



1st SEMESTER 2019/2020

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UNIVERSITY OF ESWATINI

MAIN EXAMINATION

PROGRAMME: LEVEL 2

**BACHELOR OF SCIENCE IN AGRONOMY
BACHELOR OF SCIENCE IN ANIMAL SCIE. (DAIRY)
BACHELOR OF SCIENCE IN ANIMAL SCIENCE
BACHELOR OF SCIENCE IN AGRIC. BIO. SYST. ENG.
BACHELOR OF SCIENCE IN AGRIC. EDUCATAION
BACHELOR OF SCIENCE IN AGRIC. EXT
BACHELOR OF SCIENCE IN HORTICULTURE**

COURSE CODE:	CPR 205
TITLE OF PAPER:	INTRODUCTION TO SOIL SCIENCE
TIME ALLOWED:	2 HOURS
INSTRUCTIONS:	ANSWER ALL QUESTIONS in Sections A & B

DO NOT OPEN THIS QUESTION PAPER UNTILL YOU ARE TOLD

SECTION A: Answer all Questions [60 Marks]

Question 1: A _____ is a group of soils found together in a landscape but differing in internal drainage class because of their slope position.

- a. soil family
- b. soil association
- c. soil union
- d. soil catena
- e. lithosequence

Question 2: When making a soil survey, soil scientists dig soil profile pits primarily for the purpose of _____.

- a. characterizing and describing the different types of soils that exist in the area
- b. locating the boundaries between adjacent soils in the field
- c. obtain samples and data points used in making computer-generated soil maps
- d. determining seasonal changes in water table depths that define drainage classes
- e. all of the above

Question 3: A typical field soil profile description is written in a standard format and for each horizon in the profile includes information such as _____.

- a. the cation exchange capacity (cmol(+)/kg)
- b. the Munsell color designation (e.g., 10YR 4/4)
- c. the percentage of sand, silt, and clay (by weight)
- d. the spectral reflectance for iron oxides
- e. all of the above

Question 4: Which of the following is a Munsell soil color designation that would likely indicate the horizon with the greatest content of organic matter?

- a. Ap
- b. Oa3
- c. 10YR6/6
- d. 10YR 8/1
- e. 10YR 2/2

Question 5: The mineral portion of a soil is composed (by weight) of 23% clay and 55% sand. What is the percentage that consists of silt? Assume that there is no gravel in this soil material.

- a. 78%
- b. 32%
- c. 22%
- d. 39%
- e. not possible to calculate

Question 6: You dig a small hole in the surface soil to a depth of about 15 cm. You are careful to collect (in a jar) all of the soil removed to make the hole. You then pour dry, fine sand into the hole until it is flush with the surrounding undisturbed soil. You begin with a 4-liter cylinder full of dry sand and end up with just 2.45 L of sand left. Later, you thoroughly dry the jar full of soil in an oven. The jar full of dry soil weighs 2,548 grams, while the empty jar weighs 300 g. What was the bulk density of the soil in place before it was disturbed?

- a. 0.92 Mg/m^3
- b. 1.45 Mg/m^3
- c. 1.64 Mg/m^3
- d. 2.65 Mg/m^3
- e. 1.04 Mg/m^3

Question 7: Which of the following is NOT an example of the soil forming process, "additions"?

- a. clay accumulation in the B horizon
- b. plant litter accumulation in the O horizon
- c. salt left behind by the evaporation of salt-laden groundwater
- d. dust deposited on the soil surface
- e. sulfur in acid rain

Question 8: The development of a mature soil profile with many distinct horizons is promoted by processes such as _____.

- a. pedoturbation
- b. illuviation
- c. erosion
- d. flooding
- e. all of the above

Question 9: The "weathering" of rocks and minerals refers to _____.

