Name _____

AGRY 465 EXAM, October 6, 2004
(100 points, 8 pages total)

(4) 1. Define soil "structure" and contrast it with "texture."

(4) 2. Describe two types of management practices that will usually <u>increase</u> earthworm populations in soils, and explain <u>why</u>.

(4) 3. Explain the terms in this equation:

$q_H = -K(\Delta T/\Delta Z)$

q_H

K

ΔT

ΔZ

(6) 4. List and briefly describe (~1 sentence each) 3 <u>soil properties or processes</u> that are affected by soil compaction.

The sketch at right shows data from a Proctor Compactability test on two different soils. Refer to the sketch to answer the next two questions.

(4) 5. What is the purpose of the Proctor test? (Choose the one best answer).
   a) to use field-measured bulk density values to predict field water contents after a heavy rainstorm
   b) to determine the soil water content at which compaction first begins
   c) to determine the bulk density at which maximum soil water content can occur
   d) to determine the soil water content at which maximum bulk density can be achieved

(4) 6. The two soils illustrated in the graph above are a silt loam soil with 1% organic matter and the same silt loam soil with 4% organic matter. Which curve represents the silt loam soil with 4% organic matter?

   a) Soil A
   b) Soil B

(4) 7. List 3 different types of compacted soil layers.

(4) 8. There are six types of soil structure commonly described. Name four. Do not include the "structureless" types, single-grained and massive.

(8) 9. 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	___ Surface soil stability to raindrop impact
c. dry crushing between 2 plates	___ Relative stability of different soils under long-term septic tank disposal fields
d. dry sieving	___Volume of pores of suitable size for root growth
e. wet sieving	
f. raindrop tower	

(6) 10. 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. shear vane	___ Ability of roots to grow through soil
b. cone penetrometer	___ Soil crust strength
c. Proctor penetrometer	___ Shearing failure of soil by tillage implements
d. modulus of rupture	

(4) 11. 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) loose soil at saturation	b) compacted soil at saturation	_____	_____
a) dry sand at BD=1.5 g/cm^3	b) wet sand at BD = 1.5 g/cm^3	_____`	_____

(4) 12. A landscaping company in Lafayette goes out near the end of winter to prepare the grounds around a business client's headquarters. They want to speed up the soil warming process in the top 2 inches of soil. Which of the following treatments would cause the soil temperatures to warm up more rapidly than bare soil? CIRCLE ALL CORRECT ANSWERS.

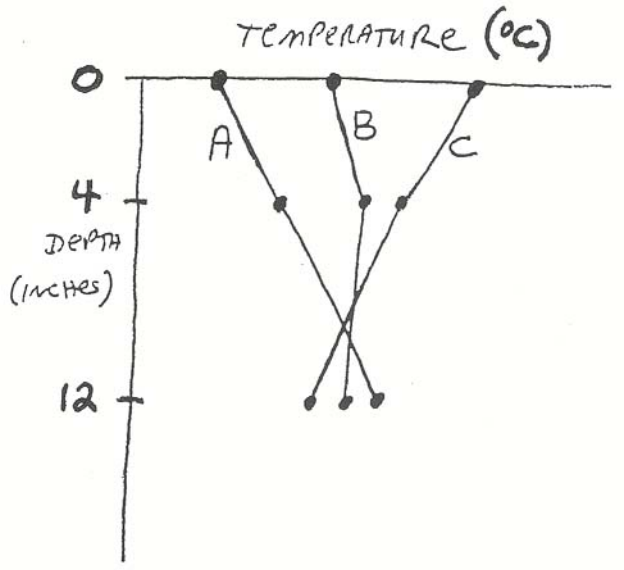
a) tilling (loosening) the soil
b) straw-mulch
c) irrigating the soil to keep it wet
d) black plastic
e) clear plastic

(4) 13. Thermocouples are used to measure soil temperature. The basic principle of their operation is:

a) Metal wire junction attached to a mercury thermometer with digital readout meter.
b) Two junctions of two different metals. A voltage is generated proportional to the temperature difference between the two junctions.
c) Two different metals that expand differently with temperature changes. The difference is expansion/contraction is measured.
d) None of the above.

(4) 14. Soil temperature vs. depth curves are plotted for 3 different times during the day: 5 PM, 12 midnight, and 6 AM.
Which curve represents each of the following times?

12 midnight _____
6 AM _____



(9) 15. Given the following data, calculate:
a) bulk density (B.D.)
b) gravimetric water content (θg) of field-wet soil
c) volumetric water content (θv) of field-wet soil

SHOW ALL WORK AND UNITS!

can empty weight 20g
can volume 70 cm^3
can plus soil in field-wet condition 142 g
can plus soil after oven-drying 120 g
density of water = 1.0 g/cm^3

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

Moist soil clod	= 435 g
Moist soil clod + saran	= 445 g
Saran density	= 1.3 g/cm^3
Bucket + water	= 500 g
Bucket + water + suspended clod	= 735 g
Water density	= 1 g/cm^3
Oven dry soil + saran	= 375 g

(9) 17. How much heat is required to raise the soil temperature of 1.0 m^3 of field-moist soil from 10°C to 15°C? **SHOW ALL WORK AND UNITS!**

θ_v = 0.25 cm^3 water/cm^3soil
porosity = 0.50 cm^3pores/cm^3soil
soil mineral particles content = 0.46 cm^3minerals/cm^3soil
organic matter content = 0.04 cm^3OM/cm^3soil
Heat capacity of air = C_a = negligible
Heat capacity of water, C_w = 1.0 cal/cm^3 °C
Heat capacity of soil minerals, C_m = 0.5 cal/ cm^3 °C
Heat capacity of soil organic matter, C_o = 0.6 cal/ cm^3 °C

(9) 18. Mean annual temperature at the soil surface at the Agronomy Research Center is about 15°C. Soil temperature variation at the surface (z = 0) during the year is predicted by this equation:

$T_o = T_{ave} + A_o \sin(\omega t) \quad = \quad 15°C + 12°C \sin(\omega t)$

Plot the predicted variation in Temperature <u>at the surface</u> and at a <u>depth of 120 cm</u>. Equations and information that may be useful follow. **Show all calculations**. (show work on reverse of previous sheet)

Thermal diffusivity = $D_H = 1.095 \times 10^5 \text{ cm}^2/\text{yr}$

d = damping depth = $\sqrt{\frac{D_H \tau}{\pi}}$

τ is time period, in this case 1 year

$A_z = A_o e^{-z/d}$

$\omega = 2\pi/\tau$

timelag = $\Delta t = z/\omega d$

z is soil depth of interest