

Study Questions: Soil Water

Note: This list is meant to help you learn the main points. They are not necessarily the exact topics or questions that will be asked on quizzes or exams. You'll see that there are more topics here than could possibly be on a single exam. But, by learning/understanding this material, you should be a long way toward doing well on the exams and in understanding soil!

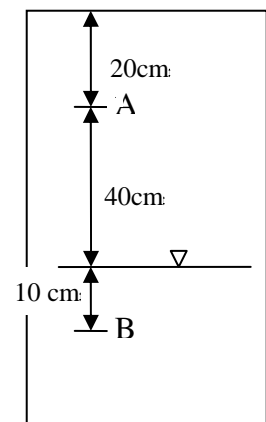
Questions like those that are grayed out (as is this line) will NOT be asked on the exams in 2005. These were not as emphasized in class this year. However, interested students review and attempt them based on your learning from your textbook.

Exercises

- 1) You take a soil sample that has a volume of 100 cm^3 . You measure the mass of this sample while moist, using a tin that has a mass of 20 g. The mass of the entire moist sample and the tin together is 150g. After oven drying at 105 C , the mass of the sample plus tin is 130 g.
 - a) What is the gravimetric water content? (Make sure to subtract out the mass of the tin in your calculation.)
 - b) What is the volumetric water content. (Note - you will need to calculate the bulk density from given info.)
 - c) Will the seeds germinate before the next rain?
 - d) What is the porosity of this soil?

2) Refer to the diagram below for the following questions.

- a) Which has the higher gravitational potential, location A or B?
- b) If the gravitational potential at the soil surface is zero, what would be the value of the gravitational potential at A and B? (Use units of *cm of water*)
- c) What is the matric potential at location B?
- d) Is the matric potential at location A positive or negative?
- e) What is the pressure potential at location B?
- f) What is the pressure potential at location A?
- g) If you have measured that the matric potential at location A is -50 cm water , what is the total water potential at A? (You can neglect the osmotic potential.)
- h) What is the total water potential at B (you can neglect the osmotic potential)?



i) Which way will the water move, from *A to B* or from *B to A*

j) Osmotic potential is one of the components of total water potential - Why could we neglect it in the questions above?

- 3 a) If the total water potential just outside of a plant root is -300 cm water, and the osmotic potential within the root is - 1000 cm water, will water go *into* or *out* of the root?
- b) If the soil dries out so that the total water potential is -2000 cm water, which way would you expect water to go, *into* or *out* of the root?

4) Define *field capacity* water content.

5) Define *permanent wilting point* water content.

6a) Define *available water content*.

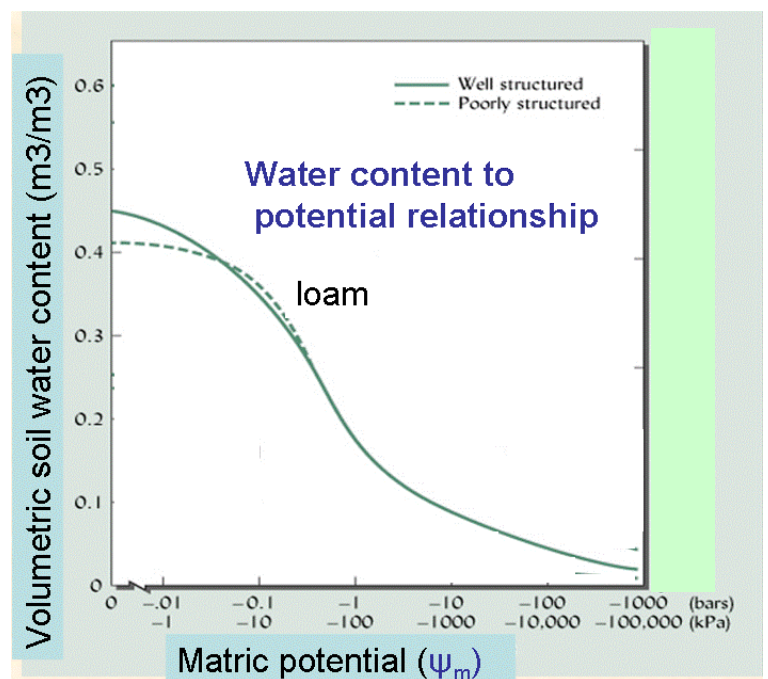
b) Another phrase used to describe the available water content of soil is to talk about the *water holding capacity* of that soil. Using your knowledge of available water content, explain why this phrase is used.

c) Which generally has a greater water holding capacity - a *sandy loam* or a *clay loam*?

d) Why does the water holding capacity depend on soil texture? Explain

e) Referring to the graph, how much available water do you have in the sampled soil?

f) At what volumetric water content would the soil be saturated? (should have two answers)



7) One strategy for irrigation is to add just enough water to bring the soil in the root zone to field capacity, but no more. Explain why adding more water would not be a good strategy.

8) Write out *Darcy's Law* and define each of the terms – including the units used for each.

9) What does *saturation* mean? What does *unsaturated* mean?

10) Explain why saturated soils have a higher hydraulic conductivity than unsaturated soils.

11) Explain why under *saturated* conditions, the hydraulic conductivity is generally greater in coarse-textured soils compared to fine-textured soils.

12) Explain why under *unsaturated* conditions, the hydraulic conductivity is generally greater in fine-textured soils compared to coarse-textured soils.

Thought question:

Brady and Weil consider *pressure potential* to include all other potentials besides gravitational and osmotic, including hydrostatic pressure, air pressure, and matric potential. (Most soil scientists separate out matric potential into its own category - if you are interested in why ask me. For the purposes of this class let's keep it separate.) *What situations do you think that pressure potential (due to hydrostatic pressure or air pressure) would play a role*

Hydrologic Cycle

1) Define the following terms and explain some of the factors that will influence their magnitude or characteristics..

Precipitation

Evaporation

Transpiration

Evapotranspiration

Groundwater

Runoff

Evapotranspiration (ET)

2) What is meant by the term *soil-plant-atmosphere-continuum*? Explain this concept.

3) What is meant by 'Soil Drainage'. Give examples of situations where artificial drainage might be beneficial. Give example(s) of situations where drainage is NOT a good idea.

4) In laying drainage tile, where should it be placed – at the water table, above the water table, or below the water table?

5) What will be the affect of placing a perforated drainage pipe in the capillary fringe zone just above the water table. (Explain in terms of water potentials.)

6) Describe the different general classes of irrigation equipment (flood/furrow, sprinkler, microirrigation), and explain when each is appropriate.

7) Explain approaches toward minimizing ET

- 8) Explain the different approaches toward monitoring ET for urposed of irrigation scheduling.
- 9) One of the answers to the above question should be using instruments that monitor soil moisture.
 - a) Describe different instruments, their range (in water potential), their advantages/disadvantages
 - b) How would you use the information generated by the equipment (What condition would trigger your decision to turn on the water?)