AFRICA UNIVERSITY
A United Methodist-Related Institution

COLLEGE OF HEALTH, AGRICULTURE AND NATURAL SCIENCES

NACP 101: INTRODUCTION TO SOIL SCIENCE

AUGUST/ DECEMBER 2020

LECTURER: MRS. S. MBIZI

DURATION: 24 HRS

INSTRUCTIONS

Answer any ONE question from any of the options 1, 2 and 3.

All working for numerical answers must be shown.

The intended number of marks is given in brackets at the end of each question.

Begin your answer for each question on a new page.

Question 1

You have completed soil analyses on three different soils that a farmer has brought into your laboratory. The three soils A, B and C have the following exchange cations in their top soils (0-15cm depth), expressed in $mmoles_c\ kg^{-1}$.

Analysis	Soil A	Soil B	Soil C
Exchangeable Ca	45	10	15
Exchangeble Mg	58	4	20
Exchangeable K	3	2	1
Exchangeable Na	2	0	8
Exchangeable H.	1	5	1
CEC	109	21	45
pH	7.2	4.8	7.8
Porosity %	51.9	32.1	30

a) Draw up a table for these three soils showing their

i. Total exchangeable bases (TEB)
ii. Percentage base saturations (% BS)
iii. Percentage hydrogen saturations (% HS)
iv. ESP values
v. Ca/Mg ratios (15)

vi. Which of the soils is likely to be clay soil? Justify your answer. (3)

vii. Comparing the Ca /Mg ratios of the three soils, which soil is likely to give problems when cropped? Explain why? (3)

viii. Using the answers from (vi) to (vii) above, which soil would you recommend the farmer to crop, and why? (3)

ix. What problem do you think might arise in terms of availability of other crop nutrients by comparing soil pH for B and C? (5)

x. What detailed advice would you give the farmer B to improve the pH of the soil for cropping? (5)

xi. Assessing soil pH, ESP value and soil porosity for farmer C, what problem would you think might arise in terms of cropping the soil? (5)

xii. What advice would you give to farmer B to do first if he wants to grow a crop in this soil? (5)

xiii. Describe the reduction process by which the availability of two plant nutrients is likely to decrease in poorly drained soils (6)\

b) Discuss the four main groups of Aluminisilicate clays. (25)

c) Discuss the factors that influence soil pH and nutrient availability under cultivated land. (25)

Question 2

a) Four soil cores were obtained from the upper 40cm of sandy loam soil under maize. The soil had been continuously ploughed for the past 10 years. Each core had a volume of $105cm^3$. The cores were oven dried at 105^oc and then weighed and the data entered in the table below.

CORE NO.	**SOIL DEPTH (cm)**	**OVEN DRY MASS (g)**	**BULK DENSITY ($Mg/m^{3)}$**	**POROSITY %**
1.	0 – 10	215	-	-
2.	10 – 20	235	-	-
3.	20 – 30	255	-	-
4.	30 – 40	230	-	-

i. Complete the missing sections in the table showing any formulae used. You need to reproduce this table or show your working on your answer sheet. Assume particle density is 2.60 MgM^{-3} (8)

ii. Comment on the meaning of % porosities obtained above. (4)

iii. Using results from the question above, explain the likely causes of the variations in bulk density down the profile. (3)

b) Discuss the factors that affect Particle density (Dp) (10)

c) Discuss the soil Pedogenic processes that act simultaneously to alter the regolith to give it the acquired characteristics that lead to the development of a soil profile with a distinctive profile that is dictated by factors of soil formation. (25)

d) Describe the reactions caused by water in soil formation citing relevant equations in your answer. (25)

e) (Discuss any four types of soil structure and differentiate between prismatic and columnar structures. (25)

Question 3

a) Discuss the chemical transformations involved in the Nitrogen cycle citing organisms responsible for the transformations. Include relevant equations in your answer. (30)

b) Describe the different Nitrogen loss and gain pathways in Agricultural Cropping Systems. (20)

c) Explain the main distinctions between saline and sodic soils. How can each be reclaimed? What three factors make a sodic soil unsuitable for plant growth? (25)

d) Discuss the following aspects of Organic matter in the soil:
i Influence of organic matter with a high and low C/N ratios on soil fertility. (10)
ii significance under cultivated land. (5)
iii Its influence on soil structure and microorganisms. (10)

END OF EXAMINATION