Name ________________________

Agry 465 Exam
November 17, 2004
(100 points) (8 pages)

(4) 1. Tensiometers measure what in the soil? (circle all true statements)
a) hydrogen concentration
b) gravimetric water content
c) volumetric water content
d) matric potential
e) osmotic potential

(4) 2. Neutron probes should be calibrated for your soil. What are the purposes of calibration? (circle all true statements)

a) to adjust readings for application of fertilizer salts such as potassium nitrate (KNO_3)
b) to adjust readings for soil pH
c) to adjust readings for hydrogen present in clays and soil organic matter
d) to adjust readings for hysteresis in the soil water retention curve
e) to adjust readings for slow neutron absorbers such as boron, chloride and cadmium (B, Cl, Cd)

(3) 3. The ceramic cups on tensiometers must remain saturated in order to function properly. At what tension will the pores in the cup desaturate?
a) 0.1 bar
b) 0.33 bar
c) 1 bar
d) 15 bar

(3) 4. TDR (time domain reflectometry) as used to determine soil water, measures the dielectric constant which is directly related to:

a) Hydrogen concentration
b) Matric potential
c) Gravimetric water content
d) Volumetric water content

(3) 5. We normally define soil available water storage capacity as
a) θ at Saturation - θ at air dry
b) θ at wilting point - θ at field capacity
c) θ at field capacity - θ at air dry
d) θ at field capacity - θ at wilting point

(3) 6. When a field tile is working and draining water from the soil, the zone immediately around the tile will have a ψ of

a) 0.0 bar
b) -0.1 bar
c) -0.3 bar
d) -15 bar

(3) 7. The sand table was used to create a tension of 50 cm of water (-0.05bar). That helps us determine the

a) saturation point
b) aeration porosity
c) field capacity
d) wilting point

(4) 8. In the aggregate size distribution lab, if the moist samples had been broken to pass through a 12 mm screen rather than the usual 8 mm screen, and then wet-sieved with the usual nest of sieves of 4.76 mm, 2mm, 1mm, and 0.21 mm, what would the maximum possible value of MWD be?

a) 12 mm
b) 4.76 mm
c) 8.38 mm
d) 6.38 mm

(6) 9. You want to measure soil water content over 2-inch increments down to 12 inches (i.e. you want 0-2", 2-4, 4-6, 6-8, 8-10, and 10-12" water contents). Which of the following methods could be suitable for this application? (some may be more time consuming than others, but are they inherently suitable?) CIRCLE all correct answers! For all 4 methods, state why the method is suitable or why it is not suitable.

a) electrical resistance blocks
Why or why not?

b) neutron probe
Why or why not?

c) TDR
Why or why not?

d) sampling with soil probe and oven drying
Why or why not?

(8) 10. Draw a sketch of a soil water retention curve (desorption), for a sand and a silt loam (include both curves on the same graph). Explain the reasons for the differences in the shapes of the two curves. (Be sure to label the axes!)

(4) 11. List at least 3 reasons why infiltration rates may decline with time during an infiltration event.

(4) 12. Circle the letter(s) in front of all true statements below:

a) Electrical resistance blocks are very accurate devices for obtaining precise water content values.

b) Electrical resistance blocks must be calibrated for your soil, in order to relate the readings to actual soil water content.

c) Electrical resistance block readings can be automated and are useful for automating irrigation systems

d) Electrical resistance blocks are no longer used and are an obsolete technology.

(4) 13. Choose the best definition of "field capacity" from the choices below.

a) soil water content of an intact core sample equilibrated at -0.1 bar potential
b) field soil water content, after a soil has been fully saturated and then allowed to drain until further drainage is negligible
c) field soil water content, after a soil has been fully saturated and then allowed to drain for 24 hours
d) field soil water content, 24 hours after any major rainfall event

(4) 14. On the field trip we saw an above-grade septic disposal system, or "mound system." What is the basic purpose of the mound compared to the standard septic disposal system?

(3) 15. On the field trip, we saw the dairy barn was being heated and cooled by what type of system that relates to what you've learned in class?

