CRSS/FANR 3060: SOILS AND HYDROLOGY **NAME_____**
HOURLY EXAM #1 SPRING 2014 **Lab Section #____**

I. Multiple Choice: Circle the *best* answer for each question. 2 pts. each.

1. The most important process in forming older, mature landscapes from initially level ones is--
   A. surface erosion and losses of soluble minerals by weathering
   B. tectonic (mountain-building) activity
   C. deposition of geologic material by wind and water
   D. the action of glaciers and other agents in importing new parent material
   E. earthquakes and volcanic events

2. The Piedmont region of the Southeast, compared to the Midwestern Great Plains, has
   A. soils with more soluble salts
   B. less overall landscape relief
   C. more highly weathered soils that are more highly leached
   D. shallower soil profiles due to higher erosion rates
   E. soils that are more poorly drained

3. The major mineral that weathers by hydrolysis to form clay minerals and oxides is--
   A. gypsum B. quartz C. hematite D. feldspar E. calcite

4. Which of the following is an important function of *macro-pores* in soils?
   A. drain excess infiltrated water from the soil profile
   B. store water for later use by plants
   C. provide space for soil microbes to live in soils
   D. prevent excessive leaching of water and nutrients from soil by slowing percolation
   E. *all* of the above are functions of micro-pores

5. A common problem managing fine textured soils is---
   A. they have too few macro-pores and are often poorly aerated
   B. they hold little water due to the predominance of macro-pores
   C. they are difficult to compact properly, leading to too much pore space
   D. they always have high bulk densities, causing poor root growth
   E. none of the above

6. Which of the following horizons is/are *eluvial* (cirle all that apply)?
   A E B C R

7. Which of the following is true of an Fe oxide surface at low pH (acidic conditions)?
   A. it is uncharged due to the balance between H and OH
   B. it takes on a negative charge due to loss of protons to the solution
   C. it becomes highly protonated, and develops a positive charge
   D. it is surrounded by H_2O molecules, and is therefore negatively charged
   E. its surface area increases, but the charge remains constant over all pH's

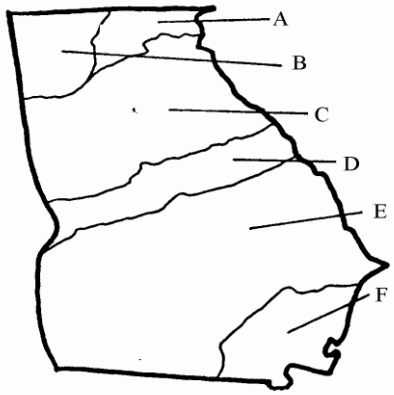
8. Two soil components that have appreciable pH-dependent charge are (circle TWO)--
A. kaolinite B. Fe oxides C. montmorillonite D. humus E. muscovite

II. Fill-in: Write the best term or response in the blank; 1 pt each.

9_____ light colored metamorphic rock found near Athens
10_____ the lightness or darkness of a color in the Munsell system
11_____ type of weathering reaction that transforms FeOOH into Fe_2O_3
12_____ an element that substitutes for Si in the tetrahedral layer of clay minerals
13_____ the "average" particle density of most common soil minerals
14_____ a functional group on humus that can be positively charged at low pH
15_____ an exchangeable cation that is considered to be "acidic"
16_____ parent material laid down in ancient lake beds
17_____ clay mineral that results from initial weathering of muscovite by hydrolysis
18_____ movement of water downwards through the soil profile toward a water table
19_____ number of tons of soil in an average acre-furrow slice
20_____ soil forming process that most directly results in formation of A horizon

III. Matching: Write the letter of the best response in the blank; 1 pt. each

21. Georgia regions
_____ igneous and metamorphic rocks; rolling topography
_____ limestone, shale, sandstone on steep topography
_____ poorly drained, recent marine sediments; Spodosols
_____ sandy aeolian parent material, formerly beach front



22. Soil forming Factors (choose only ONE, but use answers more than once if needed)
_____ why Histosols form in certain areas
_____ causes difference between Ultisols and Alifsols in GA Piedmont
_____ results in Mollisol formation on Great Plains of Midwest
_____ reason for Oxisol formation in Hawaii

A. Time
B. Parent material
C. Relief
D. Organisms
E. Climate

23. As soils are compacted by tillage or traffic, indicate whether the following soil properties INcrease (↑), DEcrease (↓), or stay the SAME/are unaffected (--).
_____bulk density
_____macropore space
_____particle density
_____micropore space

24. As soil humus levels are increased over a period of years, indicate whether the following soil properties INcrease (↑), DEcrease (↓), or stay the SAME/are unaffected (--).
_____bulk density
_____CEC
_____aggregation (granular structure)
_____soil pH

IV. Short Essay/Problems: Write a concise, to-the-point, legible answers to the following questions; *show* your calculations for any partial credit. 3 pts. each.

