Name________________

Special Problem 9c

(a) Pure methane is available at 1 atm and 50°C. Calculate the adiabatic flame temperature of this fuel with air at stoichiometric ratios from 0.75 to 1.20. Assume that the initial air temperature is 50°C. The stoichiometric ratio is defined as:

$$SR = \frac{n_{oxidizer}}{n_{fuel}} \Big/ \left(\frac{n_{oxidizer}}{n_{fuel}}\right)_{stoich}$$

When the O_2 is the limiting reactant (i.e., SR < 1), a combination of CO and CO_2 is formed, with 100% of the methane and O_2 consumed. The value of SR only uses reaction (1) below, since reaction (2) is an unwanted side reaction. You can use the following two chemical reactions, each with its own extent of reaction, to calculate the moles of CO and CO_2 formed at each stoichiometric ratio.

$$CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O \qquad (\xi_1)$$

$$CH_4 + 1.5\ O_2 \rightarrow CO + 2\ H_2O \qquad (\xi_2)$$

Please perform the calculations at SR = 0.75, 0.8, 0.9, 1.0, 1.1, and 1.2. For simplicity, please assume a basis of 1 gram-mole of methane for each calculation. Please use the high temperature heat capacity coefficients from the Janaf tables.

(b) Please repeat part (a) with pure O_2 in the oxidizer stream instead of air.

(c) Please comment on the trends with SR and on the trend with the amount of inert (N_2).