BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF AGRICULTURE AND ENVIRONMENTAL SCIENCE

DEPARTMENT: NATURAL RESOURCES

PROGRAMME: BSc NATURAL RESOURCES MANAGEMENT

COURSE CODE (7): NR128: INTRODUCTION TO SOIL SCIENCE

DURATION: 2 HOURS TOTAL MARKS: 70

JUN 2024

INSTRUCTIONS TO CANDIDATES

Answer *Three* questions out of the following five questions. You must answer question *One* from Section A and any *Two* questions from Section B.

SECTION A (COMPULSORY)

1.1. A soil horizon is ___

A. Horizontal layer parallel to and beneath the soil surface
B. Above the soil surface
C. Vertical and beneath the soil surface
D. Not a component of the soil profile

1.2. What is the correct sequence of soil horizonation in a fully developed soil profile?

A. E-A-B-O-C-D
B. D-E-C-O-B-D
C. B-A-O-D-E-C
D. O-A-E-B-C-D

1.3. A soil solum is made up of:

A. C horizon
B. C + D horizon
C. A+B+C horizon
D. A+B horizon

1.4. Which of the following is not a soil forming factor?

A. Climate
B. Illuviation
C. Relief
D. Time

1.5. Available forms of nitrogen for plants are ___

A. NH_4^+(ammonium) and NO_2^-(nitrite)
B. NH_4^+ and NO_3^- (nitrate)
C. NO_2^- and NO_3^-
D. Amino acids

1.6. Which clay mineral has highest cation exchange capacity (CEC)?

A. Kaolinite
B. Illite
C. Vermiculite
D. Montmorillonite

1.7. Soil structural units having horizontal axis larger than the vertical axis are described as:

A. Prismatic
B. Blocky
C. Platy
D. Columnar

1.8. If the ratio; carbon: nitrogen: phosphorus in soil organic matter is 100:10:1. Soil organic matter with 48% organic carbon has a nitrogen content of...

A. 1-2 %
B. 4-5%
C. 9 -10%
D. 18-20 %

1.9. The correct description of a rhizosphere is___

A. Part of soil in contact with root surface
B. Part of soil in contact with plant stem
C. Part of soil below a growing plant
D. Any part of the soil profile

1.10. Available water is held between___

A. Saturation and wilting point
B. Field capacity and hygroscopic coefficient
C. Saturation and field capacity
D. Field capacity and wilting point

1.11. If a soil has the colour code of 2.5YR 3/6, the correct breakdown of the code is ___

A. **Hue**=2.5, **Value**=YR3, **chroma**=6
B. **Hue**=2.5YR; **Value**=3, **chroma**=6
C. **Hue**=6, **Value**=2.5YR, **chroma**=3
D. None of the above

1.12. The climatic conditions that are most conducive for the formation of saline soil are:

A. High precipitation and low temperature
B. High precipitation and high temperature
C. High precipitation and moderate temperature
D. Low precipitation and high temperature

