

**SOIL 3600 Soils and Landscapes in Our Environment**  
**Final Exam**  
**Sunday, December 20, 2020**  
**1:30-4:30pm, take home**  
**Instructor: Mario Tenuta**

Name: \_\_\_\_\_

**Instructions:**

SOIL 3600 Final Exam set for 1:30-4:30pm Sunday Dec 20, 2020

If you are registered with Student Accessibility Services, they have contacted me already and have told me how much extra time to provide you to complete the exam.

Exam is designed to be completed well within 3 hours, actual time to complete will of course vary with student, but for most, well within 3 hours.

Exam is open book but if you rely on seeking information from lecture material, online or the textbook, you won't have time to complete the exam.

You can write or type the exam. You can print and write into this document. If you write, take pictures of the pages and email back to me. Email typed exams back to me.

The exam is to be completed independently. I will be taking extra time to mark the exams because I will be comparing responses between students for the purpose of finding copying between students.

Answers are to be full sentence and in paragraphs with explanation, integration and details to be provided. Note the use of words such as explain, how, why, detail and others in the questions. Too many students didn't explain and detail answers in the mid-term.

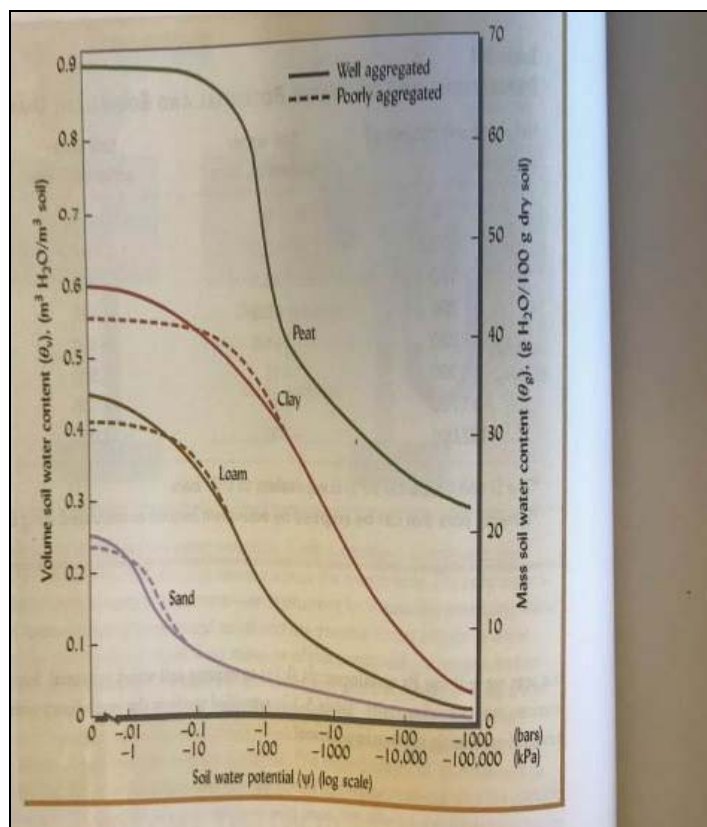
This final emphasizes the material since the mid-term but as the lectures and laboratories are designed to complement each other as the course progressed, there is expectation of integrating knowledge throughout the course and in this final.

Questions regarding clarifications of the wording of questions can be sent by text to 204-290-7827. Don't email in case I see it late.

This exam has a total of 100 marks.

I have enjoyed teaching you all. Please, when you see me ever in person, do say hello. I will like to put faces to your names. Good luck, Mario

