Midterm Exam #1, 1 hour
4 questions, 100 points

**Question #1: (20 points)**

A partially saturated soil with S=0.50 has a moist density $\rho = 1650\ kg/m^3$. When more water is added to the same soil then S=0.75 and $\rho = 1750\ kg/m^3$. For this soil, find:

   a) the porosity n;
   b) the void ratio e;
   c) the specific gravity of the soil solids; and
   d) the dry unit weight of this soil.

**Question #2: (25 points)**

Consider seepage occurring in the soil layers within the U-tube below. It is given that: H=1.5m; and that $k_A = 3 \cdot 10^{-4}\ m/s$; $k_B = 3 \cdot 10^{-5}\ m/s$; $k_C = 3 \cdot 10^{-6}\ m/s$

**a)** What is the hydraulic gradient in each of the soil layers A, B, and C?
**b)** What is the discharge velocity in each of the three layers
**c)** What is the flow rate q through the U-tube?
**d)** What is the magnitude and direction of the overall seepage force exerted on the layered soil system by the seeping fluid?
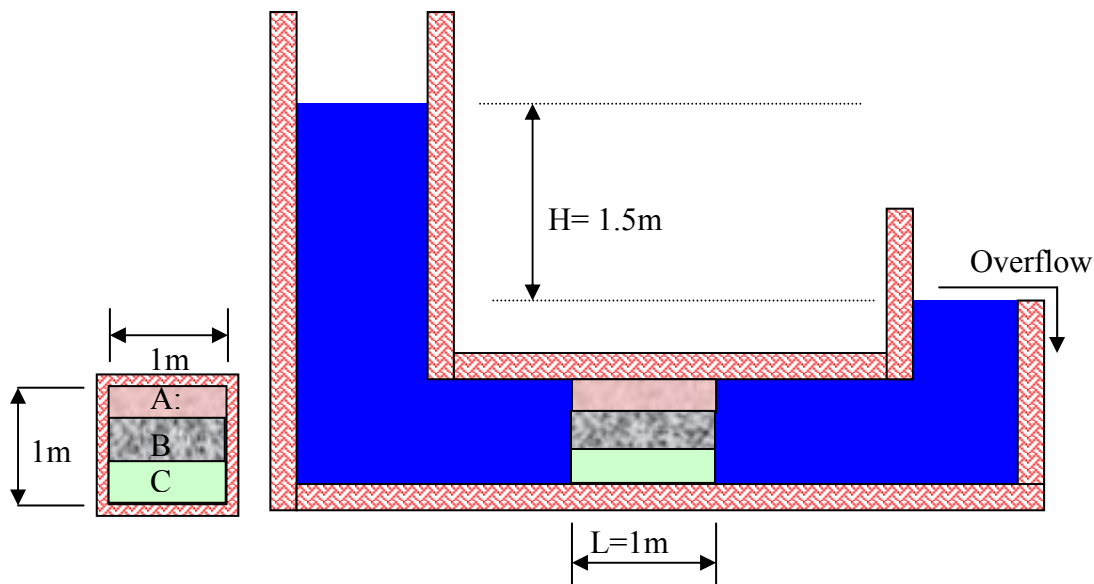
**Question #3:  (15 points)**

    a.  In a few sentences, discuss and explain what effective stresses in soils are.
    b.  How are effective stresses related to pore pressures?
    c.  In general when seepage is occurring in soil, how can one calculate the fluid pressure at specific locations in the soil?

**Question#4:  (40 points)**

Consider the soil slope below that makes an angle α with the horizontal.  Water is flowing horizontally and when it reaches the free face of the slope, it trickles down the face of the slope. (You can neglect the trickling flow down the face.)

    a.  What is the pore pressure at point P a distance d beneath the free surface?
    b.  What is the hydraulic gradient in the soil?
    c.  What are the magnitude (per unit volume) and direction of seepage forces in the soil?
    d.  If at P, the total vertical stress is given by $\sigma_v = \gamma_{sat} \cdot d$, what is the vertical effective stress at P?