Tutorial Questions

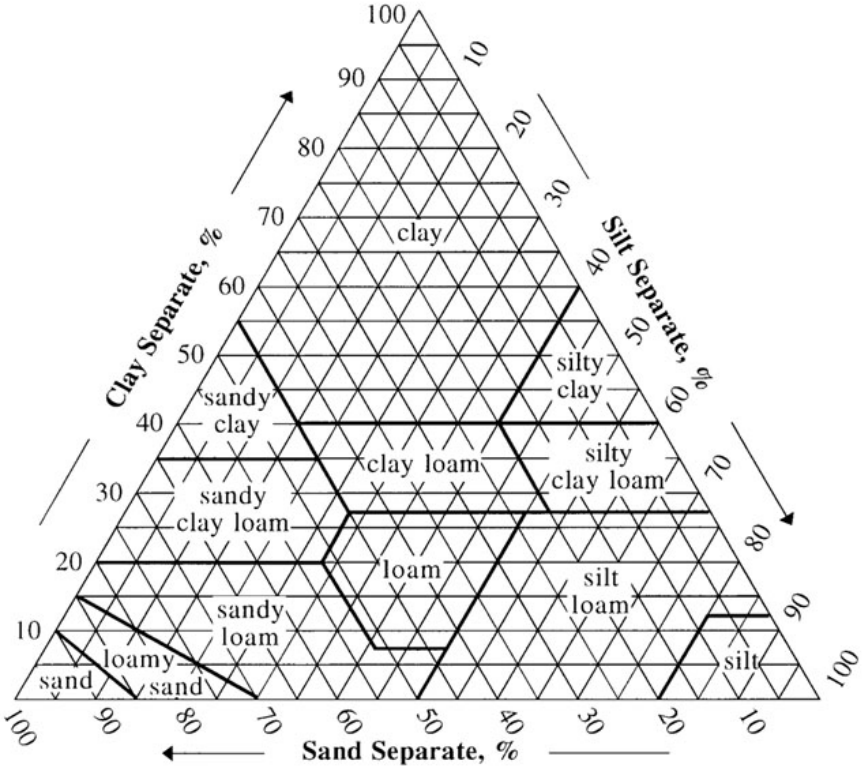
for Tutorial at 1 pm on August 21 and repeated at 2 pm on August 22

Soil: Components, composition, charge and contaminants

PLEASE bring along your lecture notes and calculators.

Soil: Components

1. List the 5 main categories of variables that influence the formation of soil.
2. Give two types of reactions that are involved in the weathering of minerals.
3. List the 4 main constituents of soil and the approximate volume percent.
4. Using the following ternary phase diagram, describe the soil components in % of the soil classified as sandy clay.



5. Complete the following table

	ISSS Particle size
Gravel	
Coarse sand	
Fine sand	0.02-0.2 mm
	0.002-0.02 mm
	<0.002 mm

6. Clay minerals play an important role in determining the properties of a soil. i) in a sentence describe a clay mineral. ii) What distinguishes different clay types? and iii) Describe the physical structure of the 4 clay types including their ability to expand, an example mineral, approximate surface area and cation exchange capacity.
7. What main characteristics distinguish clay minerals from sand and silt?

Soil: Composition

8. In a paragraph discuss isomorphous substitution in minerals.
9. Determine the surface area of TiO_2 particles with a diameter of 40 nm, and a density of 3.9 gcm^{-3}, assuming the particles are spherical and monodisperse in size.
10. Organic matter in soil is derived substantially from the breakdown of plant matter. Describe the general properties of humic substances? What function does organic matter have in soil?
11. List the binding interactions between humus and mineral clays.
12. What is the main role of water in soils?
13. Given that the surface tension of water is 0.0728 Jm^{-2}, density is 1000 kgm^{-3}, gravitation is 9.8 ms^{-2}, θ is 20 °, calculate the radius of a tube required to draw water into the tube heights of 0.001 m, 0.01 m and 0.10 m.
14. How is gas in soil general different in composition to atmospheric gas?
15. Plant macronutrients come from 3 main sources. List the nutrient and their sources.
16. Which of the following forms of these nutrients are more easily available:
    a. K mica or KNO_3,
    b. N NO_3^- or proteins,
    c. P apatite or HPO_4^{2-}
17. What pH gives best availability of (i) the macronutrients, (ii) both the macronutrients and the essential micronutrients?
18. In a paragraph describe the nitrogen cycle between nitrogen in the atmosphere, soil and plants.
19. In one sentence describe the affect of the pH of soil.

Soil: Charge

20. Soil is considered a dynamic system. Describe the processes that occur within a soil containing humus, mineral clays, precipitates and oxides.
21. Two types of surface charge exist on soil particles. (i) What are they called? (ii) How are then different?
22. a) What is the name of the experimental technique used to determine surface charge? b) Define isoelectric point, describing what occurs to surface charge at pH above and below this point
23. Describe the difference between a chemical surface interaction and an electrostatic surface interaction.
24. Define cation exchange capacity. What parameters influence the cations exchangeability?

25. Given a soil containing 15 % smectite, 10 % kaolinite and 5 % humus estimate the soil CEC from these approximate CEC values at pH 7:
    humus 200 cmol/kg,
    smectite 100 cmol/kg and
    kaolinite 5 cmol/kg.
26. If there was an increase of 1 % humus in soil, how much will the CEC of soil at pH 7 increase? As many soils have a CEC between 5-20 cmol/kg, is this a significant increase?

Soil: Contaminants

27. What are 4 hazards associated with contaminated soil?
28. List 5 different sources of soil contamination.
29. Briefly describe the in-situ washing process of contaminated soil.
30. Soil can be contaminated through a range of sources. Chose one of the following and write a brief paragraph detailing a particular source, reaction mechanisms that may occur and a mode of site remediation. 1. Atmospheric heavy metal. 2. Organic agricultural chemical.