higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

SOIL SCIENCE
NQF LEVEL 3

(1011003)

19 November 2018 (X-Paper)
09:00–12:00

This question paper consists of 14 pages.

NCV

Copyright reserved

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.

NCV

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 Micro-nutrients are so called because ...

A plants require them in very small quantities for their growth, development and production.
B they occur in small quantities in the soil.
C they are very small in size.
D they are marketed in small containers.

1.1.2 One of the following is NOT TRUE about the nutrient 'Oxygen'.

A It is a non-essential plant nutrient.
B Plants obtain it from the atmosphere or from the water as oxygen gas (O_2).
C Together with C and H, they form important components of organic molecules.
D It is an essential plant nutrient.

1.1.3 One of the following is classified as a micro-nutrient.

A Carbon (C)
B Iron (Fe)
C Calcium (Ca)
D Phosphorus (P)

1.1.4 Symbiotic nitrogen fixation in the soil occurs as a result of the ...

A action of free-living micro-organisms such as Nicrosomonas.
B interaction of the bacteria e.g. Rhizobium with leguminous plants such as beans.
C lightning action in the atmosphere.
D interaction between fungi and algae in the soil.

1.1.5 The fertiliser 3: 2: 1 (22) Zn is an example of ...

A a straight nitrogenous fertiliser.
B a straight zinc fertiliser.
C mixture fertiliser.
D organic fertiliser.

Copyright reserved

1.1.6 The main plant nutrient component in Ammonium sulphate is ...

A nitrogen.
B sulphur.
C sodium.
D urea.

1.1.7 The ratio of potassium (K) in the fertiliser 3 : 2 : 4 (40) is ...

A 4%.
B 40%
C 17.8%
D 44.4%

1.1.8 A large open area for grazing livestock is known as ...

A sour veld.
B sweet veld.
C communal land.
D rangeland.

1.1.9 The most important gas released during photosynthesis is ...

A carbon dioxide.
B oxygen.
C nitrogen.
D carbon monoxide.

1.1.10 Plant material A has the C : N ratio of 8:1, while plant material B has the C : N ratio of 60:1. Therefore ...

A plant material A has lower nitrogen content than plant material B.
B plant material B will decompose faster than plant material A.
C plant material A will decompose faster than plant material A.
D plant material A has a higher carbon content than plant material B.

1.1.11 A mechanised irrigation system with wheels to move around the field is …

A a subsurface irrigation system.
B a centre-pivot irrigation system.
C a drip irrigation system.
D drag pipes with main line system.

Copyright reserved

1.1.12 The best time to apply lime is ...

A Several weeks before planting.
B At planting.
C During flowering stage of the crop.
D Once the crop is well established.

1.1.13 The pH of an extremely acid solution is ...

A 14
B 7
C 1
D 5.1

1.1.14 Water loss from the soil surface and plant leaves in a vapour form is known as ...

A evapo-transpiration.
B diffusion.
C evapo-respiration.
D osmosis.

1.1.15 One of the following does not contribute in acidifying the soil:

A Leaching
B Fertilisation of soil
C Liming
D The process of decomposition

(15 × 1) (15)

NCV

1.2 Choose an/a item/word 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	A component of chlorophyll	A	cohesion force
1.2.2	Addition of a fertiliser on a existing crop without incorporating it in the soil	B	H^+
		C	ecosystem
1.2.3	Acidifying ions	D	fertigation
1.2.4	Force that holds the water molecules together	E	adhesion force
		F	magnesium
1.2.5	Community of plants and animals in a particular environment	G	topdressing
		H	OH^-
		I	chlorine
		J	population

(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 agricultural industry is so old and well established that it does not require modern technology.

1.3.2 Most crops prefer the soil pH that ranges between 5.5 and 7.0.

1.3.3 Sodic soils are characterised by high concentration of sodium ions.

1.3.4 Reserved alkalinity occurs as free lime in the soil.

1.3.5 Parallel contours across the slope assist in slowing down water loss through runoff.

(5 × 1) (5)

Copyright reserved

1.4 Complete the following sentences by filling the missing word(s). Write only the word(s). Write only the word(s) next to the question number (1.4.1–1.4.10) in the ANSWER BOOK.

