

**Problem Set 5**

Issued: Day 15

Due: Day 17

(10 points total)

BE.462J/3.962J

Spring 2003

1. Two hydrogels are prepared from two different candidate polymers for controlled release of a protein drug, interleukin-2 (IL-2). The gels exhibit the same swelling ratio at equilibrium, but gel A (formed by cross-linked polymer A, repeat unit molecular weight  $M_0 = 100$  g/mole) has a molecular weight between cross-links of 3,000 g/mole, while gel B (formed from cross-linked polymer B,  $M_0 = 95$  g/mole) has a molecular weight between cross-links of 12,500 g/mole. Separate measurements showed polymer chains of polymer A and polymer B that have the same molecular weight have the same unperturbed end-to-end distance ( $\langle r_0^2 \rangle^{1/2}$ ). Finally, the hydrodynamic size  $r$  of the drug (IL-2) is one tenth the mesh size of gel B.

- a. Will diffusion of IL-2 through these two gels be the same or different? Calculate the ratio of the diffusion coefficient in gel A to that in gel B.
  
  
  
  
  
  
  
  
  
  
- b. Explain in physical terms how two gels could have equal swelling ratios but different mesh sizes and diffusion rates for an entrapped drug. (It may be helpful to try to sketch the physical situation to explain the case described above where two gels have different molecular weights between cross-links but equivalent swelling ratios.)