Question #1: (20 points)

A saturated soil completely filling a container of volume 0.05 m³ has a mass of 100 kg and water content of 25%. Compute $G_s$ and $e$ for the soil. Assume that $\rho_w = 1000$ kg/m³.

Question #2: (25 points)

Consider seepage occurring in the soil layer within the U-tube below.

a) What is the hydraulic gradient in the soil layer?

b) What is the direction and magnitude of the seepage force exerted by the seeping pore fluid on the soil layer?

c) If the maximum shear stress that can be developed between the soil and the U-tube is 25 kPa, how high large would $H$ need to be to initiate slippage between the soil and the walls of the tube?
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 seepage occurring around the levee shown below. For the soil: \( e = 0.8; \) \( G_s = 2.7; \) and \( k = 10^{-6} \text{ m/second}. \) Given the flownet, and the dimensions provided, compute the following:

a) The volumetric flow rate beneath the structure per unit width in the out-of-plane direction;
b) The fluid pressure at the tip of the sheet-pile cutoff.
c) The factor of safety against heaving in the critical region;
d) The dept of water on the upstream side of the levee that would induce liquefaction in the critical region.

To receive full credit, remember to show all of your work.