

Soil Mechanics

Midterm Exam

Time: 105 minutes

Spring 2008

Name:

Student ID:

1. The wet densities (ρ) and degrees of saturation (S) of a soil are given in the following table:

$\rho(\text{kg/m}^3)$	S (%)
1694	50
1806	75

- Determine void ratio (e).
- Determine specific gravity (G_s).

(20 points)

2. Describe briefly the crystalline or atomic structures, engineering properties, and applications of the following minerals.
 - a. Kaolinite
 - b. Montmorillonite

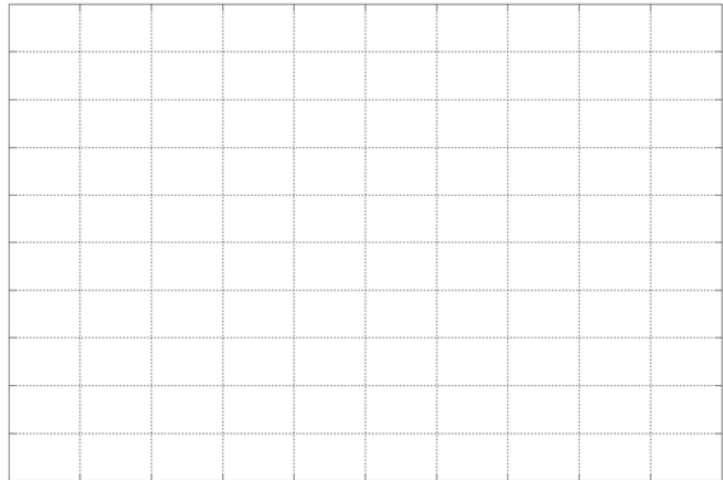
(20 points)

3. The laboratory test data for a standard Proctor test are given in the table below:

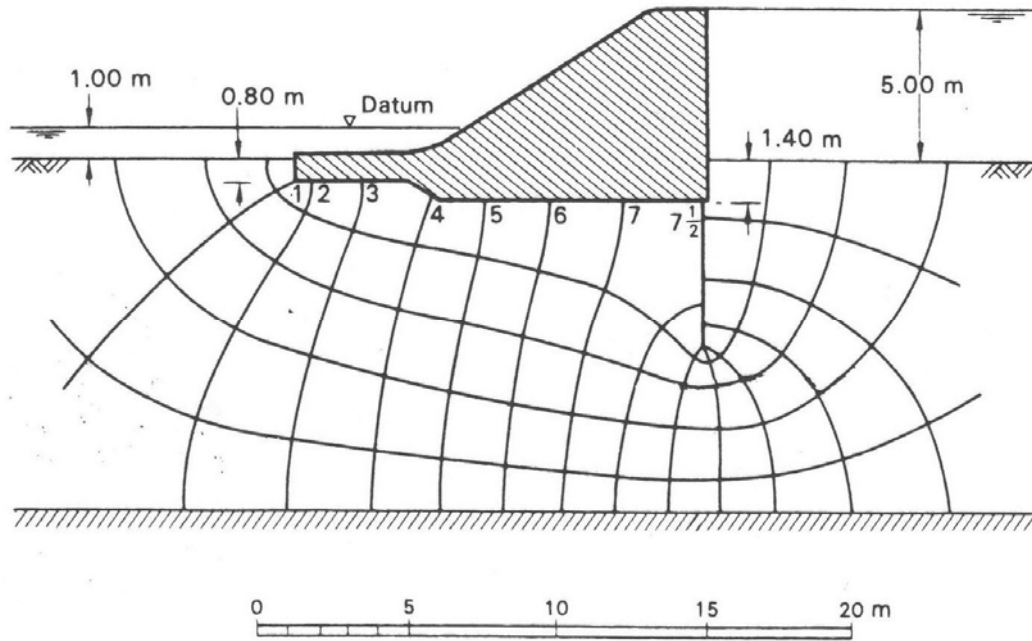
Volume of Proctor Mold (cm^3)	Mass of Wet Soil in the Mold (kg)	Water Content (%)
943.9	1.76	12
943.9	1.86	14
943.9	1.92	16
943.9	1.95	18
943.9	1.93	20
943.9	1.90	22

- Plot γ_d vs. water content (ω). ($\gamma_d = \frac{\gamma}{1+\omega}$)
- Plot ZAV curve. ($\gamma_{ZAV} = \frac{\gamma\omega}{\omega + \frac{1}{G_s}}$)
- Find the maximum dry unit weight in kN/m^3 .
- Find the optimum water content.

(20 points)



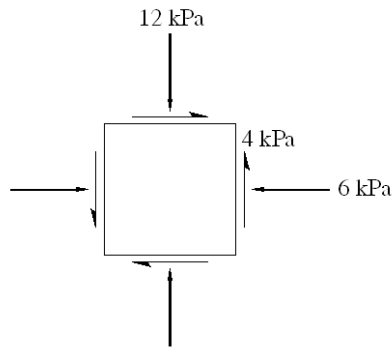
4. The section through a dam is shown in the following figure.



- a. Compute the flow under the dam per meter of dam if the coefficient of permeability is 2.5×10^{-5} m/s.
- b. Find the total uplift force.

(20 points)

5. The state of stress on a small element is $\sigma_v = 12 \text{ kPa}$, $\sigma_h = 6 \text{ kPa}$, and the shear stress is 4 kPa .



- Find the magnitude and directions of the major and minor principal stresses.
- If the material is a loose sand, can you say whether the element is in a state of failure? Why? (Assume $\phi = 40^\circ$).

(20 points)

Bonus Question (2 points)

Suppose you need to build an airport for landing heavy aircrafts on a very loose and saturated soil. How do you build this airport in a few days?