higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

SOIL SCIENCE

NQF LEVEL 3

(1011003)

19 November 2019 (X-Paper)
09:00–12:00

This question paper consists of 11 pages.

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TIME: 3 HOURS
MARKS: 150

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Start each section on a NEW page.
5. Use only blue or black ink.
6. Write neatly and legibly.

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SECTION A

QUESTION 1

Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.15) in the ANSWER BOOK.

1.1 The two main forces that hold water in soil are …

A adhesion and cohesion.
B hydrogen and covalent bond.
C ionic and polar covalent bond.
D pull and push.

1.2 Soil that lacks oxygen and may cause the roots to eventually suffocate and rot is called … soil.

A aerobic
B anaerobic
C drought
D loamy

1.3 pH scale is used to measure the chemical reaction in soil and readings from 7 to 14 indicate … soil.

A extremely acid
B neutral
C alkaline
D acidic

1.4 The comfort zone for most plants is between a pH of … and …

A 4; 7.
B 6; 7.
C 3; 8.
D 5; 7.

1.5 A shortage of water in plant tissue is called …

A water stress.
B transpiration.
C respiration.
D photosynthesis.

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1.6 The instrument that accurately measures soil moisture content and can monitor wetting and drying phases in soil:

A Class A evaporation
B Tension meter
C Neutron hydroprobe
D pH meter

1.7 The best time to irrigate crops is when …

A the soil is completely dry.
B the soil is saturated.
C plants have reached permanent wilting point.
D the soil is fairly wet.

1.8 Marginal chlorosis refers to the yellowing of the margins of the leaf. Choose ONE element of which a deficiency causes marginal chlorosis.

A Nitrogen
B Iron
C Calcium
D Magnesium

1.9 Which ONE of the following terms represents the condition where drops of water move out along the small pores of the leaves?

A Necrosis
B Chlorosis
C Transpiration
D Guttation

1.10 After soil analysis, phosphorus was found to be deficient.

Which ONE of the following mixed fertilisers will correct this deficiency?

A 3:4:3 (30)
B 3:2:1 (25)
C 2:3:4 (40)
D 3:2:0 (25)

1.11 … is conversion of organic elements to inorganic forms through the decomposition process.

A Immobilisation
B Mineralisation
C Denitrification
D Nitrification

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1.12 In a situation where both soil macro-pores and micro-pores are occupied by soil water, the soil is said to be …

A anaerobic.
B sodic.
C drought-prone.
D saturated.

1.13 Which ONE is a method of fertiliser application done by spreading it at the base of the plant?

A Band placing
B Top dressing
C Fertigation
D Hand spreading

1.14 Water that is not tightly held by capillary forces and drains downward through the profile is called … water.

A stationary
B hygroscopic
C cohesion
D free

1.15 An agricultural lime that can be added to acidic soils, especially sandy soils, as they often lack magnesium, is known as …

A calcitic limestone.
B ammonium nitrate.
C dolomitic limestone.
D ammonium sulphate.

(15 × 1) **[15]**

QUESTION 2

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'True' or 'False' next to the question number (2.1–2.5) in the ANSWER BOOK.

2.1 Soil that is transported and deposited away from its origin is called sediment.

2.2 Rangeland is a large, open area for grazing livestock.

2.3 Adhesion is the attraction of water molecules to other water molecules.

2.4 Texture is the portion of soil volume that occupies air and water.

2.5 Structure is the portion of soil volume not occupied by solid particles, but by air and water.

(5 × 1) **[5]**

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QUESTION 3

Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–J) next to the question number (3.1–3.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
3.1	The wearing of land surface by running water, wind, ice or other geological agents, including landslides and soil creep	A	crusting
3.2	The crops planted to reduce nutrient leaching following the main crop	B	ecosystem
3.3	The organic particles that cause soil particles to stick together	C	erosion
3.4	Situation where the top layer of the soil becomes hard and impermeable to roots and water	D	rangeland
3.5	Moving stock from one grazing area to another to give grass or browse time to recover	E	catch crop
		F	overgrazing
		G	rotational
		H	monocropping
		I	humus
		J	animal diversity

(5 × 2) **[10]**

QUESTION 4

Complete the following sentences by filling in the missing word or words. Write only the word or words next to the question number (4.1–4.9) in the ANSWER BOOK.

4.1 Organic fertilisers must first be decomposed by the … in the soil before they are in the correct inorganic forms available to plants. (1)

4.2 Plants have … symptoms when they do not have enough of the essential nutrients. (1)

4.3 … is the activity of preparing the soil for planting crops. (1)

4.4 … is the term used to describe the signs of death in any living tissue. (1)

4.5 Chlorosis refers to a … of the leaf. (1)

4.6 Growth is controlled not by the total resources available, but by the … resource. (1)

4.7 … is a method of growing plants without soil. (1)

4.8 Calcareous soils are soils with a high concentration of free … and … carbonate. (2)

4.9 In terms of water requirements, the … stage of a plant is the most critical. (1)
[10]

QUESTION 5

Give ONE term for each of the following descriptions. Write only the term next to the question number (5.1–5.10) in the ANSWER BOOK.