1.13. Red colour in soils is due to _____

A. Fe^{3+} (ferric iron)

B. Fe^{2+}(ferrous iron)

C. Al^{3+}

D. Mg^{2+}

1.14. Sodic soils can be reclaimed/managed by:

A. Addition of gypsum

B. Leaching

C. Addition of lime

D. Addition of Ammonium nitrate

1.15. The central cation on an octahedron is _____

A. Al^{3+}

B. Zn^{2+}

C. Si^{4+}

D. Fe^{2+}

1.16. Which type of clay mineral is montmorillonite?

A. 1:1

B. 2:1 non-expansive

C. 2:1:1

D. 2:1 expansive

1.17. Hydrogen bonding is found in which clay mineral?

A. Kaolinite

B. Montmorillonite

C. Vermiculite

D. Illite

1.18. Source(s) of negative charges in the soils is (are)___

A. Deprotonation only

B. Protonation and isomorphous substitution

C. Isomorphous substitution only

D. Deprotonation and isomorphous substitution

1.19. With reference to the lyotropic series, which statement is not correct?

A. $Al^{3+} > Ca^{2+} > Mg^{2+} > K^{+} > Na^{+} > H^{+}$ is the preferential adsorption order on exchange sites

B. It can be overridden by mass flow

C. Monovalent cations are adsorbed ahead of multivalent cations

D. The concept can be applied in fertilizer and lime management

1.20. In which soil type is surface crusting likely to be a problem?

A. Sandy soil
B. Silty clay loam
C. Loamy soil
D. Clayey soil

1.21. The correct ranking according to clay content for the following soil textural classes is___

A. Loamy sand>sandy loam>sandy clay loam
B. Sandy loam>loamy sand>sandy clay loam
C. Sandy clay loam>sandy loam>loamy sand
D. Sandy clay loam>loamy sand>sandy loam

1.22. Which of the following statements is not true about sesquioxides?

A. They are oxides of iron and aluminium
B. They facilitate aggregation in soils
C. They are part of soil organic matter
D. They indicate the degree of soil chemical weathering

1.23. Which force acts on soil water to cause capillarity?

A. Gravitational force
B. Adhesive force
C. Cohesive force
D. All of the above

1.24. Which type of soil develops from basic rocks under moderate rainfall?

A. Clayey soil
B. Loamy soil
C. Clayey and sandy soils
D. Sandy soil

1.25. What is the second level of the Zimbabwean classification system?

A. Soil order
B. Family
C. Soil series
D. Soil group

1.26. For a soil classified as Chiredzi 4P.2, which statement is correct about the Zimbabwean soil taxa?

A. **Order** -2, **Group**-4; **Family**-Chiredzi ; **series**-4P.2
B. **Order**-siallitic; **Group**-4, **Family**-P; **series**-4P.2
C. **Order**-4; **Group**-2, **Family**, 4P; **Series**-Chiredzi 4P.
D. **Order**-2 (Calcimorphic), **Group**-4 (Siallitic); **Family**-4P; **Series**-Chiredzi 4P.2

1.27. Which of the following soil is best for soil cultivation?

A. Sandy
B. Sandy loam
C. Clay loam
D. Clay

1.28. Flow of nitrogen in soil mainly through__

A. Mass flow
B. Diffusion
C. Interception
D. Osmosis

1.29. Micro-nutrient flow is mainly a _____ process in soil.

A. Mass flow
B. Diffusion
C. Interception
D. Osmosis

1.30. What effect does organic matter addition have on bulk density?

A. Increase
B. No effect
C. Reduce
D. Altered

Total: 30 Marks

SECTION B

2. Relate the factors of soil formation to the distribution of soil resources in Zimbabwe. **[20Marks]**

3. (a) Analyse the effect of organic and parent material on soil colour. **[10 Marks]**

   (b) Explain three factors that affect soil aeration. **[6 Marks]**

   (c) Describe the changes that occur in soil bulk density down the soil profile. **[4 Marks]**

4 Discuss how the quality of organic residues affect their decomposition and availability of nitrogen in the soil. **[20 Marks]**

5. (a) With the aid of a soil profile, illustrate the illuviation and elluviation processes. **[4 Marks]**

   (b) A soil has the following chemical properties:

Ca^{2+}	30 $mmoleskg^{-1}$
Mg^{2+}	19 $mmoleskg^{-1}$
H^{+}	6 $mmoleskg^{-1}$
K^{+}	9 $mmoleskg^{-1}$
Na^{+}	12 $mmoleskg^{-1}$
Al^{3+}	8 $mmoleskg^{-1}$

Calculate:

(i) Cation exchange capacity (CEC), **[2 Marks]**

(ii) sodium adsorption ratio (SAR), **[2 Marks]**

(iii) exchangeable sodium percentage (ESP) and **[2 Marks]**

(iv) percentage base saturation. **[2 Marks]**

(c) For the soil in 5(b) above comment on its:

(i) suitability for cropping and **[2 Marks]**

(ii) erodibility. **[2 Marks]**

(d) Explain why maize seed in Zimbabwe is dressed with sodium molybdate. **[4 Marks]**

END OF PAPER