1. Water is “dipolar”.
   a. Please explain or diagram what we mean when we say water is “dipolar”. (3 points)
   b. Why is this property important with respect to nutrient leaching through soils? (2 points)

2. The pH of "pure" water is 7.0, but the pH of "natural" rainfall is about 5.6. Please clearly explain or show me the reaction that takes place to make natural rainfall "acid rain". (3 points)

3. How many more H⁺ per liter are there in “natural” rainfall than “pure” water? (assume that activity equals concentration) (4 points)

4. Please list three (3) reasons why natural, perennial ecosystems are more “closed” with respect to nutrient movement than annual agricultural ecosystems. (3 points)
   1.
   2.
   3.

Total points this page = 15 out of 100.
5. Please list one U.S. state or Canadian province where phosphorus and potassium fertilizers are mined. (2 points)

Phosphorus:

Potassium:

6. Please complete the following table. (6 points)

<table>
<thead>
<tr>
<th>Element</th>
<th>Symbol</th>
<th>Chemical Form taken up by plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>Ca</td>
<td></td>
</tr>
<tr>
<td>Magnesium</td>
<td>Mg</td>
<td></td>
</tr>
<tr>
<td>Sulfur</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>Manganese</td>
<td>Mn</td>
<td></td>
</tr>
<tr>
<td>Boron</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td>Zn</td>
<td></td>
</tr>
</tbody>
</table>

7. Please fill in the blanks. (4 points)

In soil test correlation studies we establish the relationship between ______________________
and ______________________. In calibration studies we establish the relationship
between ______________________ and ______________________.

8. Please list four factors that can influence soil test correlation/calibration studies. (4 points)

1. 
2. 
3. 
4.

Total points this page = 16 out of 100.
9. Please diagram the Build-up, Maintenance, and Drawdown portions of the Build-up and Maintenance philosophy of making fertilizer recommendations below. Include in your diagram the correct label for each axis, the shape of the lines (curve), the three different regions of the curve with appropriate label, the critical level, the maintenance limit, the fertilizer rate that corresponds to the maintenance rate, and the fertilizer rate responsible for building the soil test level. (10 points)

10. Please match the fertilizer recommendation concept or philosophy that is most closely associated with the following statements. (9 points)

BUM = Build-up and Maintenance
NUT = Nutrient Sufficiency
CAT = Cation Saturation Ratio

Fertilize the plant:
Fertilize the soil:
Relies heavily on calibration studies:
Soil cations should have specific relative amounts of Ca, Mg, and K:
Soil test provides a probability of yield increase to fertilizer application:
Soil test provides percentage of nutrients that can be supplied by the soil:

Total points this page = 19 out of 100.
11. Please fill in the blanks. (5 points)

The proper soil sampling depth for turf is ____ - ____ inches for all soil test recommendations, but we exclude the thatch layer. In conventionally tilled crop fields we collect a ____ - ____ inch sample for all soil test recommendations. However, in no till crop fields we collect a ____ - ____ inch sample for pH only and a ____ - ____ inch sample for all other soil test information.

When sampling by soil type or management unit, the maximum area represented by one composite sample should not exceed ______ acres. The proper number of individual soil cores that should be mixed together to send to the laboratory for analysis is ______ (a small range for this answer is acceptable).

12. Please list the four steps involved in soil testing. (4 points)

1. 
2. 
3. 
4. 

13. Please diagram how you would collect samples in a grid collection system using centerpoint or multipoint sampling if the boxes below represent the boundaries of an individual 2.5 acre grid. A series of "x"s is sufficient. (4 points)

Total points this page = 13 out of 100.
14. Given the following soil test:

<table>
<thead>
<tr>
<th>Organic Matter</th>
<th>Buffer pH</th>
<th>CEC</th>
<th>P (Bray P₁)</th>
<th>K</th>
<th>Ca</th>
<th>Mg</th>
<th>K</th>
<th>Ca</th>
<th>Mg</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>-- % --</td>
<td>cmol(+) kg⁻¹</td>
<td>cmol(+) kg⁻¹</td>
<td>cmol(+) kg⁻¹</td>
<td>cmol(+) kg⁻¹</td>
<td>cmol(+) kg⁻¹</td>
<td>cmol(+) kg⁻¹</td>
<td>cmol(+) kg⁻¹</td>
<td>cmol(+) kg⁻¹</td>
<td>cmol(+) kg⁻¹</td>
<td>cmol(+) kg⁻¹</td>
</tr>
<tr>
<td>3.8</td>
<td>6.0</td>
<td>6.9</td>
<td>7.4</td>
<td>39</td>
<td>118</td>
<td>800</td>
<td>235</td>
<td>4.1</td>
<td>54.3</td>
<td>26.6</td>
</tr>
</tbody>
</table>

What is the soil test P value in lbs/acre? (2 points)

What is the percent base saturation of this soil? (3 points)

15. Please fill in the blanks. (6 points)

Nitrogen immobilization will generally occur when the C:N ratio is greater than ______:1.___________ is most likely to occur under saturated soil conditions and warm soil temperatures when nitrate-N is present. When urea is surface-applied to high pH soils, the most likely N loss mechanism is ____________________________.

16. Nitrification in soils is a two-step process. Please diagram both steps and include in this diagram the microorganisms involved for each step. (5 points)

17. How does a nitrification inhibitor work (what is its mode of action)? (2 points)

18. How does a urease inhibitor work (what is its mode of action)? (2 points)

Total points this page = 20 out of 100.
19. How much limestone (pure CaCO₃ all passing a 60 mesh sieve, 50g/equivalent) is needed to neutralize the acidity generated by applying 90 lb N/acre if diammonium phosphate (NH₄)₂HPO₄, 18 - 46 - 0) is the fertilizer material used? (atomic wt. of N=14 g/mole) Show me the calculations!!! (6 points)

20. Given the following soil information: 2.0 percent organic matter, organic matter is 60 percent carbon, C:N ratio of this organic matter is 25:1.
How many pounds of organic matter nitrogen are present in an acre of this soil if an acre weighs 2 million pounds? Show me the calculations!!! (4 points)

21. A farmer asks you which of the these three fertilizers, urea, UAN, or ammonium nitrate will perform best as a fertilizer source when surface-applied to no-till corn two weeks before planting. The pH of her 0-4 inch soil sample is 6.9. What will you tell her and why? (Just give me the correct fertilizer and the primary reason for choosing it) (4 points)

22. Please fill in the blanks. (3 points)

Approximately _________ percent of the global N supply is in the lithosphere. The atmosphere contains the majority of the other _________ percent of the global N supply. Only about 1/_______________th of the global N supply is available to plants at any given time.

Total points this page = 17 out of 100.