microscopy to determine microstructure or crystalline structure of a material. (5 marks)
  - b. What is the minimum accelerating voltage that must be applied to produce Cu  $K\alpha$  line? (2 marks)
  - c. Briefly describe the two ways you will use in preparing a powder sample for X-ray diffraction experiment. (5 marks)
  - d. Name three (3) types of electron guns and describe the sources of the following: secondary electrons, Auger electrons and unscattered electrons. (6 marks)
3.
  - a. Briefly describe the following types of electron microscopes: Transmission electron microscope, Scanning electron microscope and Scanning Transmission microscope. (6 marks)
  - b. State 5 differences between a Transmission electron microscope and a Light Microscope. (5 marks)

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- c. What is the meaning of the figures 10/0.25 written on an objective lens? (2 marks)
- d. A compound light microscope uses green light ( $\lambda=0.52\mu\text{m}$ ) to image a specimen through an objective lens with numerical aperture of 1.4. Calculate the resolving power of this microscope. (4 marks)

## SECTION B

1. The figure below shows X-ray powder diffraction patterns of NaCl and KCl. Peaks in the diffraction patterns are labelled with Miller indices,  $h k l$ , indicating the set of lattice planes responsible for that diffraction peak.



- a. Mention three (3) features of a diffraction pattern that define a unique fingerprint x-ray powder pattern for every crystalline material. (6 marks)
- b. Compare the X-ray diffraction patterns of the isostructural compounds NaCl and KCl in the figure and explain why the KCl peaks are shifted to lower angles relative to the NaCl pattern. (6 marks)
2. You have been provided with a piece of rock mineral sample for observation and analysis.
- How will you prepare a thin section of the sample in order to observe the rock forming minerals under the metallurgical microscope? (2 marks)
  - Describe how you will prepare your rock mineral sample for analysis with the XRD and XRF. (2 marks)
  - Briefly explain the difference between the X-ray diffraction (XRD) and the X-ray fluorescence (XRF). (4 marks)