EXAM 2 NAME___________________________

CRSS 3060: Soils and Hydrology

Fall 2013 (18 Oct 13) Lab Section_______

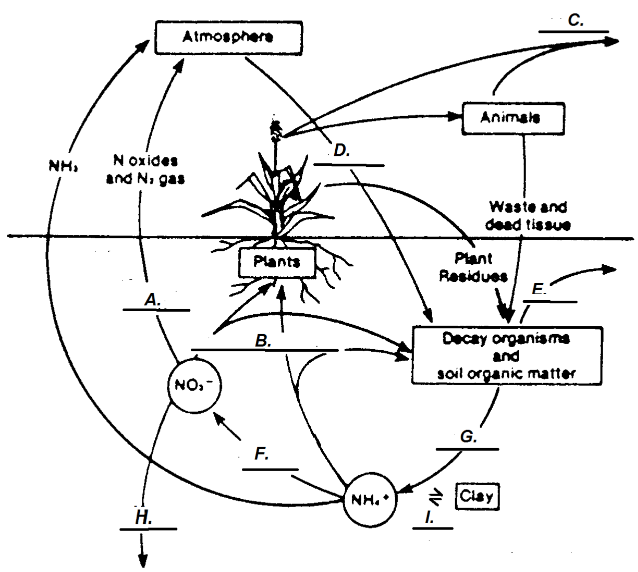
Directions: Most of this exam is fillin-type responses; print legible answers. For short answer questions, be brief and to-the-point; for calculations, show all formulas and steps to receive partial credit.

1. As pH ***increases*** from 4 to 6 in a typical Georgia Ultisol Ap soil, show for each soil property below whether the property INCREASES (↑), DECREASES (↓), or STAYS THE SAME (--). (1 ea)

A. concentration of H+ in soil solution _____
B. (+) charge on Fe oxides _______
C. exchangeable acidity _______
D. amount of plant-available P in soil _______
E. % base saturation_____
F. CEC of soil_____
G. bulk density ______
H. solubility of Zn in the soil _______

2. *N-cycle:* write the letter from the diagram next to the appropriate process. (1 ea)

____ nitrification
____ denitrification
____ harvest
____ leaching
____ cation exchange
____ mineralization
____ immobilization
____ erosion



3. Matching: (1 ea)

____ invented the commercial reaction to make NH_3
____ first stated the law of the minimum
____ described how chemical reactions re-equilibrate
____ imagined little mouths on roots that ingested soil

A. Justus von Liebig
B. Le Chatilier
C. Fritz Haber
D. Jethro Tull

____ bacteria symbiotic with legumes; fix N_2 into proteins
____ fungi symbiotic with many plants, aid in water and nutrient uptake
____ major decomposers in soil; includes many bacteria and fungi
____ organisms that live in poorly drained soils

A. anaerobes
B. mycorrhizae
C. Rhizobium
D. heterotrophs

_____ soluble at low pH, often deficient in alkaline soils
_____ strongly adsorbed by Fe oxides at low pH
_____ most expensive macro-nutrient; large plant requirement
_____ toxic at high pH; often deficient in acidic soils

Mo
N
K
P
Cu

4. Fill-Ins:

________________________minimum C:N ratio of residue at which short-term N mineralization occurs
________________________instrument used in lab to measure cations in solution
________________________a soil sample made up of a number of smaller samples, mixed together
________________________soil contaminant that behaves similarly to micronutrient cations in soil
________________________instrument used in lab to measure blue color for P determination
________________________trade name for K or K-containing fertilizers
________________________mineral that is major source of P in rock phosphate deposits
________________________name or abbreviation of most commonly used P fertilizer; 0-50-0
_______________________ soil moisture tension when rapid gravitational drainage has ceased.
_______________________ attraction of water molecules to charged surfaces
_______________________ the equation for hydraulic head in soil

5. A 3-gram soil sample was extracted with 40 mL of a salt solution to measure exchangeable cations. Mg was measured in the solution, and found to be 0.23 meq/L. (Mg is 24 g/mole)

