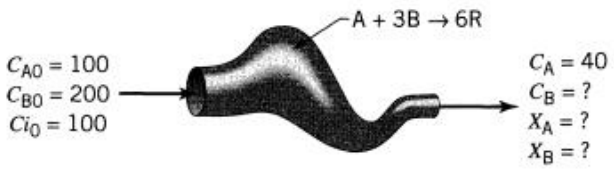
1) Consider a feed C_{Ao} = 100, C_{Bo} = 200, C_{io} = 100 to a steady-flow reactor. The isothermal gas-phase reaction is

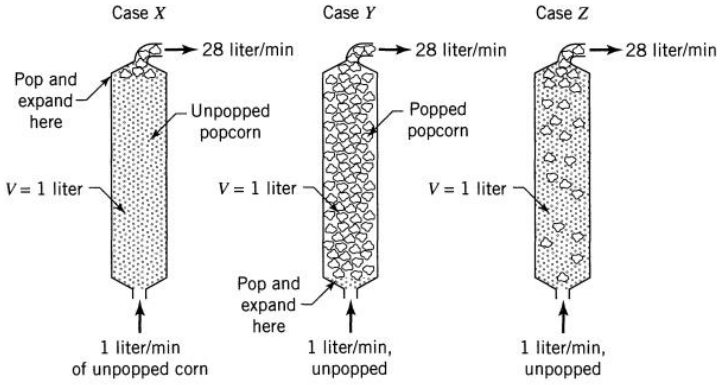
A+3B→6R

If C_A = 40 at the reactor exit, what is C_B, X_A, and X_B there?



2) In a steady-flow popcorn popper 1 liter/min of raw corn is fed which produces 28 liter/min of product popcorn.

Consider three cases, called X, Y, and Z. In case X all the popping occurs at the back end of the reactor. In case Y all the popping occurs at the front end of the reactor. In case Z the popping occurs somewhere between entrance and exit. In all three cases find the value of holding time ($\bar{t}$)& space time(τ).



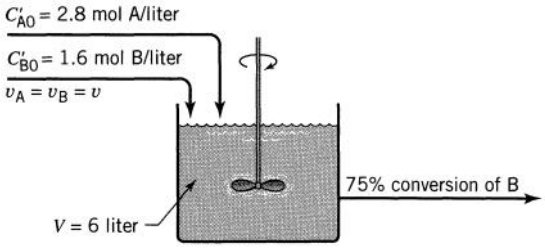
3) The elementary liquid phase reaction

$$A+2B \rightleftarrows R$$

With rate equation

$$-r_A = -\frac{1}{2} r_B = (12.5 \text{ liter}^2/\text{mol}^2.\text{ min})\, C_A C_B^{\,2} - (1.5 \text{ min}^{-1})\, C_R$$

is to take place in a 6-liter steady-state mixed flow reactor. Two feed streams, one containing 2.8 mol A /liter and the other containing 1.6 mol B/liter, are to be introduced at equal volumetric flow rates into the reactor, and 75% conversion of limiting component is desired. What should be the flow rate of each stream? Assume a constant density throughout.



4) The reaction A→ Products is to be carried out at constant temp in a CSTR followed by a PFR in series. The overall conversion achieved by in the reactor system is 95%, volume of CSTR is 75L. C_{Ao}=2mol/L & ν_o = 4L/min

$$-r_A = 0.1C_A^2 \ \frac{mol}{L.Min}$$

Find the X_{CSTR} and $V_{PFR.}$

5) A reaction A→B of unknown kinetics is to be carried out isothermally using two plug flow reactors of equal volume, arranged either in series or in parallel. In the parallel arrangement the feed is split equally between the two reactors. The total feed rate and the inlet concentration of the reactant respectively are the same for both the arrangements. Which arrangement does give higher overall conversion and why?

6) Consider the following reaction. If molar flow rate of A is 0.6 mol/sec. Calculate the reactor volume required for 80% conversion of A. use data given in following table. (Simpson 1/3rd rule can be used for solving the equation)

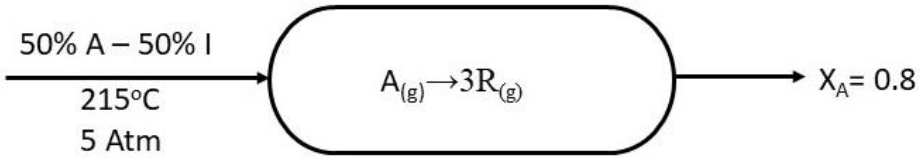
A→B

X	0	0.1	0.2	0.4	0.6	0.7	0.8
$-1/r_A$	2.22	2.70	3.33	5.13	8.85	12.7	20

7) A homogeneous gas reaction A →3R has a reported rate at 215^{o}C.

$$-r_A = 10^{-2}\, C_A^{1/2}, \frac{mol}{L.Sec}$$

Find the space-time (τ) needed for 80% conversion of a 50% A - 50% inert feed to a plug flow reactor operating at 215^{o}C and 5 atm (C_{Ao} = 0.0625 mol/liter)



8) At 650°C phosphine vapor decomposes as follows:

$$4PH_3 \rightarrow P_4(g) + 6H_2 \quad \text{where, } -r_{phos} = (10\ hr^{-1})C_{phos}$$

What size of plug flow reactor operating at 649°C and 11.4 atm is needed for 75% conversion of 10 mol/hr of phosphine in a 2/3 phosphine-1/3 inert feed?

9) The elementary irreversible aqueous-phase reaction A + B → R + S is carried out isothermally as follows. Equal volumetric flow rates of two liquid streams are introduced into a 4-liter mixing tank. One stream contains 0.020 mol A/liter, the other 1.400 mol B/liter. The mixed stream is then passed through a 16-liter plug flow reactor. We find that some R is formed in the mixing tank, its concentration being 0.002 mol/liter. Assuming that the mixing tank acts as a mixed flow reactor, find the concentration of R at the exit of the plug flow reactor as well as the fraction of initial A that has been converted in the system.

10) A liquid-phase isomerization A→B is carried out in a 1000 gallon CSTR that has a single impeller located halfway down the reactor. The liquid enters at the top of the reactor and exits at the bottom. The reaction is second-order. Experimental data taken in a batch reactor predicted the CSTR conversion should be 50%. However, the conversion measured in the actual CSTR was 57%. Suggest reason for the discrepancy and suggest something that would give closer arrangement between the predicted and measured conversion. Back your suggestion with calculation.