

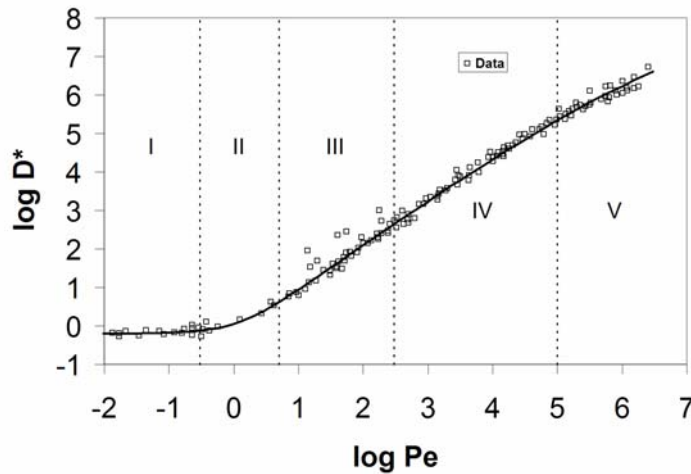
Assignment 4:

- Solve the Poiseuille equation for water at 25C flowing in a 1 mm wide fracture 1 meter in length a) driven by gravity  $u(x) = \frac{G}{2\mu}(a^2 - x^2)$  when the fracture is vertical and b) driven by a pressure gradient of  $0.98 \text{ kg m}^{-2} \text{ s}^{-2}$  when the fracture is horizontal. Ignore entry length effects. You can find the viscosity of water in the Handbook of Chemistry and Physics. Plot the velocity profiles.

- Compute the Reynolds number for each case in Problem 1. What is the significance of these particular numbers for the flow?

- Compute the expected dispersion coefficient for toluene using Taylor's formula for each case in Problem 1  $D = D_m + \frac{U^2 W^2}{210 D_m}$  assuming laminar flow. U is the mean velocity and  $W = 2a$ .

- We wish to estimate dispersion of toluene in an aquifer composed of uniform particles of diameter 1 mm. The mean pore water velocity is known to be  $0.001 \text{ m s}^{-1}$ . Compute the Peclet number  $Pe (= v l / D_m)$ . Using the attached graph (Fried and Combarous, 1971), find  $D^*$  ( $= D_d / D_m$ ). Compute  $D_d$  ( $= D^* D_m$ ).



- Repeat Problem 4 for 0.01 mm particles. What is the relative importance of diffusion and hydrodynamic dispersion in Problems 4 and 5?

- The problem in the aquifers of interest is the arrival of toluene at a well field from a leaking gas tank 1000 m away. Give a third estimate of the dispersion coefficient based on the scaling relations (Neuman, 1995) shown on the attached graph. What are the relative magnitudes of the dispersion coefficients computed from the grain size and the scale of the transport problem?