(6) 16. Rank the following 3 soils (1 = highest, 3 = lowest) for each of the soil physical properties listed in the table.

	water content -0.1 bar	saturated hydraulic conductivity	water content -15 bar	plant available water
sand				
clay				
silt loam				

(3) 17. <u>Why</u> do we drain soils? Give three reasons.

The following equations and information may or may not be needed to work some of the problems. They are here for your reference if you need them.

DARCY'S LAW

$$q_w = -K \frac{\Delta H}{\Delta L} \quad \text{OR} \quad Q = -KA\frac{\Delta H}{\Delta L}$$

POISEUILLE'S LAW

$$Q = -\frac{\pi R^4 \rho g \Delta H}{8 \eta L}$$

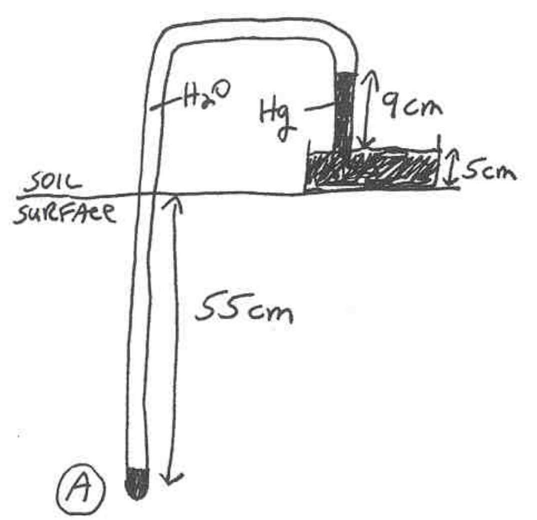
Assume $\rho_w = 1 g/cm^3$

$g = 980\ cm/sec^2$

$\eta = 1.0 \times 10^{-2} \frac{g}{cm\ sec}$

$$K_{EFFECTIVE} = \frac{L_{TOTAL}}{\left(\frac{L_1}{K_1} + \frac{L_2}{K_2}\right)}$$

(8) 18. A mercury tensiometer is installed in the soil as shown. Calculate the pressure head, gravitational head, and total hydraulic head of the soil at point A, using the soil surface as the reference elevation. **SHOW ALL WORK AND UNITS!**



ASSUME:

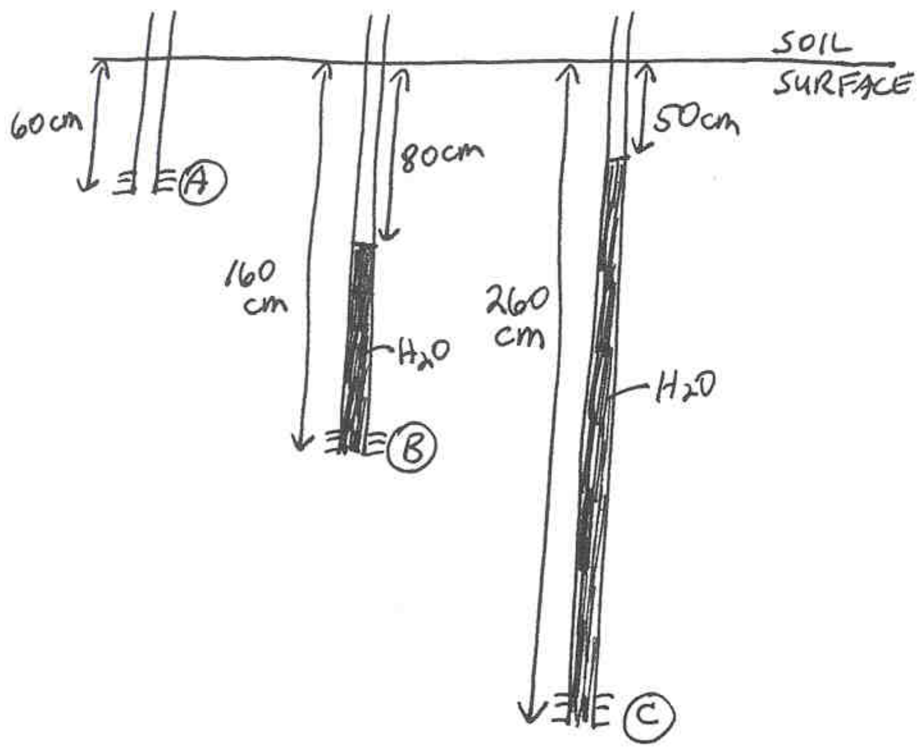
$\rho_{H_2O} = 1.0\ g/cm^3$

$\rho_{Hg} = 13.65\ g/cm^3$

(8) 19. A nest of piezometers is installed as shown.