1) Marks = 7.5

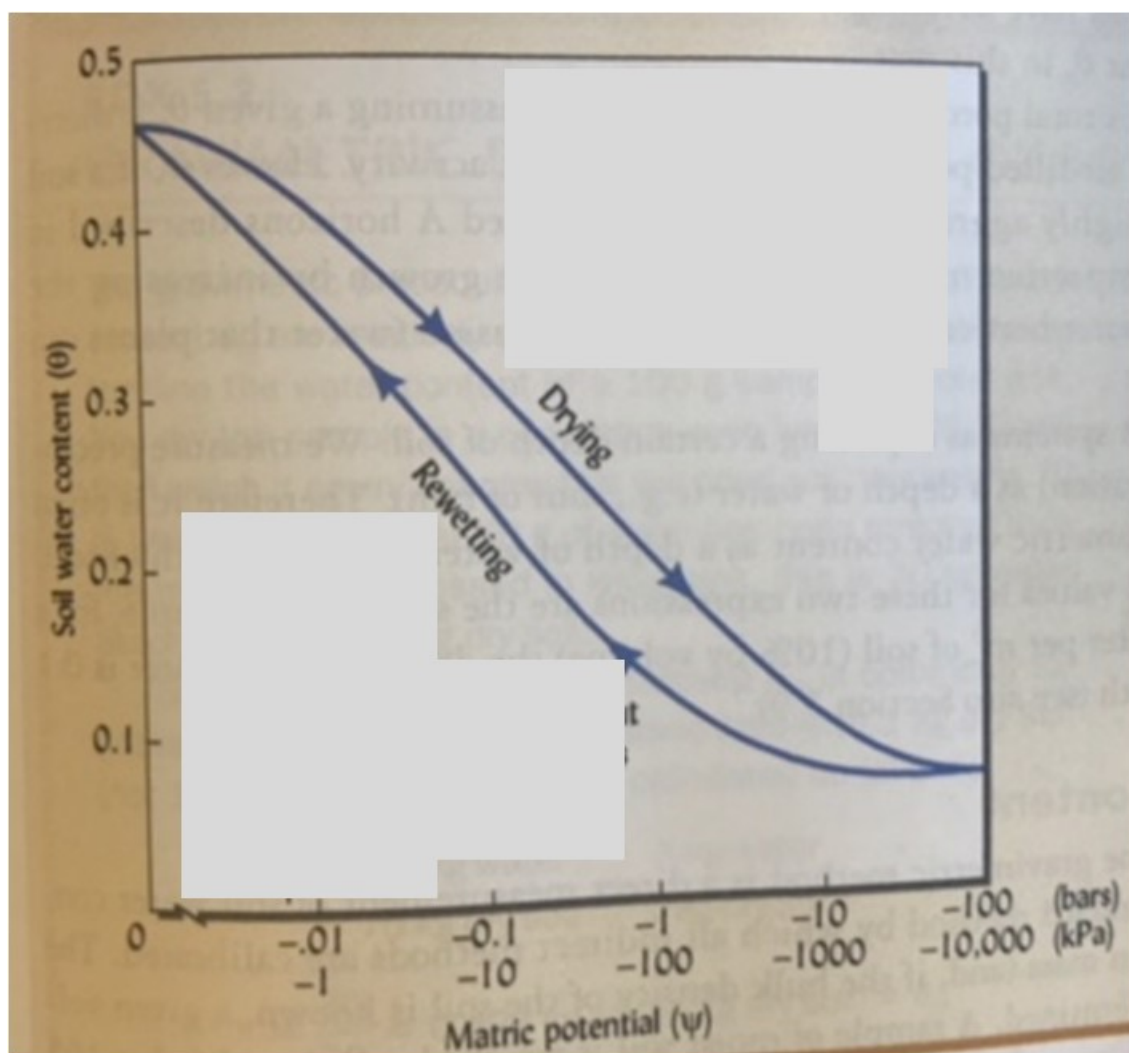


1a) What is the relation the figure above depicts called. Explain how it used for managing soils?

1b) Explain why is the sand not able to hold much water below -1 KPa (that is more negative KPa than -1)?

1c) Explain why the poorly aggregated clay soil is able to hold less water above -10 KPa (less negative than -10) but more water around -100 KPa than the well aggregated soil?

