

GWANDA STATE UNIVERSITY



FACULTY OF LIFE SCIENCES

DEPARTMENT OF CROP SCIENCES

BACHELOR OF SCIENCE (HONOURS) DEGREE IN CROP SCIENCE

LCS 1104 INTRODUCTION SOIL SCIENCE

FIRST SEMESTER EXAMINATION

February 2022

This examination paper consists of 4 pages

Time Allowed: 3 hours

Special Requirements: Calculator, Soil texture triangle

Examiner's Name: Mathema. N

INSTRUCTIONS

1. Answer **all** questions in Section A
2. Answer **two** questions in Section B

MARK ALLOCATION

QUESTION	MARKS
SECTION A	60
SECTION B	40
TOTAL ATTAINABLE MARKS	100

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SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

Question 1

A farmer took his three soil samples to a laboratory and obtained the following data:

Soil texture: soil sample A = 85% sand, 10% silt and 5% clay

Soil texture: soil sample B = 10% sand, 20% silt and 70% clay

Soil texture: soil sample C = 35% sand, 30% silt and 35% clay

Bulk density: soil sample A = 1500kg m^{-3}

Bulk density: soil sample B = 1100kg m^{-3}

Bulk density: soil sample C = 1300kg m^{-3}

- Determine the type of soil for each of the three soil samples (A, B and C) using the texture triangle [3]
- Assuming that particle density for each soil sample is equal to 2600kgm^{-3} . Calculate the % pore space for each of the soil samples? [10]
- From the results obtained in part b) explain the relationship between bulk density and porosity. [2]
- Explain the difference in soil porosity between soil sample A and B [5]

Question 2

With the aid of a diagram, (5)

describe the characteristics of the following soil layers (horizons) that you normally see when you dig two (2) meter deep soil pits

- O horizon [3]
- A horizon [3]
- B horizon [3]
- C horizon [3]
- R horizon [3]

Question 3

a) Outline the structure of the following Alumino-silicate clays, clearly stating the; ratio of octahedral to tetrahedral sheets, bonding between layers, surface area, physical stability and degree of swelling due to water absorption:

- Kaolinite [3]
- Montmorillonite and Vermiculite [3]

iii. Hydrous Mica

[3]

iv. Chlorites

[3]

b) Using your knowledge of Aluminosilicate clays, explain why Vermiculite is used as one of the materials for preparing seedling growth medium.

[2]

c) Discuss why the red soils found around Filabusi and Harare are less value to farmers than the black soils found in Nyamandlovu or Chisumbanje under the following headings;

i) Reactions leading to their formation

[2]

ii) Types of clay

[2]

iii) Nutrient and water holding capacity

[2]

SECTION B: ANSWER ANY TWO QUESTIONS IN THIS SECTION

Question 4

Suppose you are asked to explain the difference in the texture and colour of soils found in Zimbabwe by one of the newspapers, outline how you would do so using the following Jenny's soil forming factors;

a) Climate

[6]

b) Parent material

[6]

c) Time

[2]

d) Relief or topography

[3]

e) Organisms

[3]

Question 5

You have been assigned to irrigate a Maize crop and obtained the following data for your soil profile:

Soil Horizon	A	B1	B2
Horizon/Root depth (mm)	0-150	150- 400	400- 900
Wilting point (mm mm^{-1})	0. 15	0.21	0. 19
Field capacity (mm mm^{-1})	0. 35	0.46	0.39

- a) Calculate the Available Water Capacity (AWC) of each horizon in $\text{mm } 100 \text{ mm}^{-1}$
[3]
- b) Calculate the PAW of each horizon
[3]
- c) Calculate the total PAW in all three horizons
[3]
- d) Briefly Outline the difference in frequency of irrigation cycles between light and heavy textured soils.
[2]
- e) Justify the importance of managing the Carbon to Nitrogen ratio of a soil.
[9]

Question 6

Classify soil organisms or biota under the following headings;

- a) Size
[6]
- b) Mode of nutrition (Auto or Heterotrophs)
[6]
- c) Oxygen requirements
[3]
- d) Evolutionary development
[5]

Question 7

- a) Describe how soil microorganisms breakdown carbon rich compounds in the process reducing the carbon to nitrogen ratio.
[15]
- b) Outline the effect of organic matter on soils
[5]

Question 8

- a) Define Cation Exchange Capacity (CEC)
[2]

b) Outline the sources of negative charge in soils

[10]

c) Illustrate four (4) causes of salinity in agricultural soils, two (2) from non-irrigated and two (2) from irrigated lands [8]

END OF EXAMINATION PAPER