AS – 568 High Temperature Gas Dynamics
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Supplementary Exercise – 2
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1. Find the equilibrium adiabatic flame temperature and composition of products for CH4-Air system at equivalence ratio of 0.8, using:
(a) Assuming only CO2, H2O, N2, O2 in products
(b) using CO, H2, OH, H, O, NO, N along with those in (a), using major-Minor method of solution. Find the excess energy due to error in assuming minor species don't change energy released or major species concentrations. Compare it with Heat of reaction above.
(c) Solve (b) with full equilibrium relations.
(d) Compare the T & compositions from the three cases above. Explain the differences.

2. (a) Plot the change in entropy per unit mole versus the extent of reaction for the adiabatic dissociation of 1 mole of pure H2 into H atoms at 500K, 1 atm.
(b) Calculate the equilibrium composition for the system at constant T.
(c) Compare the peak point with the calculated equilibrium composition.
(d) Repeat the above parts with pressure = 2 atm.
(e) Repeat the above parts with T=1500K.
Note: Total of 12 parts to this problem.

3. Solve problem 1 at equivalence ratio of 1.2.

4. Consider the system:

(i) $H + OH \leftrightarrow H2O$
(ii) $H2 + O \leftrightarrow H2O$
(iii) $H2 \leftrightarrow H + H$
(iv) $O2 \leftrightarrow O + O$
(v) $H + O \leftrightarrow OH$

Write the equations for solving the final composition of the mixture of the 6 species, at any given P & T. How many equations do we need? Which of the equations is/are superfluous? Can we express that set of reactions in terms of linear combinations of the rest?