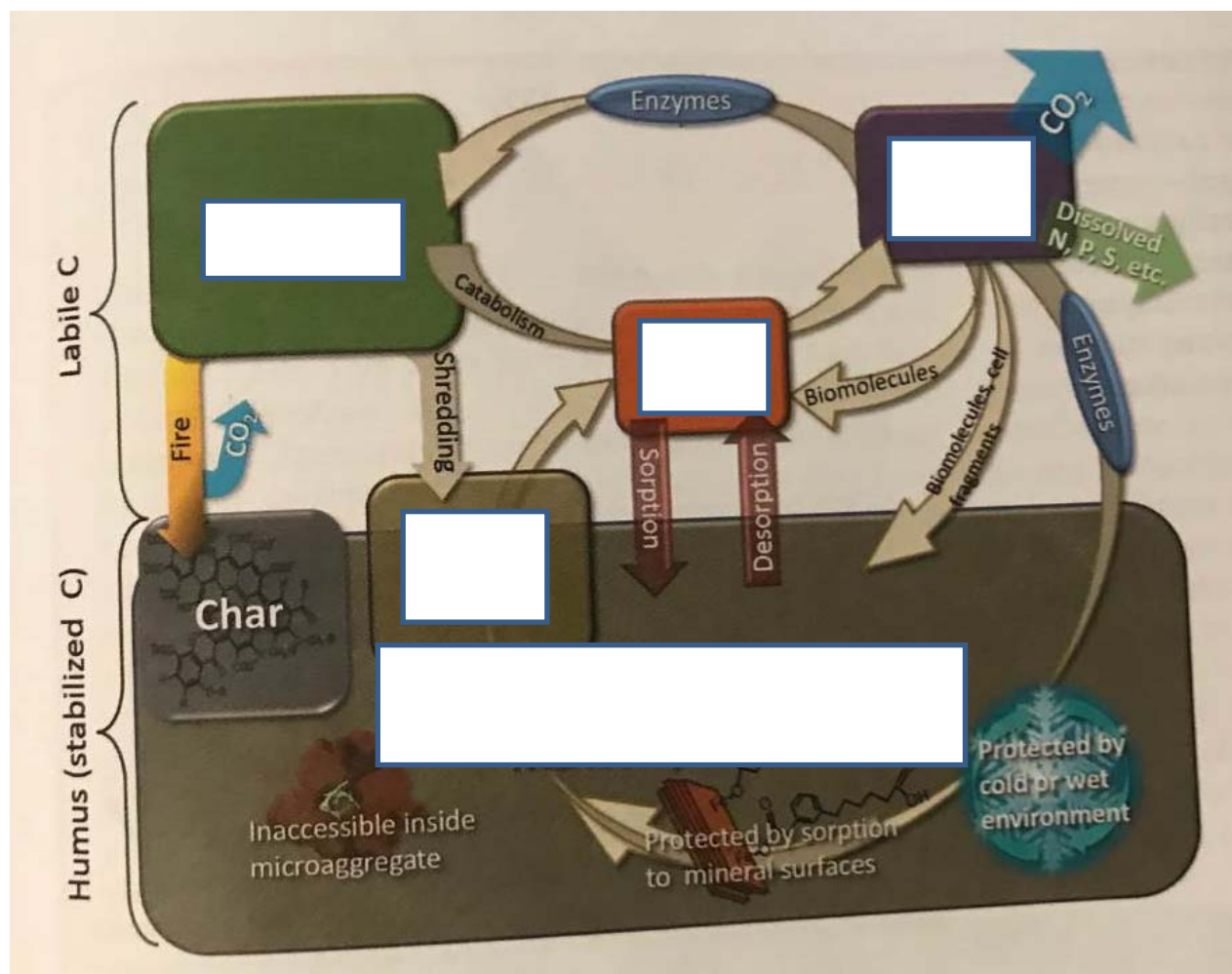
2) Marks = 7.5



2a) What is the phenomenon above called where soil water content is different for a particular soil matric potential when drying or wetting soil?

2b) Explain why soil water content is lower upon wetting of soil than drying soil at the same matric potential?

2c) Explain why is the soil water content higher upon drying of soil than wetting soil at the same matric potential?