1.4.1 The two nutrients required for regulating osmosis and maintaining salt water balance are chlorine and ...

1.4.2 Plants absorb nitrogen from the soil mainly in the form of nitrate and ... ions

1.4.3 The pH reading on neutral soil solution is ...

1.4.4 ... are wire containers filled with earth or rock mainly used to stabilize the gullies.

1.4.5 In the fertiliser 4 : 3 : 2 (22) the first number (which is 4) represents the macro-nutrient ...

1.4.6 Chlorosis is an indication of lack of ..., which is the photosynthesis pigment.

1.4.7 The acronym (abbreviation) CEC stands for ... adsorption capacity.

1.4.8 With ... type of farming, the farmer plants the same crop year after year.

1.4.9 The downward movement of water through the soil is influenced by ...

1.4.10 Hydrogen ions that have entered the soil solution and are participating in chemical reactions form part of ... acidity.

(10 × 1) (10)

1.5 Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.5.1–1.5.10) in the ANSWER BOOK.

1.5.1 An instrument used to measure surface tension as a measure of moisture

1.5.2 Negatively charged soil components such as clay and humus onto which plant nutrients are adsorbed

1.5.3 Without air or oxygen

1.5.4 The process whereby drops of water are forced out along the margins of the leaves, especially when the temperature is low

1.5.5 A condition where plant leaves droop due to shortage of moisture

Copyright reserved

1.5.6 Soil detached, transported and deposited far from its place of origin

1.5.7 The artificial application of water to soil in the event where rainfall is not adequate to support plant growth, development and production

1.5.8 Chemicals used to control weeds

1.5.9 The acidity levels allowable in the soil for a given crop without affecting yield

1.5.10 A mixture of sample soils taken from different homogeneous sample sites, to be send to the laboratory for analysis

(10 × 1) (10)
[50]

TOTAL SECTION A: 50

SECTION B

QUESTION 2

2.1 Explain the principle or idea of tolerance limits in your own words. Use one plant nutrient as an example to support your explanation. (3)

2.2 Differentiate between *necrosis* and *chlorosis*. (4)

2.3 Experienced farmers may have an extensive knowledge regarding visual nutrient deficiency. However, visual nutrient deficiency symptoms can be misleading.

2.3.1 List THREE reasons why visual nutrient deficiency may present problems. (3)

2.3.2 State what commercial farmers should do to resolve the problems of visual nutrient deficiency symptoms. (1)

2.3.3 Discuss visual change in colour as an indication of nutrient deficiency. Your discussion should be supported by examples. (5)

Copyright reserved

2.4 Read the following paragraphs and answer the questions.

> Mr. Jabu's wife had outstanding financial skills. After her death Jabu's farm deteriorated very fast. Jabu started selling all assets used for crop production to safe his livestock he loved so much.
>
> Piet Hlongoane, an emerging farmer, bought a farm some 400 km away from Jabu's. The farm was not in production for five years and all production records could not be found. On hearing of the sale of assets at Jabu's farm he wasted no time to purchase what he could, including two truckloads of fertilisers. Some of the labels of the fertiliser bags' were completely faded and thus could not be identified.

2.4.1 State what was Jabu's reason for continuing with livestock farming? (1)

2.4.2 Give an opinion on his chances of succeeding on his own, without seeking advice. Give a reason to support your answer. (2)

2.4.3 Indicate what should guide Piet Hlongoane to decide which fertilisers to purchase. (1)

2.5 Calcium is one of the macronutrients essential for plant growth, development and production.

2.5.1 State TWO functions of calcium on plants. (2)

2.5.2 Give ONE symptom of calcium deficiency in plants. (2)

2.5.3 Indicate in which form calcium is absorbed by plants (1)

[25]

QUESTION 3

3.1 Differentiate between *blended fertilisers* and *compound fertilisers*. (4)

3.2 Give TWO reasons why it is important to irrigate the land or garden after the fertiliser was applied by broadcasting. (2)

3.3 For many years farmers used animal manure to fertilise their soils.

List THREE benefits of manure on soil. (3)

Copyright reserved

3.4 A compost heap requires proper treatment to achieve positive results.

Discuss the importance of each of the following related to compost treatment.

