



MACHAKOS UNIVERSITY

University Examinations for 2017/2018 Academic Year

SCHOOL OF AGRICULTURAL SCIENCES

DEPARTMENT OF AGRICULTURAL EDUCATION AND EXTENSION

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR BACHELOR OF
SCIENCE IN AGRICULTURAL EDUCATION AND EXTENSION

KRM 304: SOIL AND WATER MANAGEMENT

DATE:18/12/2017

TIME:8.30-10.30 AM

Instructions: Answer question ONE and any other TWO questions

QUESTION ONE (30 MARKS)

What are the main objectives of studying soil and water management (8 marks)

- a) Differentiate the soil structure and soil texture (2 marks)
- b) A soil sample contains 75 meq Na^+/L , 15 meq Ca^{2+}/L , and 10 meq Mg^{2+}/L . What is the SAR of this soil? (4 marks)
- c) Explain how Irrigation-induced erosion can be managed (3 marks)
- d) State how compaction by wheel traffic, cultivation equipment, animals or natural processes affect soil water movement (3 marks)
- e) Explain three management practices that prevent solute contamination (6 marks)
- f) Explain how burning of residue causes erosion (2 marks)
- g) Explain how tillage and compaction affect infiltration (2 marks)

QUESTION TWO (20 MARKS)

- a) What are the properties of salt affected soils (3 marks)
- b) Briefly explain the characteristics of the salt affected soils (9 marks)

- c) Explain the procedure for reclaiming saline soils (4 marks)
- d) The EC_{iw} of a farmer's irrigation water is 3 mmhos/cm and it is being used to grow sugar beets which have a EC_t of 7 mmhos/cm. How much total water is required in order to maintain productivity? Assume sugar beets have a seasonal water requirement of 76.2cm for ET and rainfall does not contribute to crop water use. (4 marks)

QUESTION THREE (20 MARKS)

- a) Explain briefly the process of soil erosion due to water (3 marks)
- b) Soil saturation and permanent wilting point are soil water conditions that affect plant growth. Explain how each condition affect plant development (6 marks)
- c) Define the terminologies persistence and mobility as agrochemical properties influencing pesticide fate and transport (4 marks)
- d) A wheat farmer wants to measure soil water content before planting. The soil in this field is a sandy loam with an estimated average PAW of 3.81cm/m of soil. Over the current growing season this producer recorded 12.7cm of rainfall, harvested 4ton/ha of wheat and estimated a 91.44cm. rooting zone. Calculate WUE for the farmer to assist him in future crop planning (7 marks)

QUESTION FOUR (20 MARKS)

- a) With the help of a sketch, explain water movement in a soil. (5 marks)
- b) Explain in detail why the determination of Electrical conductivity (EC) and sodium adsorption ratio (SAR) are important in assessing the quality of irrigation water (3 marks)
- c) A farmer presents you with some analysis from a saturated paste extract. The following were measured: Na⁺ = 412 mg L⁻¹, Ca²⁺ = 28 mg L⁻¹, Mg²⁺ = 10.5 mg L⁻¹, EC = 197 mS m⁻¹ (Molar masses are Na⁺=23, Ca²⁺=40.1 and Mg²⁺=24.3).
 - i. Calculate the SAR for this soil. Show your calculations. (5 marks)
 - ii. What can you deduce about this soil from the SAR and EC values? (2 marks)
 - iii. How would you propose the farmer go about remediating the condition? (5 marks)

QUESTION FIVE (20 MARKS)

- a) Give examples of three colloidal materials present in a soil. (4 marks)
- b) In each case, explain the influence of colloidal material on soil properties. (6 marks)
- c) Maize is to be grown in an area with an annual rainfall of 550 mm. The estimated water requirement from irrigation is 800 mm. The salinity level in the irrigation water is 200 mSm^{-1} , while the tolerable EC level of water draining from the root zone is 1500 mSm^{-1} .
- i. Determine the leaching requirement (LR). (5 marks)
- ii. What is the total depth of irrigation water (D_i) that must be applied to achieve this leaching? (5 marks)

Equations

1. $\text{EC}_{i+r} = D_i \cdot \text{EC}_i / [D_i + D_r]$
2. $\text{LR} = \text{EC}_{i+r} / \text{EC}_d$
3. $D_{i+r} = (D_i + D_r) / (1 - \text{LR})$
4. $D_i = D_{i+r} - D_r$