INDIAN INSTITUTE OF TECHNOLOGY, BOMBAY

**Department of Metallurgical Engineering and Materials Science**

**MM 209: THERMODYNAMICS : 2019-20: FALL**

**Tutorial 2 Date:13/08/2019**

1. **A coal burning burner is fed with powdered coal (assume pure carbon) preheated to 1800K and dry air (N2:O2=79:21, by volume) preheated to 1200K. The coal-to-air ratio is such that the product is only a gas containing CO and N2 ##. Perform a material balance and a heat balance and calculate the adiabatic flame temperature (of the product gas).**

Take only 1 kg carbon as the mass basis. You need to present data as **mass and heat balance tables, fully filled.**

Sensible heats are enthalpy above 298K :( HT - H298)=

Data:

|  |  |  |  |
| --- | --- | --- | --- |
| **Mass balance** : Basis 1 kg of carbon | | | |
| input | kg | Output | kg |
| Carbon  Oxygen  Nitrogen |  | CO:  Nitrogen: |  |
| Total |  | Total |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Heat Balance** | | | |
| Input | kJ | Output | kJ |
| Sensible heats  Carbon :298K  Oxygen:1200K  Nitrogen:1200K  Reaction heat: Σ n(-ΔH298f) = | 0 | Sensible heats  CO :  Nitrogen:  Losses | **0** |
| Total |  | Total |  |

Calculation :

Verify by substituting in the table and checking balance

1. **Natural gas (86 vol% CH4, rest N2) is burnt with stoichiometric amount of air (79 vol % N2, rest O2, just sufficient for complete combustion to CO2 and H2O) in a gas burner in a furnace. What is the theoretical maximum temperature of the flame, if the natural gas and air enter the burner at 298 K? Present answer in mass and heat balance tables. Take 1 mol of natural gas as basis. Use data from data tables**

*## we will see later that this is not strictly possible.*