higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

SOIL SCIENCE
NQF LEVEL 3

(1011003)

7 March 2018 (X-Paper)
09:00–12:00

This question paper consists of 13 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. Write neatly and legibly.

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SECTION A

QUESTION 1

1.1 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 (1.1.1–1.1.15) in the ANSWER BOOK.

1.1.1 Most plants grow best at a pH between ...

A 5,5 and 7,0
B 5 and 5,5
C 6,5 and 9,0
D 8,5 and 13

Soil pH controls chemical reactions in the soil. Answer the following TWO questions on the effect of soil pH on the availability of phosphorus.

1.1.2 Which element reacts with phosphorus at a pH above 7,5 and ties it up?

A Iron
B Calcium
C Sulphur
D Nitrogen

1.1.3 Which element reacts with phosphorus at a pH below 5,8 making it an insoluble compound?

A Zinc
B Iron
C Copper
D Calcium

1.1.4 The solution used to cause hydrogen ions to leave the particle surface and enter the soil solution:

A Litmus paper
B Limestone
C Buffer
D pH

1.1.5 The method of growing crops, that involves no disturbance to soil where seeds have been planted into slits in the soil and the soil is protected by residue:

A Minimum tillage
B Ploughing
C Harrowing
D No till or zero tillage

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1.1.6 A 50 kg bag of LAN with 10% active ingredients costs R30,00. How much is nitrogen only?

A R3,00
B R3,14
C R5,00
D R2,50

1.1.7 The two main forces that hold water in the soil:

A Adhesion and cohesion
B Gravity and capillarity
C Cohesion and absorption
D Surface tension and adhesion

1.1.8 A substance that changes colour over a range of pH values:

A pH indicator
B Electric pH meter
C Atomic absorption spectrophotometer
D Electrode

1.1.9 A large corkscrew tool commonly used to bore into the ground to take soil samples:

A Spade
B Disc plough
C Auger
D Digging fork

1.1.10 Fertiliser containing only one element is called a … fertiliser.

A straight
B complete
C mixed
D incomplete

1.1.11 … is the relative proportion of the different soil particle sizes in a given soil.

A Structure
B Till ability
C Micropore
D Texture

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1.1.12 Which ONE of the following is NOT a condition that affects limiting factors?

A Seasonality
B Soil texture
C Type of crop
D Growth stage of crop

1.1.13 ONE of the following materials CANNOT be used to make compost:

A Leaves
B Wood chips
C Soft drink bottles
D Newspapers

1.1.14 The most water-efficient irrigation system:

A Trickle irrigation
B Furrow irrigation
C Sprinkler irrigation system
D Flood irrigation system

1.1.15 Plants absorb nitrogen mostly in the form of …

A nitrogen gas and nitrite.
B ammonium ion and nitrate.
C limestone ammonium nitrate.
D amino acids and nitrite.

(15 × 1) (15)

SAMPLE

1.2 Choose a term(s) from COLUMN B that matches a description in COLUMN A. Write only the letter (A–J) next to the question number (1.2.1–1.2.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
1.2.1	Moving stock from one grazing area to another	A	interveinal chlorosis
1.2.2	Non-indigenous plants that encroach natural vegetation and reduce the area available for grazing	B	potassium
1.2.3	Inorganic ions that form when rock particles are broken down by weathering	C	overall chlorosis
1.2.4	Macronutrient that is very important for fruit development	D	rotational grazing
1.2.5	Yellowing of the leaf tissue between the veins	E	alien plants
		F	nitrogen
		G	mineral salts
		H	animal diversity
		I	essential nutrients
		J	cash crops

(5 × 2) (10)

1.3 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (1.3.1–1.3.5) in the ANSWER BOOK.

1.3.1 The downward movement of water by gravity is called capillarity.

1.3.2 Soil water moves sideways or towards the root zone by percolation.

1.3.3 Evaporation is the loss of water through the surface of the leaf.

1.3.4 Gullies or dongas are large and more permanent features.

1.3.5 Effective rooting depth is the soil depth at which 85–90% of the roots of a particular plant occur.

(5 × 1) (5)

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1.4 Give ONE term for each of the following descriptions. Write only the term next to the question number (1.4.1–1.4.10) in the ANSWER BOOK.

