

Name: _____

SOILS 446-01
SOIL FERTILITY AND PLANT NUTRITION
SPRING 2008 – FINAL EXAM
100 POINTS

Answer the questions completely. Show all your work. Work alone – this is not a group project. The answers to the questions below must be typed and submitted to me as a Microsoft WORD document by April 25, 2008. Send your completed exam to: bmahler@uidaho.edu

1. Given the following soil test data, answer parts a through k (33 points; 3 points each)

A soil test shows the following:

Nutrient	meq/100g soil
Ca ⁺⁺	9.9
Mg ⁺⁺	2.1
K ⁺	2.0
Al ⁺⁺⁺	7.6
NH ₄ ⁺	0.6
Na ⁺	0.1
SO ₄ ⁻	4.2
H ₂ PO ₄ ⁻	2.1

- a. Calculate the CEC of the soil:
- b. Calculate the percent base saturation of the soil:
- c. Calculate the percent aluminum saturation of the soil:
- d. Calculate the amount of aluminum in the soil in pounds per acre (assume the soil sample represents the surface six inches of soil);
- e. Calculate the amount of potassium in the soil in pounds per acre (assume the soil sample represents the surface 12 inches of soil):
- f. Which essential elements would likely be deficient in this soil? Defend your answer.
- g. Calculate the amount of magnesium in the soil sample in pounds per acre (assume the soil sample represents a 12 inch soil sample):
- h. Estimate the soil pH:
- i. Is the above soil suitable for growing soybeans? Why?
- j. Is the above soil suitable for growing corn? Why?
- k. Given excess rainfall or over-irrigation, if you applied urea (U) to this soil, would nitrate leaching be a potential problem? Defend your answer.

2. Rank the plant available form of the following nutrients from most to least likely to leach in a soil and defend your ranking: (4 points)

N, P, K, S, Ca, Mg, B, Cu, Mn

3. What are the advantages and disadvantages of an essential nutrient being mobile compared to immobile within a plant? (3 points)
4. Answer the following questions about nitrogen fertilizers: (6 points)
- Why is ammonium nitrate (AN) less acidifying than urea (U)?
 - Why did ammonium nitrate become the most widely used N fertilizer in the late 1940s?
 - How do nitrogen fertilizers acidify soils?
 - How serious is soil acidification in northern Idaho?
5. As far as soil fertility is concerned, what is an ideal soil pH? Defend your answer. (4 points)
6. Estimate the CEC of a soil that contains 2.5% organic matter and is 32% clay. Half the clay is kaolinite, while the other half is illite? Show your work. (3 points)
7. The following question pertains to growing a winter wheat crop (a cool season crop) in northern Idaho. A soil sample taken to a depth of 12 inches showed that the soil contains 2.1% organic matter. Show your work for each part of the calculation (4 points; 2 points each part)
- How much N will be mineralized during the growing season in this soil? Show your calculation.
 - How much extra N will have to be added to this field to prevent immobilization if you incorporate 4.5 tons of a cereal residue into the soil right before planting? This residue contains 1.6% nitrogen.
8. What is the ideal soil organic matter content for a homeowner's yard? Defend your answer. (4 points)

9. Nitrogen fixation is a very important process in both human-influenced and natural ecosystems. Describe the type of nitrogen fixation process (asymbiotic, symbiotic-legume, symbiotic non-legume, etc) that is most common in each of the following systems and state the quantities of nitrogen that are commonly fixed in each system. (9 points; 1.5 points each)
- A natural prairie ecosystem in the Northern Great Plains
 - A forest in Idaho county
 - An irrigated alfalfa field in southern Idaho
 - A pea field in northern Idaho
 - A rice paddy in Vietnam
 - A tropical rain forest in Brazil
10. Under what conditions would you consider using a slow release N fertilizer? (3 points)
11. Describe the pros and cons from an environmental standpoint of the use (manufacture, shipping, human health, use and potential impact on water quality) of each of the following N fertilizer materials (5 points)
- Anhydrous ammonia
 - Ammonium nitrate
 - Urea
 - Solution 32
 - Sulfur coated urea
12. Based on the information you obtained in this class, how could you improve nitrogen use efficiency in a crop grown in south-central Idaho (irrigated conditions)? Choose corn, winter wheat, potatoes, or sugar beets and outline a strategy. Defend your answer. (4 points)
13. What are the SIX most important nitrogen cycle processes found in forest ecosystems. List them, describe the processes in forest ecosystems, and defend your answer for including each process in the top SIX. (6 points)
14. Provide me with TWO real life examples in Idaho or Washington where VOLATILIZATION would be a problem. Describe each situation in detail. (4 points; 2 points each).
15. I live in an irrigated agricultural area of southern Idaho. I just had my well tested and found out that it contained 5.8 ppm $\text{NO}_3\text{-N}$. Please answer the following: (4 points; 2 points each)
- Is my well water safe to drink? Defend your answer.
 - Has my well water been impacted by human activity? What should be done to protect my well water in the future?

16. I need to apply 216 pounds of nitrogen per acre to a one-acre field. How many pounds of each material do I need to reach the 216 pounds of nitrogen? (4 points; 1 point each)

- a. ammonium nitrate**
- b. ammonium sulfate**
- c. urea**
- d. 29-0-0**