202-203 Soil and Water Resources, Semester 2 2004 examination
You are to answer six (6) questions. You must answer two (2) questions from each section. Separate script books are to be used for each section

The University of Melbourne

The Institute of Land and Food Resources

Semester 2 Assessment 2004

202-203 Soil and Water Resources

Reading Time 15 minutes
Examination Duration 3 hours
This paper has 5 pages including this cover.

Authorized Materials
Hand held calculators are allowed

Instructions to Invigilators
Students will require script books only (initially 3)

Examination paper can be deposited in Baillieu Library

Instructions to students
This paper contributes 50% of the total subject mark.
You are to answer six (6) questions. There are three (3) sections. You must answer two (2) questions from each section.
Separate script books are to be used for each section

All questions are of equal value.

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Section 1

1. Soil (and plant) tests are used to help make decisions about the management of land systems for productivity, profitability and resource protection. Describe, using four example soil tests, how soil testing may influence management decisions. Include a description of what the implications of a very high value and a very low value would be on both production and the quality of adjacent water resources.

or

How can soil tests be used to infer the cycling and availability of micronutrients?

2. Describe the key distinguishing properties of five of the main soil orders, recognized in the Australian Soil Classification of Isbell (1996), which are found in Victoria. What land management issues can be inferred from these soil properties.

3. The following is an extract from a soil test report.

Available phosphate (Colwell P)	170 mg/kg
Available phosphate (Olsen P)	80 mg/kg
pH (water)	5.2
pH ($CaCl_2$)	4.5

Exchangeable cations

Calcium	6.40 meq/100 g
Magnesium	1.25 meq/100 g
Sodium	1.10 meq/100 g
Potassium	1.00 meq/100 g
Aluminium	2.95 meq/100 g

(Note – 1 meq/100 g is equivalent to 1 cmol charge (+)/kg)

(a) Perform whatever calculations are necessary on the above results to determine if the soil is likely to require gypsum and/or lime, and give reasons for your conclusion.
(b) What other factors need to be managed in this soil for improved productivity and protection of adjacent water resources? Make a recommendation as to how each limitation could be remedied? (both parts are of equal value)

4. Compare and contrast the physical and chemical properties of smectite and kaolinite and discuss the important field features of soils dominated by these clays. Give an example of a soil type in which each mineral dominates the clay fraction.

Section 2

5. Provide a brief definition of the following terms as they relate to soil:

- isomorphous substitution
- texture contrast profile
- hydraulic conductivity
- cation exchange capacity, and give two examples of important cation exchange reactions in soil
- slaking and dispersion
- mineralization and immobilization

(all parts are of equal value)

6. Describe how the nature, composition and turnover of soil organic matter may differ between two land management systems. Include reasons for these differences and implications for soil conditions.

or

Describe the processes leading to soil acidification.

7. Compare and contrast the main pools and processes of nitrogen, phosphorus and potassium in soil, and the key factors determining nitrogen and phosphorus availability. Include the effect of waterlogging on availability of N and P.

8. Sketch a soil water retention curve (or moisture characteristic), identifying the major points of interest for plant performance. Discuss how the soil water retention curve can aid land management.

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Section 3

9. You are a land manager converting a long term pasture to a tree plantation. Explain how this land use change may affect the local hydrologic balance, with reference to each of the factors in the water balance equation.

10. An irrigator applies 7 ML of irrigation water per hectare per year to 30 ha of trees and pasture. The annual average evapotranspiration and rainfall is 850 mm and 420 mm respectively. The electrical conductivity of the irrigation water is 1000 μS/cm, with sodium as the dominant cation.

(a) What is the potential depth of water accession to groundwater each year, assuming no runoff occurs?

(b) What is the leaching requirement and leaching faction? Is enough leaching occurring to avoid salinizing the root zone?

(c) What is the potential volume of groundwater accession for the 30 ha of pasture?

(d) What are the implications of this irrigation management for the region in which it occurs, and how could practices be improved? (each part is of equal value)

11. What are the principal water management issues facing the Murray-Darling Basin Commission? Discuss how you expect the incidence of these problems to vary within the basin?

or

Discuss the implications of the Victorian White Paper on water management "Securing our water future together" for two land uses.

12. Describe the factors affecting on-site soil erosion rates, and distinguish these from the factors affecting off-site water quality. For an example land use, suggest three ways these factors can be influenced to protect water quality?

13. Soil properties control the availability of water to plants. a) Discuss these properties. b) How does the capacity of the soil to conduct and store water influence plant productivity and c) How does the capacity of the soil to conduct and store water influence the quality and quantity of water resources? (each part is of equal value)

14. Soil organic matter consists of all the living and dead organic material in soil.

(a) Describe the two major groups of organisms that are most important in nutrient release.

(b) Explain why certain fractions of organic matter are important in nutrient release while other fractions are important as a nutrient exchange surface.

(each part is of equal value)

15. Discuss how soil type influences vegetation type, using examples from field trips (you may include field trips associated with other subjects).

end of exam