A. Calculate exchangeable Mg in meq/100g. (3)

B. Convert this value to lbs Mg/afs. (3)

6. A soil contains the following exchangeable cations (in meq/100g): Al: 1.5; Mg: 0.3; Ca: 2.3; K: 0.55; Na: 0.12.

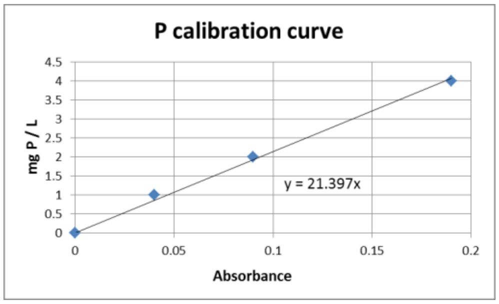
A. Calculate CEC of this sample. (2)

B. Calculate % base saturation. (2)

7. A soil sample of 5 g was extracted with 30 mL of dilute acid in a P soil test. An absorbance value of 0.07 was obtained when P was measured in this solution.

A. What is the ppm (mg/L) P in this solution? (2)

B. Calculate lbs P/acre in this soil. (3)



C. Use the table below to rate this soil and make a P_2O_5 recommendation. (1)

Soil test P	Rating	P_2O_5 recommended (lbs/a)
0-15	L	80
15-30	M	40
30-50	H	20
>50	VH	0

8. A fertilizer recommendation calls for the following application (in lbs/a): N, 120; P_2O_5, 60; K_2O, 40. Calculate how much of the following fertilizers to apply to meet his recommendation: 0-0-60, 30-0-0, 0-50-0. (3)

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9. Capillary rise-- (2)

a. is higher in coarser textured soils (bigger particles)

b. decreases as pore sizes decrease

c. occurs in all small diameter tubes regardless of material

d. increases with increasing cation exchange capacitye. is inversely proportional to pore radius

10. True/False: (1 ea)

______ porosity is equal to the volumetric moisture content at field capacity

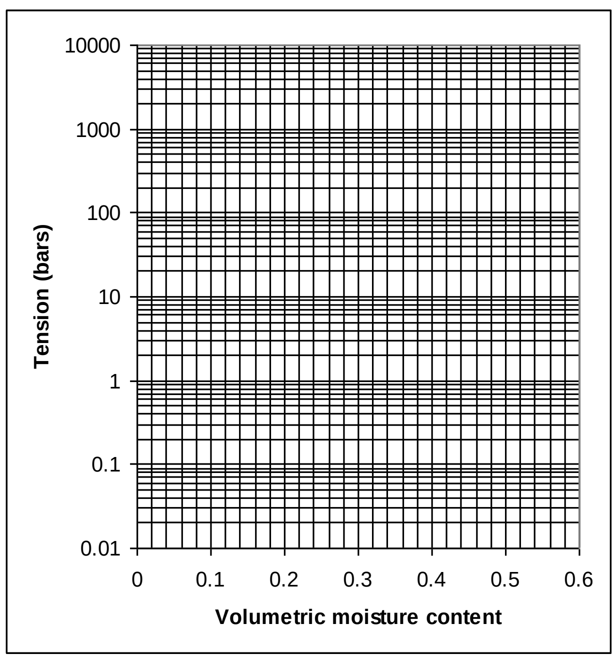
______ kinetic energy is an important aspect of soil water movement

11. A core of soil was taken from an A horizon that is 30 centimeters thick and has a bulk density = 1.25 g/cm^3. Lab testing of the soil mass at various soil tensions produced this data:

tension (bars)	0	0.1	15	10,000
soil mass	142	128	108	100
water mass				
grav. H_2O content				
vol. H_2O content				

A. Complete the table above (10)

B. What is the equivalent depth of water (in cm) available to plants at field capacity in this horizon? (3)



C. How many gallons of water is this amount per acre? (7.48 gallon= 1 ft^3) (3)

D. Use the data and graph above to draw a soil moisture characteristic curve. Assume tension at saturation is 0.01 bars (since a log scale has no zero). (2)

12. What does the term “sustainable” mean to modern agricultural production, specifically in terms of the inputs necessary to maintain productivity? (4)

13. Describe the law of diminishing returns; draw a graph showing how the law applies to fertilizer applications to crops. (4)

14. List some advantages of using organic fertilizers compared to inorganic ones. (4)

BONUS: Calculate the actual % K in 0-0-60. (K=39, O=16, Cl=35). (2)