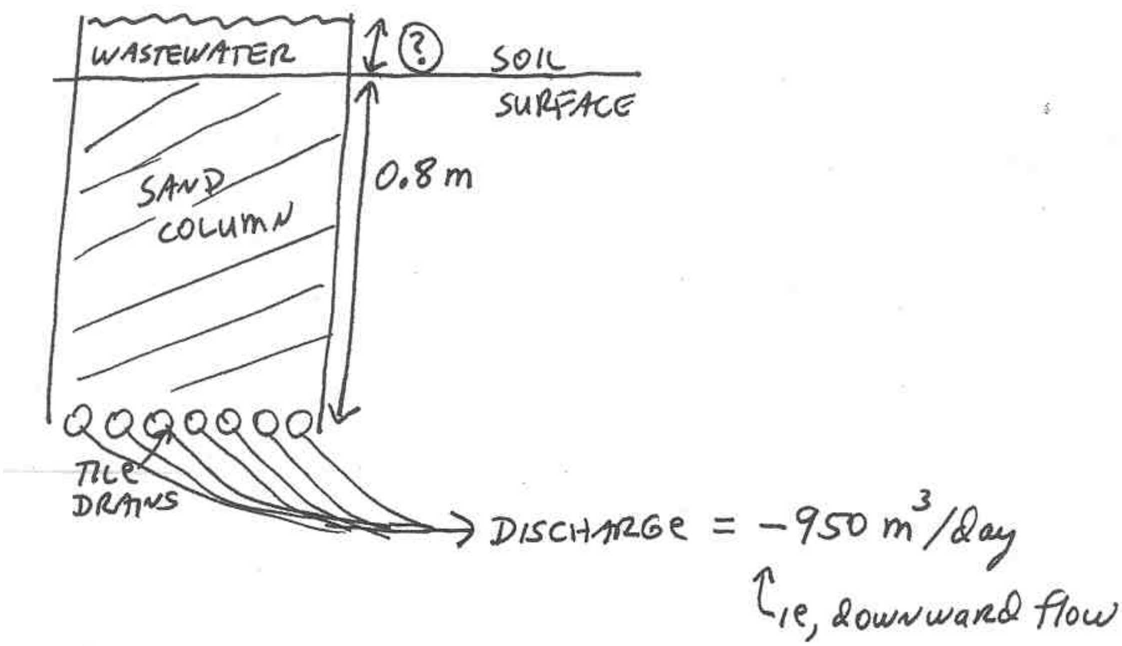
a) Calculate the pressure head, gravitational head, and total hydraulic head of the soil at points B and C, relative to the soil surface.

b) What is the best estimate of the water table depth in this profile, given the data?



(8) 20. A food processing plant is using soil filtration as the final step in treating the wastewater before discharge into the river. It ponds the water in large basins (total area of basins is 600 m^2), where it flows under saturated conditions through the soil to tile drains at a depth of 0.8 m. They must dispose of 950 m^3 per day. What ponding depth do they need in the basins, in order to dispose of this volume of wastewater? SHOW ALL WORK AND UNITS! (you may have been given more information than you need to solve the problem)

Pressure head at tile drains = 0 cm
Saturated hydraulic conductivity = 1.2 m/day
Saturated volumetric water content = 0.40
Sand content = 95%
Area of basins = 600 m^2



(7) 21. A double-ring infiltration test was run in the field, with the same equipment we used in lab. Given the data below, calculate the infiltration rate over the time period given. **Final units must be expressed as cm/hr.**

SHOW ALL WORK AND UNITS! Partial credit will be given when I can follow your work and thought process.

Assume area of inner ring = 800cm^2
Remember 1 ml = 1 cm^3

Actual Time	Water Volume in Supply Jug
10:00 AM	4.0 liters
10:15 AM	1.9 liters