

GLY-4822

Assignment 4

1. Write the porosity n in terms of the total volume V_T and the pore volume V_p .
2. What is the pore volume in terms of the total volume and the solids volume V_s ?
3. Use the results of 1 and 2 to show that

$$n = 1 - \frac{V_{solids}}{V_{total}} \quad (1)$$

4. The solid density $\rho_s = M_{solids}/V_{solids}$ and the bulk density $\rho_b = M_{solids}/V_{total}$. Use these to show that

$$n = 1 - \frac{\rho_b}{\rho_s} \quad (2)$$

5. Explain the volumetric water content.
6. What are the pressures (relative to atmospheric pressure taken as 0 at the water surface) 1 and 2 meters down in a swimming pool? What are the pressure heads (in meters of water) at that depth?
7. If the water surface is taken as the elevation datum, what are the elevation heads 1 and 2 meters down in the pool?
8. What are the total heads 1 and 2 meters below the surface of the pool?
9. The following table contains data obtained from a 10-cm long, 2.54 cm diameter column of glass beads of approximate size 186 μm . Use the data to compute the hydraulic conductivity K .

dh/dx	Q (ml s^{-1})
1.35	0.11
2.35	0.19
3.75	0.3
5.1	0.4

10. Use the approximate Kozeny-Carman equation

$$k = \frac{n^3}{(1-n)^2} \frac{d_m^2}{180} \quad (3)$$

to estimate the intrinsic permeability of the bead pack. Then convert the intrinsic permeability to hydraulic conductivity using the following equation:

$$K = k \frac{\rho_w g}{\mu} . \quad (4)$$

The bulk viscosity μ is the kinematic viscosity ($10^{-6} \text{ m}^2 \text{ s}^{-1}$) times the density. Compare this Kozeny-Carman estimate of the hydraulic conductivity (based on crude estimates of n and grain size) with the estimate obtained by direct measurement in Question 9.