3.4.1 Temperature control.

3.4.2 Occasional wetting of the compost.

(2 × 2) (4)

3.2 The following is an abridged sample of a Soil Testing Submission Form.

Study it and answer questions.

Do you want fertiliser options?	Bioclimate
Map and reference (see reverse	Sample date

SAMPLE DEPTH CODE

1. Topsoil sample 4. 45 – 60 cm (subsoil)
2. 15 – 30 cm (subsoil) 5. Over 60 cm (subsoil)
3. 30 – 45 cm (subsoil)

Note. No nutrient or liming recommendations will be given for samples taken depths.

Your sample indication	Our lab number	Previous crop code	Intended crop code			Is crop to be irrigated?	Sampling depth code	Area of land (ha)
			Choice 1	Choice 2	Choice 3			
1		2	10	7	8	Yes	1	2,5
2							3	
3								

Crop codes

1. Maize grain (limited input options)	5. Wheat – winter	9. Sunflower	12. Sugar cane
2. Maize grain	6. Cotton	10. Dry beans	13. Sorghum grain
3. Maize silage	7. Soya bean	11. Lupin	14. Sweet potatoes
4. Potatoes	8. Sunflower		

3.5.1 Name the first choice crop this farmer intends to plant. (1)

3.5.2 Indicate whether the farmer practice or intends to practice crop rotation or monoculture.

Give a reason for your answer. (3)

3.5.3 Indicate the depth to which the farmer collected sample 2. (1)

3.5.4 Deduce from the sample form, practices that would increase this farmer's yield. (2)

Copyright reserved

3.6 A 50 kg bag contains the fertiliser 2 : 3 : 4 (30).

Calculate the active ingredient in this 50 kg fertiliser bag? Show al calculations. (3)

3.7 Explain why clay soils need more lime than sandy soil with the same pH reading. (2)

[25]

QUESTION 4

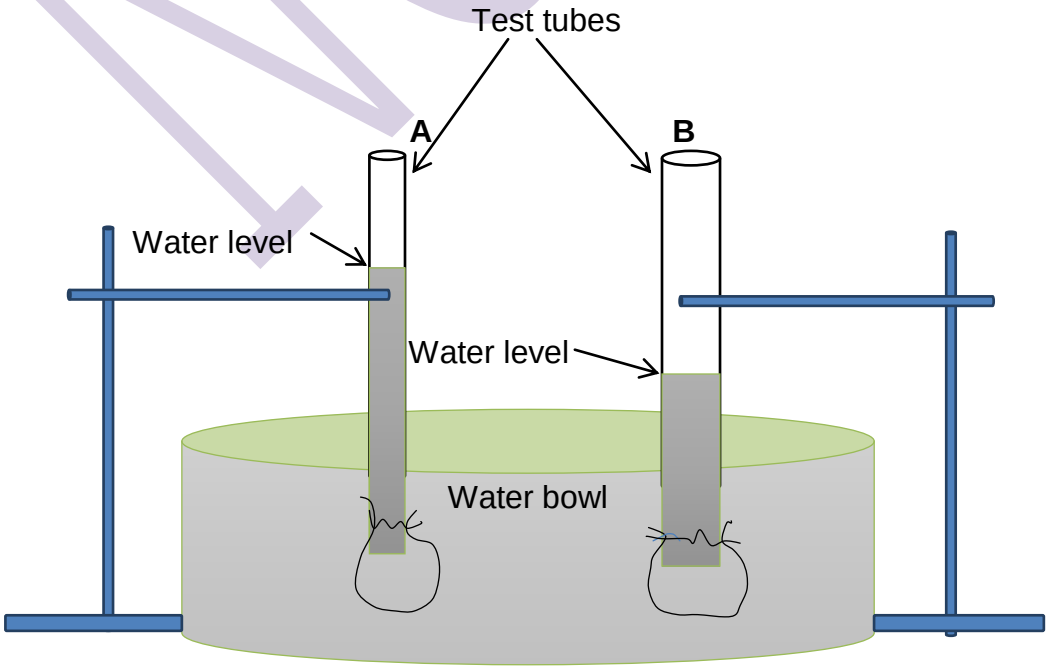
4.1 Soil texture has a huge impact on soil moisture. Use the following table to compare clay and sandy soils with regard to the following water-related characteristics. Redraw this table.

