Name ___________________________

AGRY 465 EXAM
October 3, 2001
(100 points, 8 pages total)

(4) 1. Why does the clod bulk density procedure overestimate the true B.D. of the soil?

(4) 2. When we perform particle size (texture) analysis, why must we remove organic matter and carbonates, and disperse clays?

(6) 3. List and briefly describe (~1 sentence each) 3 factors that affect the susceptibility of a soil to compaction.

(4) 4. What are soil conditioners, and what do they do?

(5) 5. You have been asked to assess a popular city park for some potential compaction problems. The park manager suggests that you take bulk density cores in the top 12 inches (in 0-4", 4-8", and 8-12" increments), in several spots in the "problem" area and in several spots without problems. You agree, but you also suggest that you make some cone penetrometer readings as well. Why? i.e. what additional factors does a penetrometer assess, that simple bulk density measurements do not?

(4) 6. Explain at least 2 different reasons why good soil structure is important.

(8) 7. Sketch a graph (label the axes) of soil bulk density vs. gravimetric water content, after compaction in a Proctor Test apparatus. What is the purpose of the Proctor Test, and what does the curve you drew illustrate?

(8) 8. Listed below in the left column are 6 methods that are used to measure some aspect of soil structure. In the right column are listed the actual information which we would like to know about the soil. For each item in the right column, choose the one best method from the choices on the left (a-f).

Methods	Desired Information
a. air-to-water permeability ratio	___Stability of aggregates to breakdown by wind erosion
b. pore size distribution	___Relative stability of different soils under long-term wastewater disposal fields
c. dry crushing between 2 plates	___Stability of aggregates to breakdown by water erosion
d. dry sieving	___Volume of pores of suitable size for root growth
e. wet sieving	
f. bulk density	

(6) 9. Various types of penetrometers and other devices are used to obtain quick estimates of soil strength for different purposes. Listed below in the left column are instruments that can be used. In the right column is listed the type of process for which an index is desired. For each item in the right column, choose the one best instrument from the choices on the left (a-d).

Instruments	Index desired
a. cone penetrometer	___Soil crust strength
b. Proctor penetrometer	___ Bearing capacity of soil for wheel traffic
c. shear vane	___Ability of roots to grow through soil
d. modulus of rupture	

(4) 10. In each of the following pairs of soils, indicate which one would have the greatest volumetric heat capacity, and which would have the greatest thermal conductivity. (It is possible that the same soil could have both the highest heat capacity and the highest thermal conductivity.)

		heat capacity (a or b?)	thermal conductivity (a or b?)
a) wet sand at BD=1.4 g/cm^3	b) dry sand at BD = 1.4 g/cm^3	_______`	_______
a) compact soil at saturation	b) loose soil at saturation	_______	_______

(6) 11. For each of the following surface soil treatments listed below, 1) state whether the average soil temperature in the top 5 cm will probably increase or decrease, compared with a bare, flat, smooth soil surface, and 2) briefly explain the reasons for the increase or decrease. (Assume it is in the spring of the year, when the soil is starting to warm up.)

a) black plastic

b) loosening (tilling) the soil

(6) 12. List and explain the 4 mechanisms by which energy may be transferred to and through soils.

(9) 13. Given the following data, calculate:

a) bulk density
b) total porosity
c) volumetric water content

SHOW ALL WORK AND UNITS!

core volume = 1200 cm^3
particle density = 2.65 g/cm^3
wet soil = 1800 g
dry soil = 1500 g
density of water = 1.0 g/cm^3

(10) 14. How many cm of water are stored in the top 60 cm of this soil profile? We measured gravimetric water content (θg) and bulk density (BD) as follows: **(SHOW ALL WORK AND UNITS!)**

Depth (cm)	θg(g/g)	BD(g/cm^3)
0-15	0.18	1.17
15-35	0.24	1.28
35-60	0.31	1.34

(8) 15. Given the following data from the clod bulk density procedure, calculate the soil bulk density. **SHOW ALL WORK AND UNITS!**

Moist soil clod	= 340 g
Moist soil clod + saran	= 352 g
Saran density	= 1.3 g/cm^3
Bucket + water	= 500 g
Bucket + water + suspended clod	= 665 g
Water density	= 1 g/cm^3
Oven dry soil + saran	= 280 g

(8) 16. You are doing an experiment to try to prolong the autumn growth of newly-established turf in a golf green. During construction of the green you installed some heating plates above the drainage system, so you could heat the soil from below. As a first approximation (estimate) of the amount of heat lost from the top of these buried plates up through soil to the air above, let's assume steady-state 1-dimensional flow of heat through the soil and no movement of water or vapor. Calculate the heat loss per m^2 out the top of the heating plates, assuming you maintain constant surface soil temperature of 10°C, constant temperature of the heating plates of 45°C, heat plate depth of 35 cm, and soil thermal conductivity of 3.2×10^{-3} cal/cm sec°C. SHOW ALL WORK AND UNITS! **Your final answer must be expressed in scientific notation and in units of cal/m^2 day!**

INFORMATION YOU MAY OR MAY NOT NEED:

Heat flow equation $q_H = -K \frac{\Delta T}{\Delta Z}$

Soil thermal conductivity = 3.2×10^{-3} cal/cm sec°C
Soil organic matter content = 1.7%
Soil bulk density = 1.45 g/cm^3