1.4.1 Equipment that accurately calculates soil moisture content and can be used to monitor wetting and drying phases

1.4.2 Soil transported and deposited away from its origin

1.4.3 Microbial conversion of ammonium compounds to nitrates and nitrites

1.4.4 Formation of a thin, compacted layer on the surface of bare soil under the impact of falling drops

1.4.5 Plants that inhibit or slow the growth of other nearby plants by releasing natural toxins or allelochemicals

1.4.6 Process where carbon dioxide is released to react with water to form carbonic acid with the release of a hydrogen ion

1.4.7 Reaction of water with calcium, magnesium and sodium to form hydroxyl ions (OH^+)

1.4.8 Long, narrow line of crop or residue designed to best achieve drying and curing

1.4.9 Large, open area for grazing livestock

1.4.10 Growth and development are very poor, causing a short plant

(10 × 1) (10)

1.5 Complete the following sentences by filling in the missing word or words. Write only the word or words next to the question number (1.5.1–1.5.10) in the ANSWER BOOK.

1.5.1 … is the attraction of water molecules to soil particles.

1.5.2 The water that leaves the bottom of the root zone is called …

1.5.3 In poorly drained soils, the large pores are filled with …

1.5.4 Ploughing where a narrow cut is made in the soil for planting seeds and covered is known as …

1.5.5 A living … is a cover crop that is intercropped with an annual or perennial cash crop.

1.5.6 The pH scale indicates how acidic or alkaline a solution is by giving the number of … ions in the solution.

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1.5.7 … is the term used to describe the amount of water held between the wet and dry soil moisture limits of the field capacity and wilting point.

1.5.8 … is the changing of an organic substance into a nonorganic substance.

1.5.9 … is how fertiliser is spread evenly over the whole area to be fertilised.

1.5.10 … are small amounts of soil taken from different sites on a piece of land or in a field.

(10 × 1) (10)
[50]

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 Differentiate between *essential* and *nonessential* plant nutrients. (2 × 2) (4)

2.2 Macronutrients are grouped into primary and secondary elements.

Give TWO examples of each. (2 × 2) (4)

2.3 The table below shows the components of a modified Hoagland nutrient solution commonly used in hydroponic systems. Complete the table by indicating the nutrients supplied by each of the components of solution.

COMPONENT OF SOLUTION	NUTRIENT OR NUTRIENTS SUPPLIED
Ammonium molybdenum oxide	
Potassium nitrate	
Molybdenum oxide	

(5)

2.4 Mr Nesane needs to know how many kilograms (kg) of each nutrient there are in a bag to meet the recommendations of the laboratory.

The recommendations for a 5 t/ha wheat were as follows:

70 kg/ha nitrogen (N)
60 kg/ha phosphorus (P)
80 kg/ha potassium (K)

The farmer has a 50 kg bag of 2:3:4 (30) fertiliser mixture available.

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2.4.1 Calculate the percentage of nitrogen and phosphorus in the fertiliser. (4)

2.4.2 How much fertiliser does he need to buy to supply the required amount of phosphorus? (4)

2.4.3 How much nitrogen will the fertiliser in QUESTION 2.4.2 supply? (2)

2.4.4 How much more nitrogen would the farmer still need after purchasing the fertiliser in QUESTION 2.4.2 to meet the nitrogen (N) requirement? (2)

[25]

QUESTION 3

3.1 Study the table below, which shows the nutrient content of animal manure (kg of nutrients). Note that ALL the animals were given food of high quality.

ANIMALS	**N**	**P_2O_5**	**K_2O**	**S**	**Ca**	**Mg**
Dairy cattle	4,5	1,8	3,6	0,5	2,7	0,9
Beef cattle	5,0	3,6	4,5	0,5	1,4	0,9
Poultry	10,5	5,0	4,5	1,4	16,4	2,7
Pigs	4,5	1,4	3,6	1,4	5,0	0,9
Sheep	12,7	1,8	9,0	0,9	5,0	1,8
Horses	5,9	2,3	5,9			

3.1.1 Give TWO types of animal manure that have the highest nitrogen content. (2)

3.1.2 Briefly discuss why sheep manure hasa higher nitrogen content than poultry manure. (4)

3.1.3 Good manure management increases economic returns.

Explain briefly what a good storage facility should look like. (4)

3.1.4 Indicate the impact of farm manure on soil microorganisms. (2)

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3.2 Read the following scenario and answer the questions.

Mr Gert Viljoen is a crop farmer who farmed on land that is acidic, but he was unaware of it. After planting his crop, he discovered that the yield of the crop was very poor. He then decided to do soil testing and discovered that the clay soil had become more acidic. Mr Viljoen not only experienced a poor yield, but also discovered that the roots of his crop had been affected.