CHARACTERISTIC	CLAY SOIL	SANDY SOIL
Infiltration rate	Slow	4.1.3 ...
Dominant pore size	4.1.1 ...	4.1.4 ...
Water-retention capacity	4.1.2 ...	4.1.5 ...

(5 × 1) (5)

4.2 An experiment was conducted to compare the upward movement of water in two glass tubes with different diameters.

Answer questions based on it.



4.2.1 Identify the tube (tube A or tube B) that would represent clay soil.

Give a reason for your choice. (3)

4.2.2 Name the natural phenomenon (related to soil-water relations) this experiment simulates. (1)

4.3 Name TWO climatic factors that would speed up the rate of evapo-transpiration. (2)

4.4 Briefly explain how organic matter can reduce the rate of percolation in sandy soils. (3)

4.5 Read the following extract and answer the questions.

BERG RIVER: A GOAL CLEARLY IN SIGHT.

'Some of the Western Cape's most important agricultural production regions are threatened by the degradation river water. As a result, irrigation water now has to be filtered at great additional expense. An update of the Berg River's rehabilitation was presented at the recent Agri. Cape Week Expo.'

'According to Steyn, 1 500ha of blue gums translate to 750 00t of biomass. If chipped and used as mulch in orchards, it can bring about a 15% saving in irrigation water and a 10% increase in soil fertility per year for seven years'

(Source: Farmer's Weekly, 4 December 2015)

4.5.1 Deduce how the unfiltered polluted river water can affect a sprinkler irrigation system.

4.5.2 Blue gum trees are alien trees that, in this case, grow on the banks of the Berg River. One of the programmes to rehabilitate this river is to remove these trees.

Give TWO reasons why these trees are undesirable.

4.5.3 Briefly explain how mulching can bring about saving in irrigation water.

4.5.4 Explain how mulching with chipped blue gum can increase soil fertility.

(4 × 2) (8)

4.6 Say in 1 metre (depth) of soil there is 35 cm of moisture available.

Calculate the AMC (Available Moisture Content) of this soil. Show all calculation. (3)

[25]

QUESTION 5

5.1 Answer questions based on the picture below. On the picture is an established crop grown on a field full of plant residues from the previous season's maize harvest.



5.1.1 Name the cropping practice shown in this picture. (1)

5.1.2 List FOUR benefits of this type of a farming practice. (4)

5.2 Rangeland owners are expected, by law, to have firebreak. Firebreaks must among other meet the following requirements:

(a) They must be wide and long enough.
(b) They should not cause soil erosion.
(c) They should be free from inflammable materials.

5.2.1 Briefly explain how firebreaks (fire paths) can accelerate soil erosion on rangeland. (4)

5.2.2 State TWO inflammable materials capable of carrying veld fire across the firebreak to the adjacent areas. (2)

5.3 One of the forms of water erosion is rill erosion.

5.3.1 Describe *rill erosion*.

5.3.2 Rills are usually not permanent.

Indicate TWO ways in which rills are wiped out.

(2 × 2) (4)

5.4 Discuss the effects of soil erosion under the following subheadings:

5.4.1 Loss of plant production

5.4.2 Off-site damage by sedimentation.

(2 × 2) (4)

5.5 Name FOUR ways of controlling erosion on cultivated land. (4)

5.6 Indicate TWO soil structure forms. (2)
[25]

TOTAL SECTION B: 100
GRAND TOTAL: 150

NCV

Copyright reserved