- a. their physical breakup into smaller particles and their chemical alteration into dissolved ions and new types of minerals
- b. the formation of soil horizon distinctions because of the effects of rain, snow, freezing temperatures, heat, atmospheric pressure, and other weather-related conditions
- c. the joining of basic elements in the earth's crust to form the minerals found in igneous rocks
- d. all of the above are correct
- e. none of the above

Question 10: Compared to that in large soil pores, water found in small soil pores _____.

- a. has a higher energy level
- b. is held more tightly by the soil
- c. is easier for plant roots to take up
- d. is more susceptible to percolation by gravity
- e. has a higher soil water potential

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Question 11: Which of the following is a cation?

- a. O_2
- b. CO_2
- c. CO_3^{2-}
- d. Cl^-
- e. K^+

Question 12: In cation exchange reactions, hydrated cations adsorbed to the surface of a colloidal particle are replaced by _____.

- a. an equivalent number of water molecules
- b. other hydrated cations
- c. an equivalent number of anions
- d. shared electrons
- e. covalent bonds

Question 13: Soil colloids are, by definition, _____.

- a. made up of mineral matter
- b. made up of organic (humic) matter
- c. crystalline in nature
- d. negatively charged
- e. smaller than 1 or 2 micrometers in diameter

Question 14: The structures of 2:1 clay minerals are so named because they contain _____.

- a. two cations for every anion
- b. two negative charges for every positive charge
- c. two oxygens for every hydroxyl
- d. two tetrahedral layers for every octahedral layer
- e. two internal surfaces for every external surface

Question 15: Isomorphous substitution creates net negative charges in clay micelles. A typical example of this process is the substitution of _____.

- a. two Na^+ ions for one Ca^{2+} ion
- b. an inner sphere complex for an outer sphere complex
- c. one O^{2-} for one OH^- in a tetrahedral
- d. Mg^{2+} for Al^{3+} in an octahedral
- e. both answers 3 and 4 above

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Question 16: A pedon is _____.

- a. a layer of soil material that has properties contrasting with those of adjacent soil layers
- b. the lowest, most specific category in soil classification, equivalent to a species in biological classification
- c. the highest, most general category of soil classification, similar to a kingdom in biological classification
- d. a column of soil that underlies just enough land area so that it exhibits all the properties characterizing a particular soil
- e. a clump of soil particles that are naturally aggregated to form a defined shape

Question 17: Which list of soil orders proceeds from the least to the most highly developed and weathered profile?

- a. Vertisols, Entisols, Ultisols
- b. Vertisols, Alfisols, Oxisols
- c. Vertisols, Oxisols, Mollisols
- d. Spodosols, Vertisols, Mollisols
- e. Aridisols, Inceptisols, Entisols

Question 18: Soils in which of the listed soil orders are LEAST likely to contain argillic horizons?

- a. Inceptisols
- b. Mollisols
- c. Alfisols
- d. Ultisols
- e. Aridisols

Question 19 .Which of the following soil pH levels indicates an alkaline soil?

- a. pH = 5.5
- b. pH = 6.5
- c. pH = 7.5
- d. none of the above indicates an alkaline soil
- e. additional information is needed to answer

Question 20: When describing soil profile on the field, which of this is correct?

- a. Describe all the site
- b. Describe the soil horizons
- c. Use soil Munsell charts for color description
- d. Collect soil samples from the bottommost horizons
- e. All are correct

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Question 21: A soil with a high CEC and pH buffering capacity would likely exhibit a high degree of _____ with regard to the effects of acid precipitation.

- a. resilience
- b. soil quality
- c. sensitivity
- d. resistance
- e. biodiversity

Question 22: Which of the following is NOT an essential plant nutrient?

- a. Hydrogen
- b. Carbon
- c. Zinc
- d. Aluminum
- e. all of the above are not essential to plants.

Question 23: Which of the following is a plant micronutrient supplied from soil solids (minerals and organic matter)?

- a. Phosphorus
- b. Magnesium
- c. Sulfur
- d. Oxygen
- e. Copper

Question 24: In a soil that contains all of these horizons, which one would be on the top?