5.1 The erosion where a thin sheet of soil is removed from the surface

5.2 The irrigation system that supplies water to the root zone and is 95% efficient in terms of water usage

5.3 Squeezing of soil particles together by heavy equipment or animals

5.4 Planting the same crop on the same piece of land year after year without changing

5.5 The situation where water stress causes poor growth and development, causing a plant to be short

5.6 The combined loss of water by evaporation from the soil and transpiration in plants

5.7 Cultivating the soil with ploughs to produce a seedbed by churning the soil

5.8 The method of growing crops that involves no disturbance to the soil and planting the crops in slits

5.9 A small amount of soil taken from different sites on a piece of land or a field

5.10 The water in the soil with ions dissolved in it, and plant nutrients or other materials

(10 × 1) **[10]**

TOTAL SECTION A: 50

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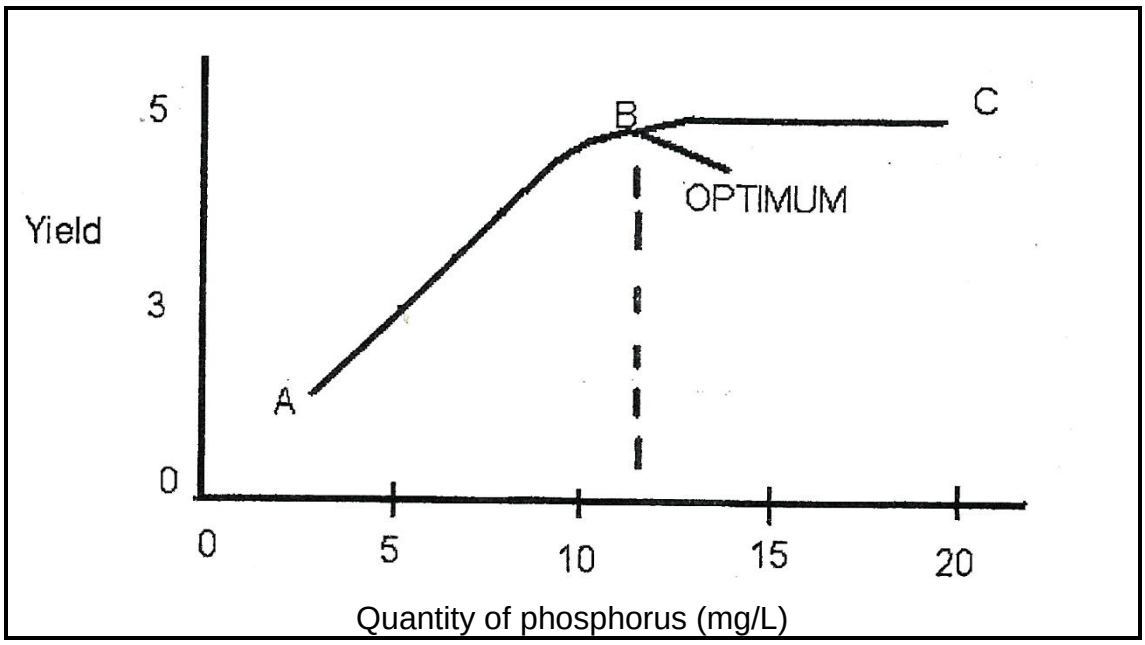
SECTION B

QUESTION 6

6.1 A soil test is of little value if there is no information on the optimum or target values. There must be optimum levels of nutrients for a specific crop to achieve a certain yield.

The graph below indicates the effect of soil phosphorus levels on maize yield. Use the graph to answer the questions.



[Source: *Soil Science NQF level 3, J de Fontaine & F Mitchell*]

6.1.1 Define the term *optimum* or *target values.* (2)

6.1.2 Explain the reasons for soil testing. (2)

6.1.3 What is the relationship between the quantity of phosphorus applied and the maize yield between points A and B? (2)

6.1.4 What is the relationship between the quantity of phosphorus and the maize yield between points B and C? (2)

6.1.5 Determine the optimum amount of phosphorus needed and state the maize yield at that point. (2)

6.1.6 Explain why point B is considered to be the optimum point in terms of the quantity of phosphorus applied. (2)

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6.2 A 50-kg bag of fertiliser mixture has a composition of 2:3:5 (20).

