Massachusetts Institute of Technology
Harvard-MIT Division of Health Sciences and Technology and
Department of Electrical Engineering and Computer Science

HST.410J/6.07J

Projects in Microscale Engineering for the Life Sciences

Homework Assignment #1

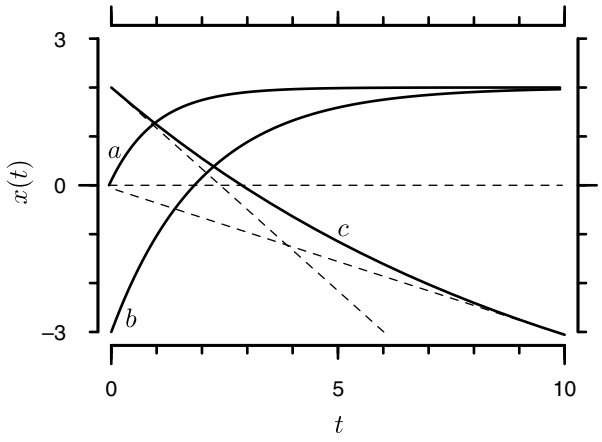
Issued: February 8, 2007
Due: February 15, 2007

Problem 1. Consider an exponential function of time,

$$x(t) = Ae^{-t/\tau} + B.$$

Part a. We can approximate this function at $t = 0$ by a straight line that passes through $x(0)$ with a slope equal to the slope of the exponential function. We can also approximate this function as $t \to \infty$ by a straight line through $x(\infty)$ with zero slope. Determine the time T where these two straight lines intersect.

Part b. Determine the time constants τ_a and τ_b of the exponential functions shown by the solid curves in the following plot labelled "a" and "b," respectively. Briefly explain your method.



Part c. Determine the time constant τ_c of the exponential function shown by the solid curve in the previous plot labelled "c." Briefly explain your method.

Problem 2. Estimate the velocity with which fluid flows through your microfluidic chamber. Describe your results by writing a one to two page report (350-700 words). Include one or two figures to support your conclusions.

Problem 3. Estimate the speed with which mixing occurs in your microfluidic chamber. Describe your results by writing a one to two page report (350-700 words). Include one or two figures to support your conclusions.

Problem 4. Submit photocopies of your lab notebook pages documenting the construction of your device and demonstration that it works. Be sure to document any problems or irregularities that you encountered.