25. A map with a scale of 1:36,000 gives a length of a stream channel to be 6.5 inches; if the channel drops 150 feet in elevation over this distance, calculate the channel gradient in %.

26. Use Le Chatilier's principle to explain how the solubility of Al changes as pH changes, using the following reaction:

$$Al(OH)_3(s) + 3H^+ \leftrightarrow Al^{+3} + 3H_2O$$

27. Define "base saturation" of a soil in words; from a plant growth point of view, do we want %BS to be high or low?

28. Explain briefly the major differences between *permanent* and *variable* charge in soils; give example minerals that contain each kind of charge.

V. Soil Profiles: Write the full, correct horizon designations in the blanks next to each horizon, and answer the questions following the soil description. 1 pt. per blank

29. Dothan series, 0-2 % slopes, in upland cultivated field, Coastal Plain province.

____0 to 8 inches; dark greyish brown (10YR 4/2) loamy sand; weak granular structure; many fine roots; very friable; strongly acid; abrupt smooth boundary.
____8 to 14 inches; greyish brown (10YR 5/2) loamy sand; weak granular structure; common fine roots; very friable; strongly acid; gradual wavy boundary.
____14 to 18 inches; yellowish brown (10YR 5/6) sandy loam; weak subangular blocky structure; friable; common fine roots; strongly acid; gradual wavy boundary.
____18 to 30 inches; yellowish brown (10YR 5/4) sandy clay loam; moderate subangular blocky structure; firm; patchy clay films on ped faces; strongly acid; gradual wavy boundary.
____30 to 45 inches; yellowish brown (10YR 5/4) sandy clay loam; moderate subangular blocky structure; few strong brown (7.5 YR 5/6) mottles; firm; common clay films on ped faces; very strongly acid; gradual wavy boundary.
____45 to 60 inches; mottled yellowish brown (10YR 5/6), strong brown (7.5YR 5/6), light grey (10YR 6/1), and dark red (10R 3/6) sandy clay l oam; weak subangular blocky structure; firm; few clay films; strongly acid.

30. Cartecay series, 1% slope, on floodplain in Piedmont; in pasture.

____0 to 10 inches; dark brown (10YR 3/3) loam; weak fine granular structure; very friable; many fine roots; many fine mica flakes; moderately acid; abrupt smooth boundary.
____9 to 22 inches; yellowish brown (10YR 5/4) loam; common medium distinct dark brown (10YR 3/3) mottles; massive; very friable; many fine roots; many fine mica flakes; thin strata of silt loam and sandy loam; moderately acid; clear smooth boundary.
____22 to 40 inches; pale brown (10YR 6/3) sandy loam; massive; very friable; many fine mica flakes; thin strata of loamy sand; common medium distinct yellowish brown (10YR 5/4) masses of iron and light gray (10YR 7/2) iron depletions; moderately acid; gradual wavy boundary.
____40 to 60 inches; gray (10YR 5/1) loamy sand; single grain; loose; few gravel; many fine mica flakes; moderately acid.

31. For these profiles, give the following:

	Dothan	Cartecay
A. Diagnostic surface horizon:	_____	_____
B. Diagnostic subsurface horizon:	_____	_____
C. Soil order:	_____	_____
D. Parent material:	_____	_____
E. Drainage class/depth to water table	_____	_____
F. Suitability of use (Good or Bad) for—		
Agricultural use:	_____	_____
Urban use:	_____	_____

BONUS (+2 pts): Most Piedmont Bt's are red; many in the Coastal Plain are yellow. Explain why, briefly, using $Fe_2O_3 + H_20 \leftrightarrow 2FeOOH$.