Problem Set 1 **BE.462J/3.962J**
Biodegradable Solid Polymers **Spring 2003**
Issued: Day 1
Due: Day 3

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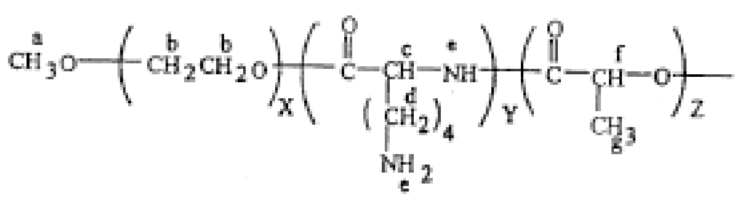
1. The chemical structure of a new degradable polymer, poly(ethylene glycol)-b-polylysine-b-poly(D,L-lactide), is shown below.

    a. Based on chemical structure alone, discuss your prediction of whether this material will degrade more quickly or more slowly than poly(L-lactide) *in vivo*.

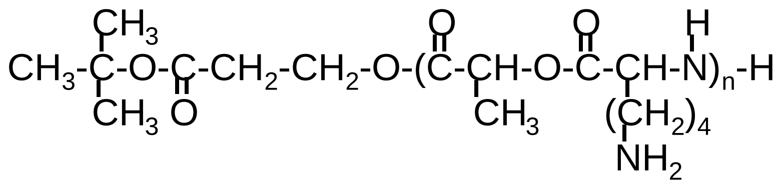
    b. Cite 2 physical data you would want to know to make a better prediction in part (a), and explain why these would aid in this estimate.

    c. What will the end-point degradation products of this polymer be if it is degraded by incubation *in vitro* in phosphate buffered saline, pH 7.4 at 37°C? Would these products be different if the material were degraded *in vivo*?



2. The generation of acidic or basic degradation products is a serious issue complicating the design of devices for *in vivo* application, even for well-established materials like poly(lactide-co-glycolide). Propose an approach to limit or eliminate the generation of a low pH within and near a PLGA device implant. Be creative! (limit ~1/2 page explanation).

3. Propose a route to synthesize the hydrolyzable polymer shown below. Show the structure of the monomers you would use and any initiators/catalysts.



4. In order to carry out studies of polymer hydrolysis on reasonable experimental timescales, a number of researchers have used elevated temperature to speed up degradation. Using the data given below, determine the degradation mechanism (surface or bulk erosion) for a sample of polycaprolactone (ρ = 1.146 g/cm^3) 0.02m thick degraded in water at 37°C and whether the mechanism is changed by degrading the sample at 85°. (Hint: assume both the hydrolysis rate constant and the diffusivity of water in the polymer have an Arrhenius form.)

At 37°C: $k = 9.7\times10^{-8}\ s^{-1}$ $\qquad$ $D_{H2O} = 10^{-8}\ cm^2s^{-1}$

At 50°C: $k = 5.4\times10^{-7}\ s^{-1}$ $\qquad$ $D_{H2O} = 3.5\times10^{-8}\ cm^2s^{-1}$

k = rate constant of PCL bond hydrolysis

D_{H2O} = diffusivity of water in PCL