Answers Tut 7

7.1

a) $278.45x10^3 \frac{J}{mol_B}$
b) $T = 320\ K$
c) $\eta = 0.0659, D_e = 5.45x10^{-9} \frac{m^2}{s}$
d) $k_c = 7.42x10^{-5} \frac{m}{s}$
e) $k_c = 1.93x10^{-4} \frac{m}{s}$

7.2

a) $W = 1.217\ kg$
b) $x = 0.19$ (Hint: Two unknowns need to be solved, T_{out}, and x_{out} of PBR. Such that $\phi = 0.1$ at reactor outlet)
d) x = 0.46

7.3

a) $\eta = 0.613$
d) $\eta = 0.14$
e) Lower η : Levenspiel of CSTR and PBR shows max in rate, according to PBR profile given – not yet at max rate with given amount of catalyst, CSTR will therefore give higher conversion than PBR (Levenspiel), which will result in a higher temperature and lower effectiveness factor. *Prove this to yourself by doing the calculations for the CSTR. Two unknowns, T and x but two equations (MB and EB)*

7.4 (Note: No mass transfer effects!)

a) $x = 0.956$
b) $C_{cat} = 0.1225 \frac{g}{L}$
c) Plot of simultaneous MB and EB shows the existence of multiple steady states in the CSTR with the new catalyst type

7.5

a) No
b) Yes
c) $k_c a_m \gg k_i'$ and $C_b \approx C_s$
d) $k_c \propto \frac{1}{d_p}$
e) x = 0.692

7.6

a) YES
b) and d)

d_p (mm)	Ideal Conversion %	k_c ($m.s^{-1}$)
3	32.6	6×10^{-2}
0.99	51.4	1.05×10^{-1}
0.1	80.6	3.2×10^{-1}

e) $k_c \propto \left(\frac{1}{d_p}\right)^{\frac{1}{2}}$