- a. A horizon
- b. B horizon
- c. C horizon
- d. E horizon
- e. O horizon

Question 25: In a soil that contains all of these horizons, which would be on the bottom?

- a. A horizon
- b. B horizon
- c. C horizon
- d. E horizon
- e. O horizon

Question 26: Compared to the B horizon, the A horizon is likely to be higher in _____.

- a. clay
- b. organic matter
- c. unweathered rock
- d. carbonates
- e. all of the above

Question 26: Which of the following soil constituents is (are) usually present as colloidal particles?

- a. sand
- b. silt
- c. clay
- d. humus
- e. both clay and humus

Question 27: Most arid and semi-arid region soils have pH levels between _____.

- a. 2-4
- b. 4-5
- c. 5-6
- d. 7-8
- e. 9-10

Question 28: The amount of hydrogen ions (H^+) in the soil solution is indicated by the _____.

- a. Eh
- b. texture
- c. CEC
- d. pH
- e. H-index

True/False?

Question 29: The difference between cation exchange capacity of a soil and the effective cation exchange capacity is that the former can be estimated by Ammonium acetate method and the latter by summation of soil base cations in the soil. (True/False).

Question 30: Excessive liming of an acidic soil will be beneficial to the soil microorganisms and crop plants without considering the amount of lime that is required. (True/False).

SECTION B: Answer all questions [40 Marks]

Question 1: Diagram below showed three profile pits (1.50m) dug at Luyengo campus.

