I. Phosphorus in Soils

A. Label the four arrows shown on the diagram in Part B: (4 points)

1. _________________________  3. _________________________
2. _________________________  4. _________________________

B. Explain the chemistry of soil phosphorus using the three boxes shown below. Define the forms of phosphorus found in each box and briefly explain how the four numbered processes affect availability of phosphorus to plants. Also, state the predominate form of phosphorus taken up by plants at pH 5.0 ______ and pH 7.5 ______ (6 points)

![Diagram of phosphorus cycling]

**Organic Unavailable P** 1 2 **Inorganic Available P** 3 4 **Inorganic Unavailable P**
II. List the remaining 7 micronutrients for plant growth (correctly spelled), their chemically available form for uptake and their fertilizer source. (9 points)

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Available Form and Valence</th>
<th>Fertilizer Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. chlorine</td>
<td>Cl^-</td>
<td>KCl</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. nickel</td>
<td></td>
<td>XXXXX</td>
</tr>
</tbody>
</table>

III. The primary function in the plant of each of these nutrients is (6 pts.)

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Primary Function in the Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molybdenum</td>
<td>_____________________________</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>_____________________________</td>
</tr>
<tr>
<td>Potassium</td>
<td>_____________________________</td>
</tr>
</tbody>
</table>

IV. Briefly explain how each of these fertilizer materials are manufactured. Include the starting material and where it is obtained and the general process that produces the fertilizer. (6 pts.)

A. 0-0-60

B. 0-46-0

C. 10-34-0
V. Briefly explain or diagram “fixed K” and “exchangeable K.” Explain how potassium in fertilizers can be fixed when added to soil. Which types of soils have the most fixing potential? (5 points)

VI. Describe a potassium deficiency on corn or alfalfa (2 points)

VII. For each of the micronutrients listed, give the information requested. - (6 pts.)

<table>
<thead>
<tr>
<th>Potential Soil Condition Where Deficiency Might Occur (2 conditions for each nutrient)</th>
<th>Most Susceptible Crop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molybdenum</td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td></td>
</tr>
<tr>
<td>Manganese</td>
<td></td>
</tr>
</tbody>
</table>
VIII. What is the maximum rate of N + K₂O that you should apply when you are using starter fertilizer in a 2x2 placement for corn?

___________ lbs N + K₂O (2 pts)

Would the pounds N + K₂O for band placement be higher or lower for soybeans?

___________ (1 pt)

Why are we concerned about applying too high of N + K₂O in band placement? (2 pts)

IX. List two situations when starter fertilizer should be used for corn production. (4 pts)

1. 
2. 

X. Discuss the fate of fertilizer P when it is applied in a band. Include in your discussion what happens to pH, solution P levels, Fe and Al concentrations and solubility of P, and the reactions that change P availability with time. Use a diagram if that is helpful in your explanation. (5 pts)

XI. Answer the following question using the soil test information provided.

<table>
<thead>
<tr>
<th>Soil</th>
<th>Buffer pH</th>
<th>Buffer %</th>
<th>CEC meq/100g</th>
<th>Ca lb/A</th>
<th>Mg lb/A</th>
<th>K lb/A</th>
<th>P ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil X</td>
<td>5.2</td>
<td>6.7</td>
<td>1.5</td>
<td>----</td>
<td>60</td>
<td>156</td>
<td>52</td>
</tr>
</tbody>
</table>

How many pounds of P is there per acre in Soil X? (2 pts.)

Soil X __________

Is this above the critical level for corn? ________
XII. The fertilizer recommendation for a corn crop is 160 lb N, 80 lb P₂O₅, and 100 lb K₂O. How much 82-0-0, 18-46-0, and 0-0-60 must be applied to meet the fertilizer recommendation.

A. 82-0-0 applied ______ lb/A (2 pts.)
   18-46-0 applied ______ lb/A (2 pts.)
   0-0-60 applied ______ lb/A (2 pts.)

Show all calculations:

B. Calculate the cost per acre for the 0-0-60 in the above problem assuming it is priced at $160 / T (2 pts.)

Bonus Question (3 pts)

Describe what Olaf Larson described as the "Fertility Cascade" used in Organic Farming (Earthcraft Farms)

or Explain "Community Supported Agriculture" as it is used by Earthcraft Farms (Organic Farming)
Select the letter of the best answer to each question and record it on the mark-sense sheet provided. (2 points each)

1. Which of these clays contains large amounts of interlayer potassium?
   A) montmorillonite  
   B) kaolinite  
   C) illite

2. Most of the potassium reaching plant roots gets to the roots by:
   A) root interception  
   B) mass flow  
   C) diffusion  
   D) complimentary ion carriers

3. If a fertilizer label reads 8-32-16 it contains:
   A) 8% total N  
   B) 32% available P₂O₅  
   C) 16% water soluble K₂O  
   D) All of the above

4. This 6-24-12 fertilizer has its potassium (most likely) in what chemical form:
   A) CaH₂PO₄  
   B) KCl  
   C) Potassium hydrogen phthalate  
   D) K₂O  
   E) P₂O₅

5. 28-0-0 is a liquid N fertilizer which weighs 10.5 lb/gal. If you wanted to apply 150 lb N/A, how many gallons of 28-0-0 must you apply?
   A) 65  
   B) 25  
   C) 10.5  
   D) 50  
   E) 100

6. The rock phosphate deposits used for manufacture of the MAJORITY of U.S. phosphorus fertilizers is found in:
   A) Canada  
   B) Tennessee  
   C) North Carolina  
   D) Florida  
   E) Texas
7. High P applications may induce this micronutrient deficiency if it is found in marginal quantities in the soil.

   A) Mo  
   B) Zn  
   C) Cl  
   D) B  
   E) All of these

8. The primary form of phosphorus used in manufacturing P fertilizers is:

   A) potassium pyrophosphate  
   B) aluminum hydrogen phosphate  
   C) apatite  
   D) gypsum  
   E) P\textsubscript{2}O\textsubscript{5}

9. A tissue analysis for corn was found to contain 2.6% N, 0.38% P and 0.42% K. Which element is most likely hindering growth?

   A) N  
   B) P  
   C) K

10. Interveinal Chlorosis of young plant leaves is most typical of a ____________ deficiency?

    A) K  
    B) B  
    C) P  
    D) N  
    E) Zn

11. Which of these micronutrients increases its availability with increasing soil pH?

    A) Mn  
    B) Fe  
    C) Mo  
    D) Zn  
    E) Cu
12. Poor growth of alfalfa (with yellow upper leaves) on a light-colored, deeply leached silt loam soil in Indiana would probably be a result of a _______ deficiency? (This deficiency is often confused with leaf hopper damage).

A) Ca  
B) Zn  
C) B  
D) N  
E) Mg

13. Which of the following nutrients is less available in organic soils because of chelation?

A) K  
B) B  
C) P  
D) Cu  
E) Cl

14. Manganese can cause problems on some soils by being

A) inhibiting Al uptake  
B) reducing cation exchange  
C) toxic at low pH, deficient at high pH  
D) toxic at high pH, deficient at low pH

15. What would be the correct fertilizer analysis for pure KNO₃ (at wts:  K = 39,  N = 14,  O = 16)

A) 14-0-39  
B) 14-39-0  
C) 14-0-47  
D) 14-88-0  
E) 14-0-88