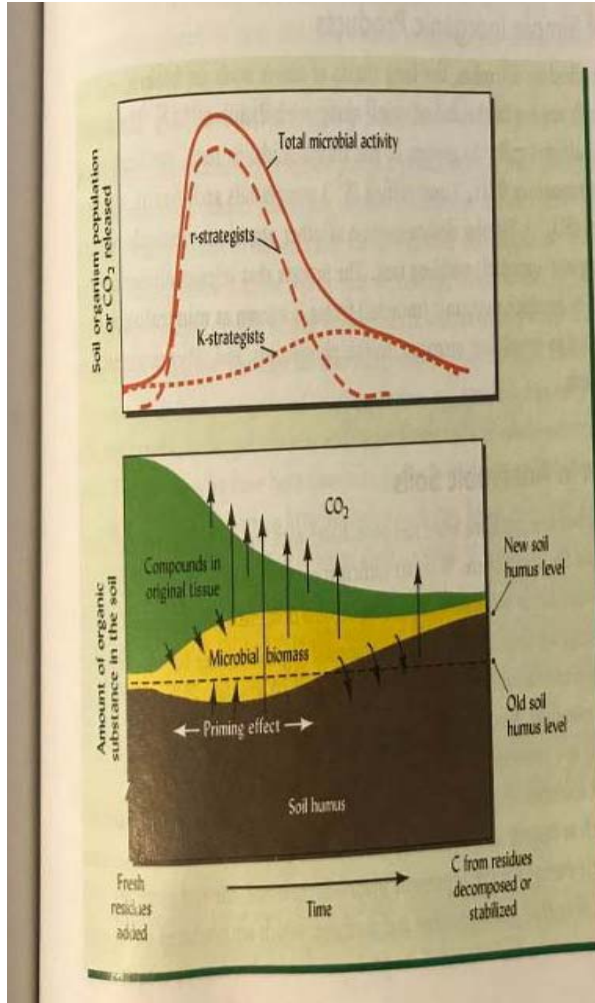
3) Marks = 7.5

3) Label the soil organic matter pools in the blank boxes above. Also explain each of those pools as well as those of Char, Protected by Environment, Inaccessible inside Microaggregates and Protected by Sorption as to their susceptibility to degradation and the processes/mechanisms responsible?





