Answers Tut 2

2.1 a) CSTR = 173.7 l PFR = 302.2 l

b) 350 K

d) 2 CSTR's x = 0.969, 1 CSTR x = 0.92 Beware! Think about the energy balance in the 2nd reactor. (Interesting to check what you get with 2 X 70 L CSTR's in series, MUCH smaller volume, but…. why?)

2.2 a) x = 0.933 OR 0.022 (plot x vs T (mol balance) and x vs T(energy) balance to notice the multiplicity)

b) x = 0.98 JUST not multiple steady states any more

c) Increase inlet T by about 20 K

d) x = 0.0003 (almost nothing)

e) Tu = 513.87 K (Reactor Temperature = 515.3 K)

2.3 Assume that tubes are available in diameters 25, 28 and 30 mm. The K in the Ergun Equation is 0.02 bar/m for a tube diameter of 30 mm (since $K \alpha G^2$ in turbulent flow it must also depend on the tube diameter).

Tube diameter (mm)	25	28	30
Tube length (m)	8.91	7.108	6.189
Conversion	0.941	0.967	0.975
Outlet P (bar)	1.133	1.609	1.748
Max T (C)	191.9	197.3	200.14

Note that the maximum in the reactor is NOT the outlet T!