Problem Set 2

Please show all the units in the calculations.

1. What is the radius of a capillary tube if water rises 25 cm in the tube? The contact angle of the water to the glass tube is 10°. The density of water is 1 g cm^{-3} and the surface tension of water is 72 dyne cm^{-1}. Give the answer in cm ($g = 9.8$ m s^{-2}).

2. The cup of a tensiometer is placed 0.7 m below the soil surface. The mercury level in a reservoir is 10 cm above the soil surface. Draw a diagram of the situation. If the mercury in a tube connected to the tensiometer rises 25 cm above the soil surface, calculate:
    a. The soil water pressure per unit volume, per unit weight, and per unit mass at the 70 cm depth
    b. Values of ψ_z, and ψ_t at the 70 cm soil depth, if the soil surface is used as the reference level.
    c. The direction of water flow between the depth of 70 cm and 150 cm if a water table is present at 150 cm depth.

3. 10 kg of water moves from point A to point B and the potal potential of the water changes form -10 N/m^2 to -15 N/m^2.
    a. How much work is done on the water?
    b. If the change in potential were due to gravity, how far would the water move?

4. A soil column is assembled in the lab as shown in the figure given below.
    What are the pressure head, gravitational head and the total head at points A and B?
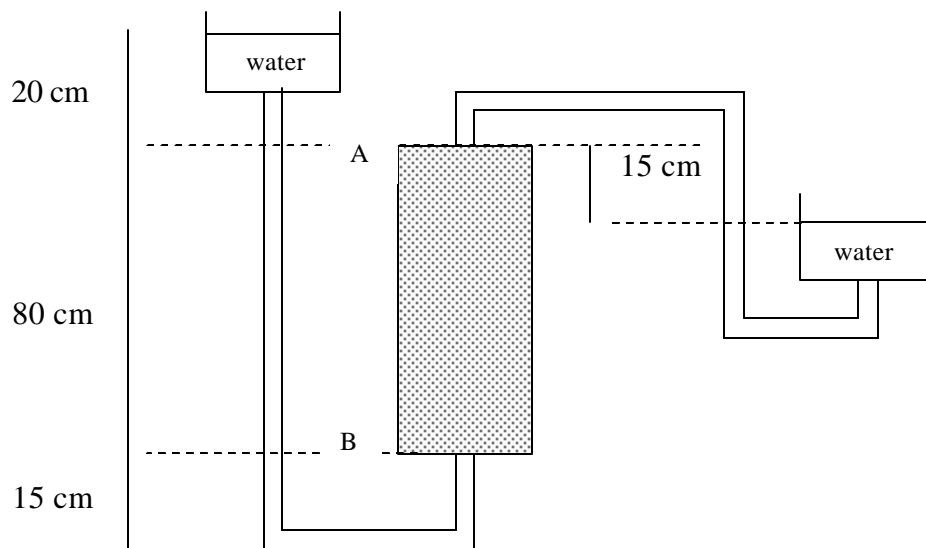
5. In the following figure, the fluid in each manometer is alcohol (density is 0.8 gr cm^{-3}), whereas the tensiometers are filled with water.
   a. What are the soil water pressure potential, gravitational pressure potential and total water potential at points 1 and 2 per unit volume, per unit weight, and per unit mass basis?
   b. What is the direction of flow between points 1 and 2?
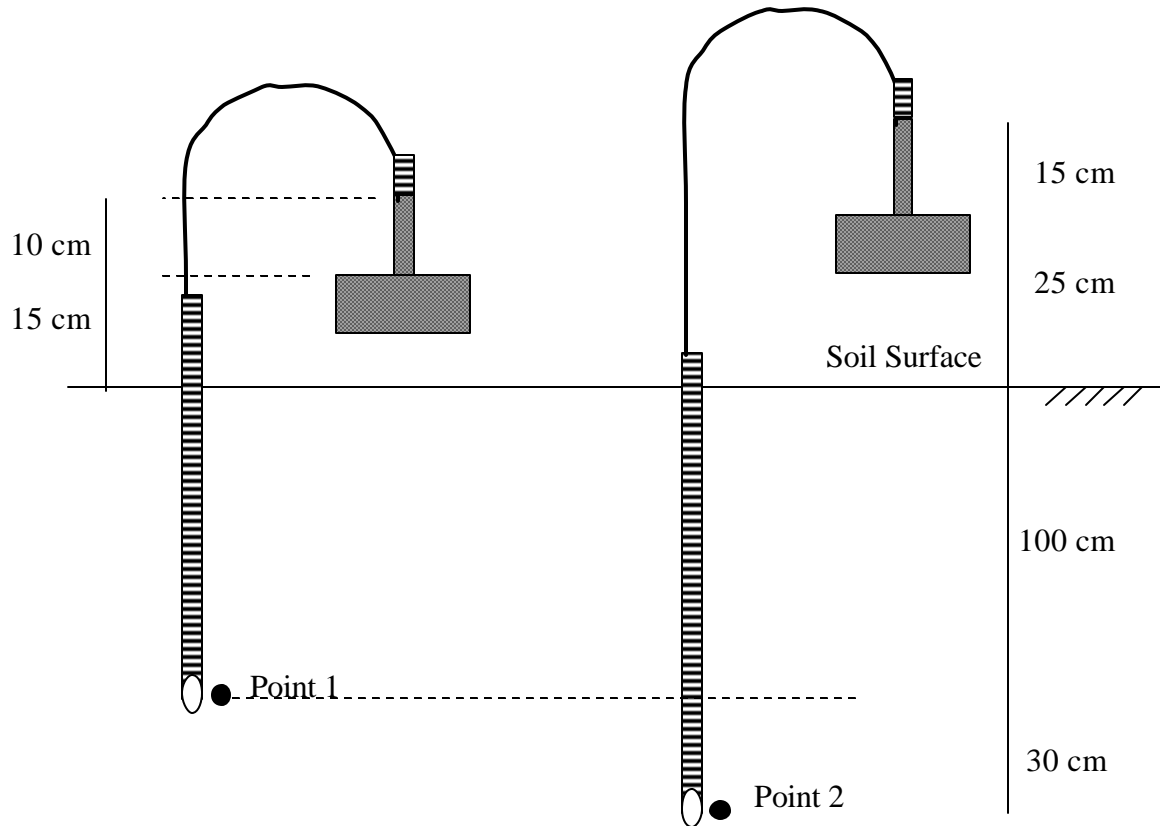
6.
   a. What is the largest pore size allowed in the porous cup of a tensiometer?
   b. What is the largest pore size allowed in the porous plate of a 15 bar pressure plate apparatus?
   c. How do temperature variations affect tensiometer measurements?