4) Mark = 7.5

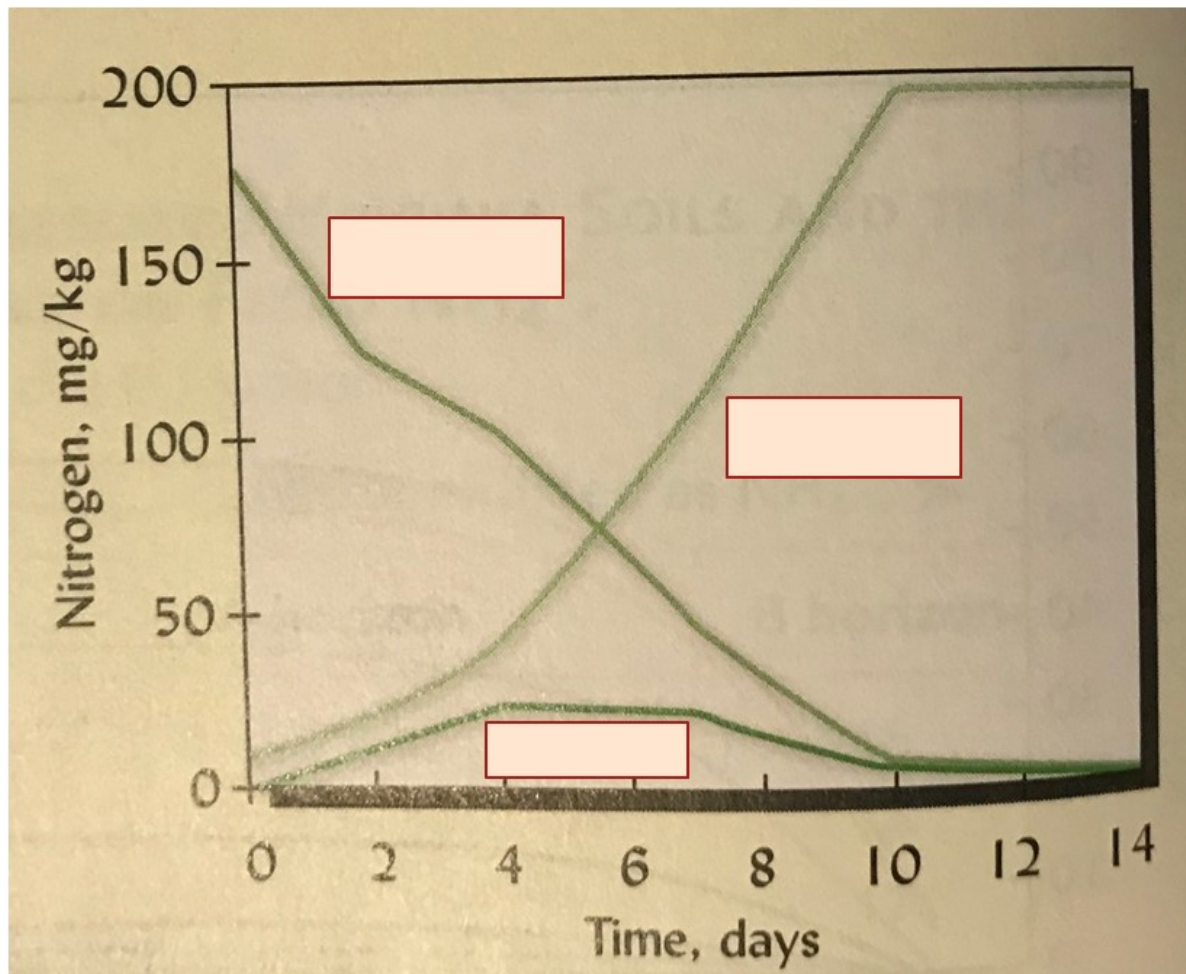


4a) Explain which compounds as components of the original plant tissue (green area) decompose most rapidly, intermediate and mostly, and the reasons why?

4b) Explain why does the population of r-strategist microorganisms crash midway through the time period?

4c) Explain what is the Priming Effect and what causes it?

5) Marks = 7.5



5a) Label the above the nitrogen inorganic ions in the sequence of nitrification over a couple of weeks in soil and explain the processes occurring over time leading to the increase or decrease of the ions?

5b) Why is the intermediate ion present about half-way during the time period? Does it often build up in soil? If so, under what soil conditions?

5d) Explain why nitrification is good for most crop plants? (1)

6) Explain why Chernozems fertile soils? (7.5)



7) What is cation exchange of nutrients in soil and explain how it occurs? (7.5)

- 8) Explain how is it that humus can be protected and stabilized much more easily in clay than sand soil? (10)



- 9) Explain the relation of soil health to the emergence, decline and sustainability of civilizations? (7.5)

10) Explain what humus is, its properties, how does it form and why is it beneficial to soil health? (7.5)

11) Do the following calculations and show your work and units (7.5 marks)

Leaves of soybean weighing 2,000 kg/ha dry fell this fall at on a field near Otterburne, Manitoba this September. The C:N ratio of the leaves is 20. Calculate if upon decomposition will the leaves mineralize or immobilize N in soil?