The image below shows the condition of the crop.



3.2.1 Name FOUR cations found in high concentration in acid soil. (4)

3.2.2 Which cation will mostly affect plant roots at a pH below 4,5? (2)

3.2.3 What signs show that the roots were affected by the cation mentioned in QUESTION 3.2.2?

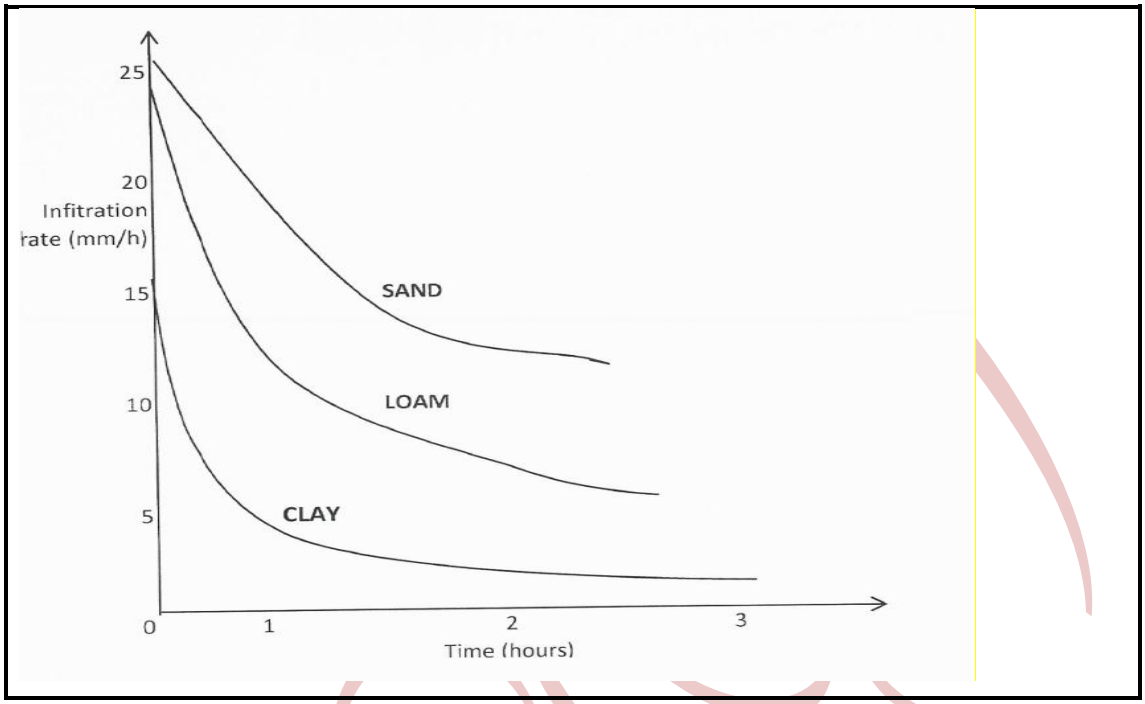
Give THREE of these signs. (3)

3.2.4 Briefly explain how soil that is too acidic will make the yield of the crop very poor. (4)

[25]

QUESTION 4

4.1 Study the graph below and answer the questions.



4.1.1 Define the term *infiltration rate*. (2)

4.1.2 Name THREE factors that influence the infiltration rate in the soil. (3)

4.1.3 According to the graph, sandy soil has a higher infiltration rate than clay soil and it took more hours for the clay to allow infiltration to be completed.

Briefly discuss the reasons for the difference in the infiltration rate. (4)

4.1.4 ListFIVE factors that can be used to increase the infiltration rate. (5)

4.2 Differentiate between a *temporary* and *permanent* wilting point. (2 × 2) (4)

4.3 Indicate any FOUR reasons why over-irrigation would reduce plant growth, development and production. (4)

4.4 Calculate the total available moisture (TAM) for a maize crop with a rooting depth of 500 mm. The soil has an available moisture capacity (AMC) of 90 mm/m.

