

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

1. *Low chromas* in the Munsell color system tell you that a soil--
  - A. has a high Fe content
  - B. has a high humus level (is dark).
  - C. is wet (waterlogged) a significant part of the year.
  - D. has oxidized forms of Fe in it.
  - E. is well-drained.
2. Soils located on *foot slopes*, compared to those of the backslope of a hillside, are usually--
  - A. formed in alluvial parent materials.
  - B. deeper, with a thicker solum and regolith.
  - C. usually a redder color and better drained.
  - D. Inceptisols rather than Ultisols or Alfisols.
  - E. similar to backslope soils, but with a thinner Bt horizon.
3. Native American Indians helped to form Mollisols by—
  - A. herding buffaloes around the Great Plains.
  - B. burning the prairies to aid hunting, thereby reducing tree growth.
  - C. cutting down the trees for wood, encouraging grass growth.
  - D. fertilizing the soil with dead buffaloes which they had run over cliffs.
  - E. cultivating wide areas of the Plains to grow corn.
4. Granular structure forms due to—
  - A. binding of Fe oxides to clays.
  - B. cation bridging between clays and humus.
  - C. compressive forces within aggregates.
  - D. binding of illuvial clay coatings on ped faces.
  - E. leaching of soluble cations from the solum.
5. Which one of the following processes occurs at the *fastest* rate during soil formation?
  - A. losses of weatherable minerals such as calcite and feldspar from the regolith.
  - B. translocation of clay and Fe into the B.
  - C. transformation of rock into parent material at the C / R boundary.
  - D. formation of humus in the A horizon.
  - E. disintegration of rock into smaller particle sizes by physical weathering.
6. The reaction " $2\text{FeOOH(s)} \leftrightarrow \text{Fe}_2\text{O}_3\text{(s)} + \text{H}_2\text{O}$ " tells you that--
  - A.  $\text{Fe}_2\text{O}_3$  (which is red) will form on hilltops rather than in wetter valleys.
  - B. most soils will have equal amounts of  $\text{Fe}_2\text{O}_3$  and FeOOH.
  - C. FeOOH (yellow color) will form more in drier climates.
  - D.  $\text{H}_2\text{O}$  is required to form FeOOH.
  - E. none of the above are true.
7. The device used in the field to measure slope gradient:  
A. hydrometer    B. clinometer    C. thermometer    D. rheometer    E. dynamometer
8. Two minerals that weather by hydrolysis to form clay minerals are (circle TWO)--  
A. calcite    B. feldspar    C. iron oxide    D. muscovite    E. quartz

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

- 9 \_\_\_\_\_ name for pores that hold and store water for plant use
- 10 \_\_\_\_\_ most common type of structure in B horizons
- 11 \_\_\_\_\_ bulk density of a soil that has 50% pore space
- 12 \_\_\_\_\_ term for parent material that weathered in place, without transport
- 13 \_\_\_\_\_ term for a land area that drains surface water to a single outlet
- 14 \_\_\_\_\_ process of soil formation responsible for formation of Bh horizons
- 15 \_\_\_\_\_ an element other than Al found in octahedral positions of clay minerals
- 16 \_\_\_\_\_ name of reaction where one ion replaces another on clay mineral surface
- 17 \_\_\_\_\_ layer of high bulk density below the A horizon, formed by repeated tillage
- 18 \_\_\_\_\_ continent that collided with N. American 300 million years ago
- 19 \_\_\_\_\_ rock that weathers by solution to form landscapes with caves, sinkholes
- 20 \_\_\_\_\_ type of reaction that weathers feldspar to clays and releases basic cations
- 21 \_\_\_\_\_ a functional group on humus that can be positively charged at low pH
- 22 \_\_\_\_\_ pH of a solution that contains 0.000001 moles/L  $H^+$
- 23 \_\_\_\_\_ term describing how clay minerals get their permanent charge

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

24. *Georgia Regions*

- \_\_\_\_\_ Steep, folded sandstone, shale; Inceptisols, Ultisols
- \_\_\_\_\_ Region along the Fall Line; aeolian sands
- \_\_\_\_\_ Recent marine sediments; Spodosols and Histosols
- \_\_\_\_\_ Rolling to flat marine sediments, mostly Ultisols



