1. Batch and continuous flow reactors

   In a batch or continuous flow reactor, the productivity is defined as the flow rate, or the volume divided by total time. Here we'll discuss a reactor with a homogeneous first-order reaction throughout volume V with rate constant k and target conversion of reactant A given by $C_{A,out}/C_{A,in} = 0.05$.

   (a) Write expressions for the productivity of plug flow and perfect mixing continuous reactors.

   (b) Write an expression for productivity of a batch reactor with downtime t_d for emptying and reloading between batch processes.

   (c) Which of these three has the best productivity, and how much better is it than the others? (Give a ratio of productivities.)

   (d) Which is likely to give the best product uniformity?

   (e) Give one advantage of batch reactors over continuous reactors.