Exam 1, Soil Physics (Agron 577), Spring 2003

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Name

Part 1: Building Blocks:

1: In the following table, each line (row) concerns a single equation. Fill in the missing entries (1/2 pt each). If the equation doesn't have a name, state what it defines (e.g., Coulomb's envelope).

Name	**Equation**	**Physical situation described**
Darcy's Law		
	$h = \frac{2\gamma\cos(\alpha)}{(\rho_w - \rho_a)gR}$	
Coulomb envelope		
Terzaghi's effective stress equation		
		Mean velocity of flow through a tube
	$R_{eff} = \frac{Area}{Perimeter}$	
		Velocity of a spherical particle settling in a viscous fluid

2: Give units for the following (1/2 pt each). Use base SI units where you can.

Pressure:	Permeability:
Gravitational head:	Strain:
Stress:	Volume wetness:
Flux density:	Particle density:

3: Briefly define and describe the following (1-2 sentences) (2 pts each):

Dilatancy:

Secondary mineral:

Part 2: Comprehension: (5 pts each except for # 7: 6 pts)

4: For a given mass of soil and water in, say, and Iowa loam, which is greater: mass wetness or volume wetness?

5: Describe a consequence of water having a high dielectric.

6: What is the <u>mineralogical</u> difference between silt and clay?

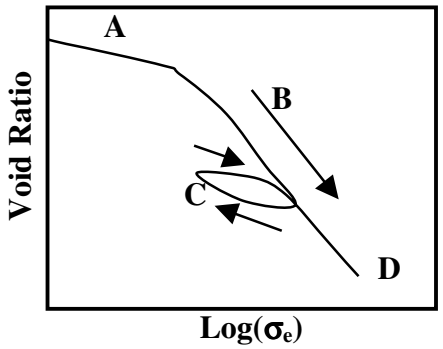
7: Fill in the table:

	Maximum possible	**Minimum possible**	**"Typical" value**
Degree of saturation			
Porosity			
Bulk density (assume $\rho_p = 2.65$ gm cm^{-3})			

8: How can you measure bulk density (ρ_b)?

9: When wet sodium-saturated montmorillonite is changed to calcium-saturated, what happens to the double layer (sketch if you want)? What happens to the clay as a whole?

10: Explain the diagram:



11: Why is water so different from chemically similar compounds such as H_2S and NH_3?

12: What factors most strongly influence soil respiration?

Part 3: Application: (15 pts each)

For all the calculations, assume that the following values apply:

Fluid viscosity: 1.25×10^{-2} kg m^{-1} s^{-1} Interfacial tension: 7.3×10^{-2} kg s^{-2}

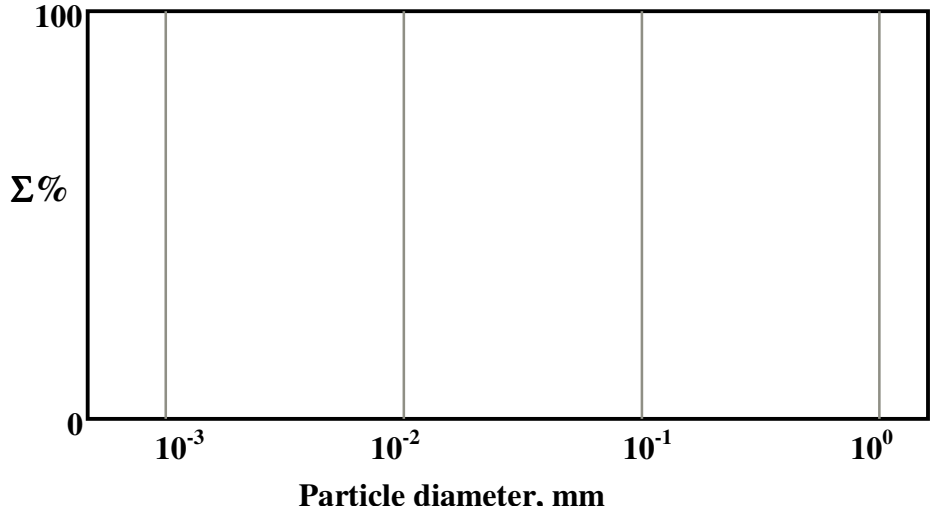
Particle density: 2650 kg m^{-3} Fluid density: 1030 kg m^{-3}

Gravitational acceleration = 9.81 m s^{-2}

13: You disperse 1 gm of soil in 1 liter of water. You then take 10 ml samples at a 15 cm depth and obtain the following data:

Time	**Sample mass, g**	**Diameter, mm**
30 sec	0.009	
4 min	0.005	
2 hour	0.002	

1) Calculate the particle diameter corresponding to each sampling event.
2) Plot the points on the graph below as a cumulative particle size distribution.
3) What assumptions was violated in performing this particular experiment and calculation?



14: You have a “soil sample” consisting of a cubic cm of solid iron, with 0.2 mm holes drilled through it in one direction only. What is the hydraulic conductivity of this “soil” if the porosity is 0.1?

15: You have two clean silica plates, each 1 m^2, whose bottom edges are touching a free water surface (see sketch). The plates are touching along the left edge, and 0.5 mm apart along the right edge.

1) Calculate the height of the water (above the free water surface) rise at each edge.
2) Draw the height profile in the sketch