25. *Soil Orders*

- \_\_\_\_\_ deep, dark, high base A horizon
- \_\_\_\_\_ form in young glacial till under hardwood vegetation
- \_\_\_\_\_ ochric or umbric over an acidic argillic
- \_\_\_\_\_ cambic horizon; found on terraces and steep slopes

- A. Oxisols
- B. Mollisols
- C. Alfisols
- D. Inceptisols
- E. Ultisols

26. *Textural Classes*

- \_\_\_\_\_ forms neither a ball nor ribbon
- \_\_\_\_\_ forms a moderate (1-2") ribbon; very gritty
- \_\_\_\_\_ forms a strong (>2") ribbon
- \_\_\_\_\_ forms a weak ribbon; smooth (no grit)

- A. clay loam
- B. sandy clay loam
- C. sand
- D. silty clay loam
- E. silt loam
- F. clay
- G. loamy sand
- H. loam

27. Clay Minerals

- \_\_\_\_\_ 1:1 clay mineral predominant in Ultisols  
\_\_\_\_\_ 2:1 clay with high charge, shrinks/swells a lot  
\_\_\_\_\_ 2:1 structure; initial weathering product from muscovite

- A. vermiculite  
B. montmorillonite  
C. illite (hydrous mica)  
D. kaolinite

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

28. On a map with a scale of 1:24,000, a slope segment is measured and found to be 3.2 inches long with an elevation (above sea level) at one end of 780 feet and at the other of 550 feet; what is the average slope gradient (in %) of this segment? (3 pts)
29. A mechanical analysis is performed on 50 g. of soil, giving a 40-second reading of 15 g/L and an 8-hour reading of 7 g/L. Calculate % sand, silt, and clay, and estimate the textural class. (4 pts)
30. A coated clod weighing 46.4 g was immersed in water and found to displace 31.7 g of water. Calculate bulk density and porosity (show units). (4 pts)
31. Which TWO of the Five Factors of Soil Formation are MOST responsible for the predominance of Ultisols in the Southeastern US? Explain briefly why this is true. (4 pts)
32. Write a chemical reaction to show how CEC develops on a carboxyl group on humus. Discuss (using Le Chatelier's principle) how soil pH affects this reaction. (4 pts)

33. If you want to calculate the exact mass of a *particular* acre-furrow slice, what two pieces of information do you need in order to do this? (2 pts)

**V. Soil Profile:** 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

34. **Pedon 1:** Piedmont province, on backslope, 6-10% slope, in young pine stand.

\_\_\_\_--0 to 1 inch; matted pine needles.

\_\_\_\_--1 to 7 inches; dark reddish brown (5YR 3/3) loam; weak granular structure; friable; many fine roots; strongly acid; abrupt smooth boundary.

\_\_\_\_--7 to 12 inches; dark red (2.5YR 3/6) clay loam; weak subangular blocky structure; friable; common fine roots; strongly acid; gradual wavy boundary.

\_\_\_\_-12 to 23 inches; dark red (10R 3/6) clay; moderate subangular blocky structure; firm; few fine roots; few clay films on faces of peds; strongly acid; gradual wavy boundary.

\_\_\_\_--23 to 53 inches; dark red (10R 3/6) clay; strong subangular blocky structure; firm; few fine roots in upper part; common clay films on faces of peds; few quartz gravel; strongly acid; gradual wavy boundary.

\_\_\_\_--53 to 72 inches; dark red (2.5YR 3/6) clay; few prominent yellowish brown (10YR 5/6) mottles; moderate subangular and angular blocky structure; firm; many clay films on faces of peds; strongly acid.

35. Give the following for this soil profile:

\_\_\_\_\_ diagnostic surface horizon name

\_\_\_\_\_ diagnostic subsurface horizon name

\_\_\_\_\_ Soil Taxonomy order of this soil

36. What is the parent material of this soil (be as specific as possible) \_\_\_\_\_

37. Give the drainage class, or depth (in inches) to the seasonal high water table: \_\_\_\_\_

38. Do you see any major limitations for the use of this soil for urban or agricultural use? \_\_\_\_\_  
Explain briefly:

39. BONUS: The surface material of the moon is a pulverized grey material; the surface of Mars is clearly a reddish color. What do these colors tell you about the composition of each, and about the probable "soil-forming processes" that have operated there over geologic time? (up to 4 pts)