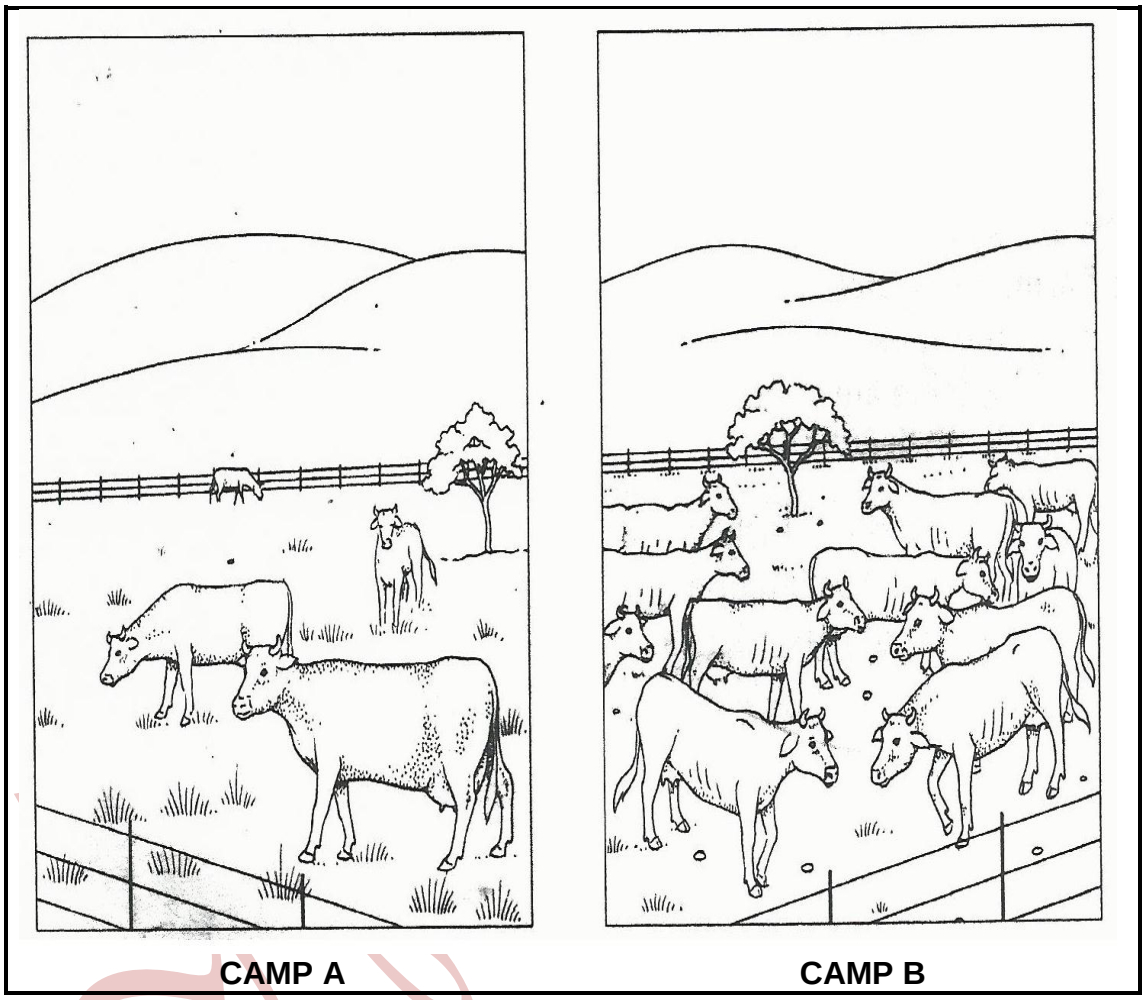
Show ALL the steps of the calculation. (3)

[25]

QUESTION 5

5.1 There are various conservation practices that can be used on rangeland to prevent soil erosion. Restriction on animal numbers (carrying capacity) is one of the conservation practices. The picture below represents this practice.

Use this picture to answer the questions.



CAMP A **CAMP B**

5.1.1 Which paddock (camp) represents the right number of livestock? (1)

5.1.2 Give a reason for the answer in QUESTION 5.1.1. (2)

5.1.3 After observing the two pictures, how would wrong farming practice affect livestock? (2)

5.1.4 Briefly discuss FOUR disadvantages of overstocking or keeping too many animals in the camp. (4 × 2) (8)

5.2 Name FOUR ways in which erosion on cultivated land could be controlled. (4)

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5.3 Describe each of the following types of erosion and explain how they occur:

5.3.1 Splash erosion

5.3.2 Rill erosion

5.3.3 Sheet erosion

(3 × 2) (6)

5.4 Briefly explain how erosion affects soil fertility. (2)
[25]

TOTAL SECTION B: 100
GRAND TOTAL: 150

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