SOIL 4683 Exam 2 Example Questions

The problems for exam 2 will be taken from this list with minor modifications. Read carefully.

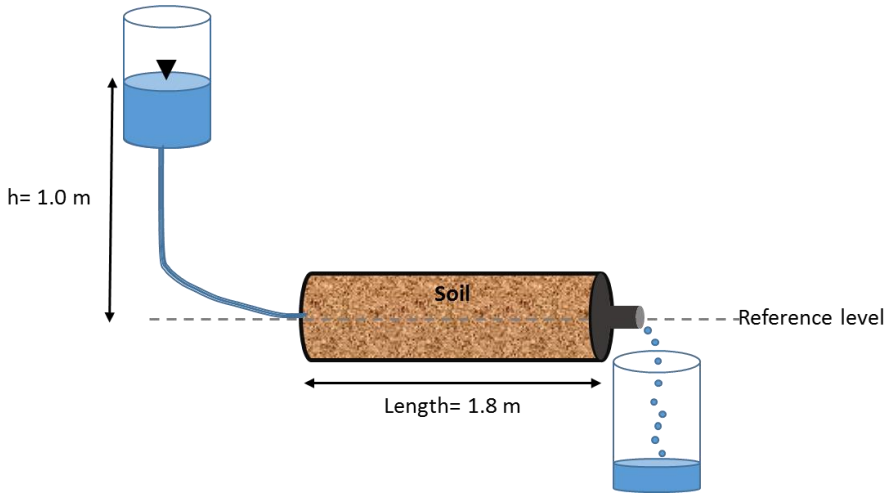
1. Define soil water potential. Define each of its three primary components.

2. Draw a figure showing an example soil water retention curve for a coarse-textured soil and one for a fine-textured soil. Label the axes. Specify the units and choose realistic maximum and minimum values for each axis. Write a paragraph in which you define the soil water retention curve and describe the differences between the curves for coarse-textured soil versus fine-textured soil.

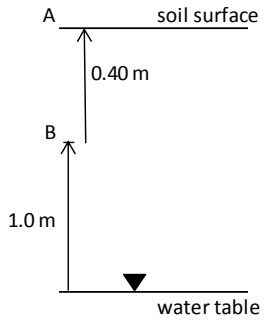
3. Define hysteresis as it applies to the soil water retention curve. Describe how hysteresis can affect the redistribution of soil water.

4. Define hydraulic resistance. Write Darcy's Law in terms of hydraulic resistance for flow through a soil with two layers of differing hydraulic conductivity.

5. A steady water flow of 6.5 cm hr^{-1} is passing through the soil column below. What is the hydraulic conductivity of the soil?



6. Look at the diagram below showing a deep, uniform sandy loam in equilibrium with a water table. Create a table showing the gravimetric, pressure, and total potentials at points A and B.



For the following question (#7) use saturated hydraulic conductivity, K_s, values of 18.3 cm/day for silt loam soil and 8.18 cm/day for clay loam soil.

7. A low-lying area in a cultivated field is often inundated with water after a heavy rain. To improve drainage the farmer has installed a subsurface drainage system which effectively maintains a free water surface at the 1.0 m soil depth. Estimate the soil water flux for the two following scenarios:
    a. fully saturated soil, 10. cm of ponded water on the surface, uniform silt loam soil from the surface to 1.0 m depth.
    b. fully saturated soil, 10. cm of ponded water on the surface, silt loam from the surface to 0.60 m depth and clay loam from 0.60 to 1.0 m depth.
8. Write the Green-Ampt equation for ponded infiltration and define each variable in the equation. List the assumptions made when using this equation.
9. Why do we often observe persistent distinct wetting fronts when water infiltrates into soil that was relatively dry prior to infiltration?

For the following questions (# 10-11) use soil parameters from the handout titled "Table 2. Green and Ampt Parameters According to Soil Texture Classes and Horizons".

10. Ponded infiltration is occurring in a loam soil. The ponding depth is 5.0 cm. The wetting front is now 15. cm deep. The initial water content of the soil was 0.10 $m^3\ m^{-3}$.
    a. Estimate the current infiltration rate.
    b. Estimate the cumulative infiltration.
11. Rainfall infiltration is occurring in a sandy loam soil. The rainfall rate is constant at 1.0 inch per hour. The initial water content was 0.15 $m^3\ m^{-3}$.

a. Estimate the depth of the wetting front when ponding first occurs.
b. Estimate how much water infiltrates before ponding occurs.
c. Estimate the time from the start of the rain until ponding.

12. Define preferential flow and its primary causes.

13. Estimate the soil water content at which drainage from the bottom of the soil profile equals 0.50 mm d^{-1} for a deeply wetted, uniform, sandy loam. Use the soil properties from the handout titled "Overview of the Campbell soil hydraulic property functions." Assume a saturated water content of 0.45 cm^3 cm^{-3}.

14. What are the three main stages of soil erosion? For erosion by water, describe the primary processes or factors involved with each of these three stages.

15. Consider a 1-L graduated cylinder with an initially uniform (i.e. well-stirred) dilute suspension of soil particles in water. Samples will be withdrawn from 10. cm below the water surface for particle size analysis. Assume terminal velocity is obtained right after stirring ends. How long should we wait before withdrawing the samples to be certain that:
    a. All the sand-sized particles have dropped below the sampling depth?
    b. All the silt-sized particles have dropped below the sampling depth?