6.2.1 What is the meaning of the figures 2, 3 and 5 in the fertiliser mixture? (3)

6.2.2 Calculate the amount (in %) of each nutrient in the mixture. (6)

6.2.3 A subsistence farmer applies three 50-kg bags of this fertiliser mixture to a small vegetable garden.

Calculate how much phosphorus the farmer has applied. Show ALL your calculations. (4)

[25]

QUESTION 7

7.1 Answer the following questions on animal manure and compost as types of organic fertilisers.

7.1.1 Compare the difference between *animal manure* and *compost.* (4)

7.1.2 Give FOUR factors that are required to create a suitable environment for good composting through micro-organisms. (4)

7.1.3 What are the benefits of using compost? (4)

7.1.4 Explain the reasons why compost is prepared above the ground in the rainy season and protected in a shed. (4)

7.2 Acidic and alkaline soils are examples of problem soils. Fill in the table below. (Copy the table into your ANSWER BOOK.)

	Acidic soils	**Alkaline soils**
Caution responsible		
pH		
Treatment to rectify		

(6)

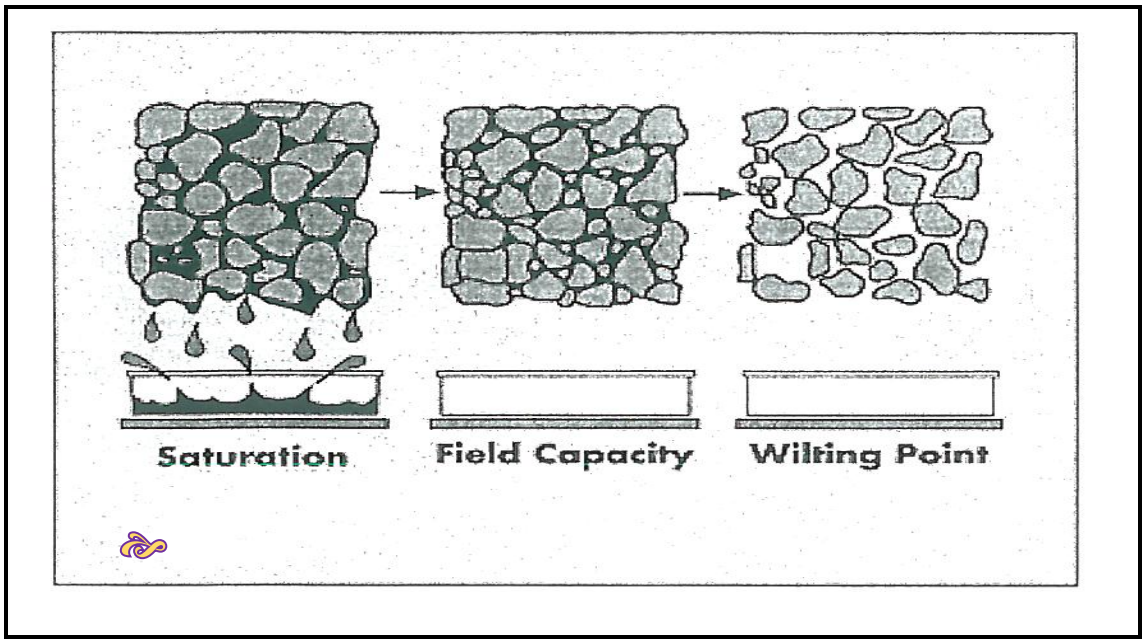
7.3 The acidity and alkalinity of soil can be determined by using litmus paper.

Explain the results when you dip litmus paper in acid, neutral and alkaline soil suspensions. (3)

[25]

QUESTION 8

8.1 Study the THREE stages of soil-water holding capacity below and answer the questions:



[Source: *http://bettersoils.soilwater.com.au/module2/2*]

8.1.1 Define the term *saturated soil.* (2)

8.1.2 Determine the soil texture with good distribution of micro-pores and macro-pores that also contains enough air and water for plant growth. (2)

8.1.3 Which type of water is found in saturated soil? (2)

8.1.4 Explain why saturated soils are unhealthy for crop growth. (3)

8.1.5 When does the soil reach field capacity? (2)

8.2 Describe the signs that show that crops are suffering from water stress in their early stages of development. (3)

8.3 Identify FIVE main factors that influence the rate of evapotranspiration. (5)

8.4 Calculate the total available moisture (TAM) for a cotton crop with a rooting depth of 700 mm. The soil has an available moisture capacity (AMC) of 130 mm/m. (6)

[25]

QUESTION 9

9.1 Answer the following questions on soil erosion:

9.1.1 Name TWO primary physical factors that have the greatest effect on the erodibility of soil. (2)

9.1.2 Distinguish between *soil erodibility* and *erosivity of rainfall.* (4)

9.2 One of the consequences of sheet erosion is crusting.

9.2.1 Define the term *crusting.* (2)

9.2.2 Explain how surface crusting takes place. (4)

9.3 Evaluate the effects of surface crusting on the following:

9.3.1 Soil-water infiltration rate

9.3.2 Plant roots

(2 × 2) (4)

9.4 State FOUR factors that are affected by wind erosion. (4)

9.5 Describe the FIVE methods used to prevent soil erosion in rangelands. (5)

[25]

TOTAL SECTION B: 100
GRAND TOTAL: 150

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