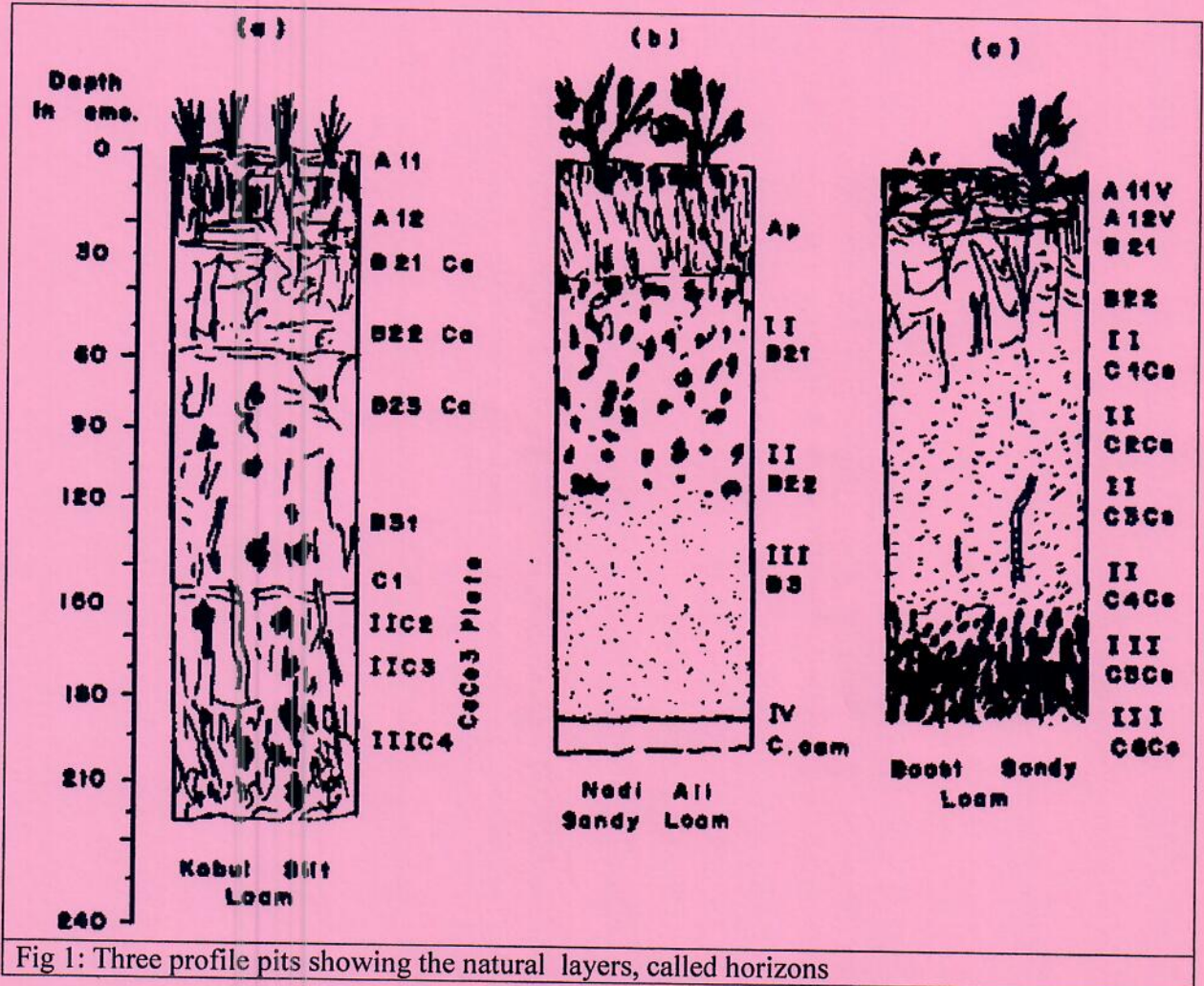


Fig 1: Three profile pits showing the natural layers, called horizons

- Mention at least five morphological properties that can be used to describe these profile pits [5 marks]
- Describe how you will sample the soils for laboratory analyses [10 marks]

Question 2: Data shown in Table 1 below is the result of the soil physical and chemical properties from the soil in Luyengo Campus. Calculate the following properties for all the horizons:

- (i) sand proportions (g/kg) [5 marks],
(ii) the effective cation exchange capacity (ECEC) [5 marks]
(iii) In which Soil Orders of the USDA can you place these two pedons? [5 marks]
(vi) How will you manage these soils for the cultivation of maize crop in Eswatini? [5 marks]
(v) Silt: Clay ratios and what is the importance of this ratio? [5 marks]

Table 1: Selected Physical and chemical properties of a wetland soil at Luyengo, Campus

Profile pits	Horizon	Depth (cm)	Sand	Clay	Silt	SOC %	SOM	BD* (g/cm ³)	ECEC [†]	Na ⁺	Mg ²⁺	Ca ²⁺	K ⁺	pHw
----- Profile Pit 1 TypicPaleustent -----														
1	O	0-25		12	30.72	3.20		1.52		0.16	0.70	0.18	0.20	4.97
1	A	25-50		14	26.72	2.52		1.50		0.15	0.98	0.18	0.47	4.88
1	Bw1	50-75		10	20.72	2.00		1.57		0.36	1.54	0.26	0.21	5.25
1	Btw1	75-105		14	22.72	1.09		1.62		0.78	0.90	0.26	0.21	5.14
1	C	105-120		6	34.72	0.98		1.49		0.57	0.72	0.71	0.17	4.83
----- Profile Pit 2 TypicPaleustult -----														
2	O	0-25		12	28.72	0.25		1.61		0.37	0.89	0.41	0.20	5.34
2	A	25-50		10	15.28	0.26		1.72		0.43	0.77	0.88	0.10	5.40
2	Bw1	50-75		10	22.72	0.15		1.75		0.30	0.68	0.78	0.47	4.97
2	Btw1	75-105		12	20	0.20		1.80		0.18	1.74	0.85	0.21	4.80
2	C	105-120		8	24.72	0.06		1.82		0.64	0.84	0.16	0.31	4.90

SOC= soil organic carbon; BD= bulk density; ECEC= effective cation exchange capacity; pHw=pH in water