Carleton University
CIVE3208/ERTH4107 Geotechnical Mechanics
Midterm Oct. 27, 2011

Duration: 1.15 hours
No. of Students: 113
Instructor: Dr. Rayhani
No. of Pages: 2
Authorized Memoranda: Closed book, calculators permitted, one single-sided hand-written 8.5 x 11 formula sheet (no graph, no photocopies)

This examination question paper *must not* be taken from the examination room.

Question # 1 **Short answer** questions: (30 marks)

a) What is the most distinguishing characteristic of Montmorillonite clay? (5)
b) Define permeability and state that which of the following soils have higher permeability? SC, CL (10)
c) Why during the construction of a clay landfill liner is it specified that the clay be compacted 1-3 % wet of the optimum water content? (5)
d) The capillary fringe is the tension saturated zone above the water table. Why doesn't gravity drainage occur in the capillary fringe and how does the capillary fringe in gravel compare to the capillary fringe in silt. (10)

Question # 2 (15 marks)

The minimum and maximum void ratios for typical silica sands are 0.46 and 0.66, respectively. What is the corresponding range of saturated unit weights in kN/m^3? ($G_s = 2.70$)
What is the volume of water contained in a cubic meter of this soil if the soil is compacted to its minimum void ratio (0.46) and the degree of saturation is 50 percent?

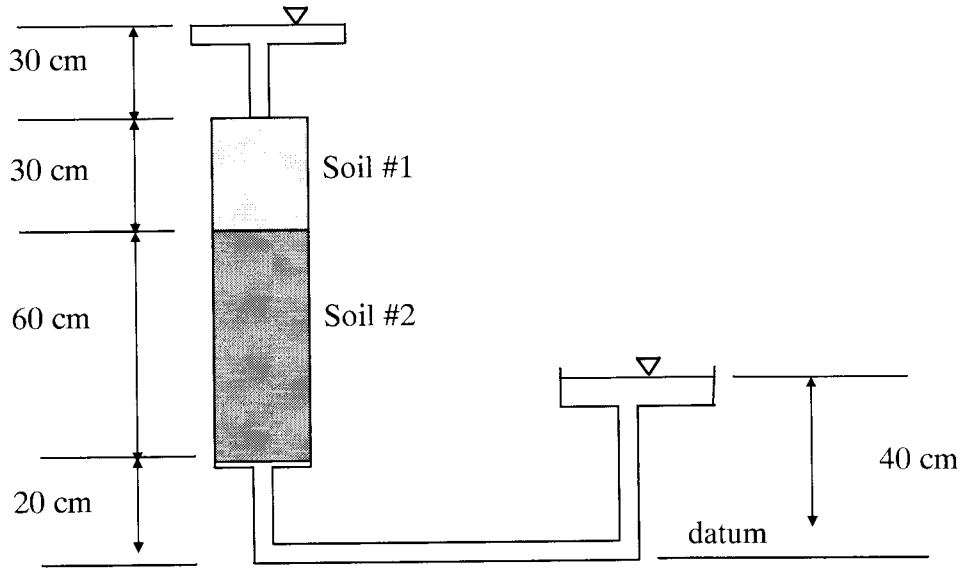
Question # 3 (20 marks)

A city inspector checked the field compaction of a soil layer using the sand cone method to determine the volume of the soil excavated. The contract specifications call for the soil to be compacted to at least 95 % of the maximum laboratory value and within ± 2 % of the optimum water content. The maximum dry density of the soil from compaction test in the lab was 1.9 g/cm^3. The volume of the soil excavated was 1153 cm^3 and its mass was 2209g. The dry mass of the soil was later determined to be 1879g. ($G_s = 2.70$)

a) What is the dry density of the soil layer?
b) What is the relative compaction?
c) Does the test meet specifications?
d) If the soil sample were saturated, what would be the water content?

Question #4 (20 marks)

Two reservoirs are connected to the soil column given below. If the cross-sectional area of the soil column is 10 cm^2, k_1 is 3×10^{-2} cm/s and k_2 is 1×10^{-5} cm/s and the soil porosity for both soils is 0.333, determine the flow through the column, the Darcy velocity and the seepage velocity.



Question #5 (15 marks)

A column load Compute the vertical effective stress at a depth of 5 m at a site where there is a homogenous deposit of silty sand and the water table is 3 m below the soil surface. The bulk and saturated unit weight of the soil are γ= 19 kN/m^3 and γ_{sat} = 20 kN/m^3.

What would be the effective stress at the same level (depth 5 m) if the ground water level rises about 1 m due to capillary fringe?