

National University of Lesotho
Faculty of Agriculture – Department of Soil Science
Final Examination

SSR 313 - Soil Chemistry:
Programmes: BSc Agriculture (Soil Science)
Year 3

December 2017

100 Marks

Time: 3 Hours

Instructions

Answer any Five (5) Questions

Question 1

Briefly describe the following (4 marks each)

- a) The clay fraction of soils
- b) The primary silicates
- c) Secondary Silicates
- d) The nature of coordination in silicates
- e) Mica minerals

Question 2

Briefly describe the following mineral groups and their implications in soil chemistry applications (10 marks each)

- a) Kaolinite group
- b) Smectite group

Question 3

Fill in the blanks and do not re-write the question.

- a) Most of the chemical reactions of soil clays are surface phenomena, for example, CEC and adsorption of water. (2 marks each):
 - i) Clay surfaces can be divided into three groups as follows: Surfaces formed mainly by a) _____ b) _____
c) _____
 - ii) _____ are surfaces characterized by surface planes of oxygen atoms underlain by Si atoms of the tetrahedrons
 - iii) _____ are surfaces characterized by planes of exposed hydroxyl groups underlain by Al, Fe or Mg atoms in the center of the octahedrons.

- b) Briefly discuss the nature of charge and cation requirement to balance charge in tectosilicate minerals where Al^{+3} isomorphically substituted for Si^{+4} , for example, Feldspar. (10 marks)

Question 4

- a) Briefly explain the diffuse double layer concept (6 marks)
b) Illustrate the Helmholtz double layer concept (2 marks)
c) Illustrate the Gouy-Chapman DDL concept model (2 marks)
d) Briefly compare and contrast the Helmholtz and Guoy-Chapman models highlighting the associated electrical potential distributions (10 marks)

Question 5

- a) Briefly describe isomorphous substitution as a source of negative charge in soils (5 marks)
b) Compare and contrast permanent and variable charge concepts and /or principles (10 marks)
c) Briefly describe the concept of the zero point of charge (5 marks)

Question 6

- a) Briefly discuss the major grouping of the elements in the periodic table (10 marks)
b) Briefly compare and contrast ionic and covalent bonds providing some examples to illustrate your answer (5 marks)
c) Briefly compare and contrasts the significance of chemical bonds in soil minerals (5 marks)

Question 7

Discuss the effects of flocculation and dispersion on plant growth (20 marks)