*Assumptions:*

Mass leaves = 2,000 kg/ha

CN: = 20

Carbon of leaves = 41%

CO<sub>2</sub>-C released from leaves = 68% of carbon

Microbial biomass C:N = 8

Amount of leaf C kg/ha = \_\_\_\_\_

Amount of leaf C kg/ha lost as CO<sub>2</sub> = \_\_\_\_\_

Amount of leaf C kg/ha into new microbial biomass = \_\_\_\_\_

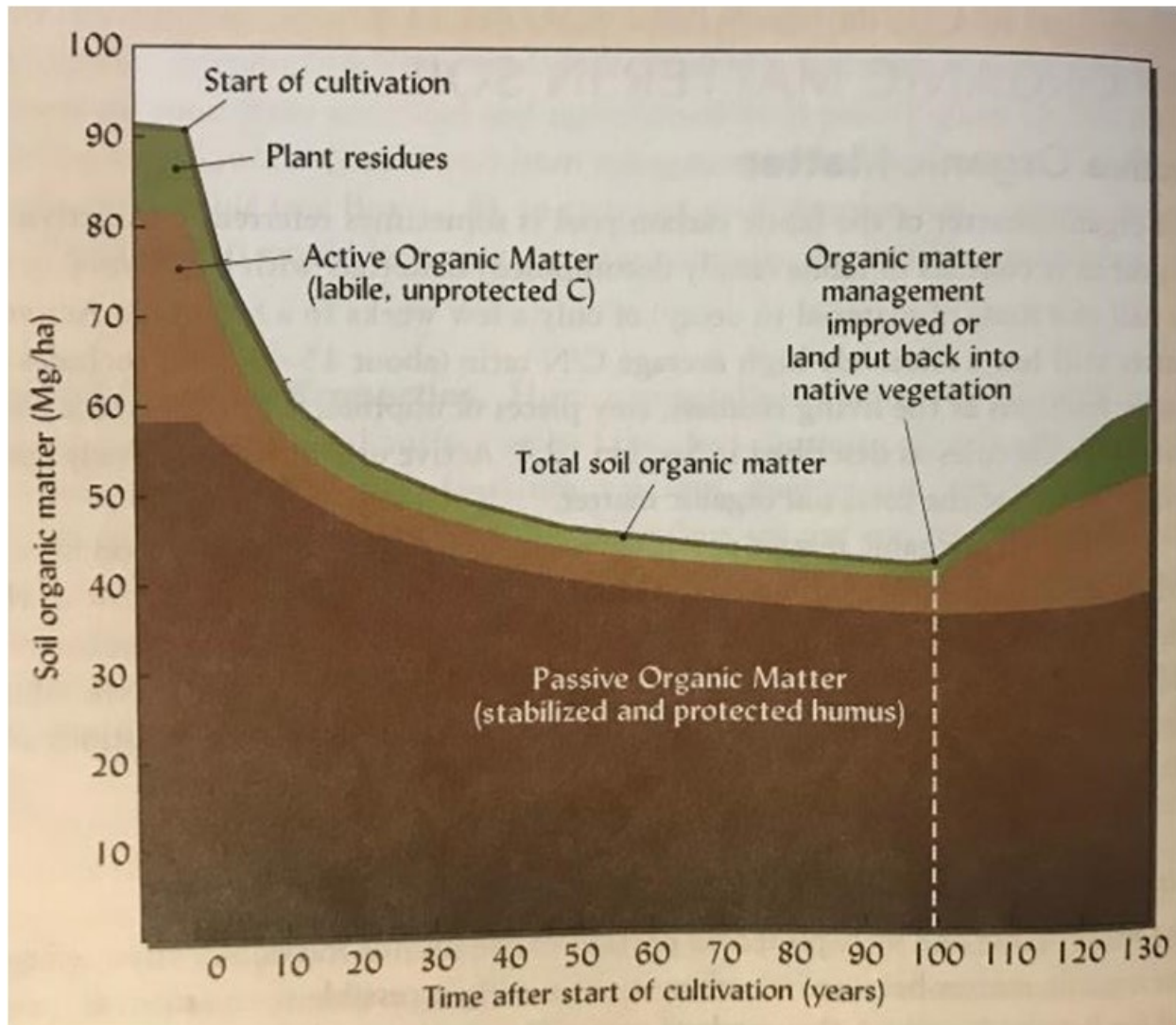
Amount of N kg/ha needed for new microbial biomass = \_\_\_\_\_

Amount of N kg/ha in leaves = \_\_\_\_\_

Amount of N kg/ha needed from or released to the soil (circle one of the underlined words) =  
\_\_\_\_\_

The decomposition of the leaves will result in immobilization or mineralization upon decomposition in soil?

12) Marks = 7.5



12a) How/why did cultivation of crops reduce total soil organic matter content of soils on the Prairies?



12b) Explain why/how does putting land back into native prairie often increase soil organic carbon content?

13) Explain what and how the composition of organic materials that affects their decomposition rate in soil? (7.5)