

HW Assignment #1

Due: Thursday, Sep 12^h before class begins

Problem #1 (20 points)

A mixture is composed of the following number of moles of various species:

<u>Species</u>	<u>No. of Moles</u>
CO	0.095
CO ₂	6
H ₂ O	7
N ₂	34
NO	0.005

- Determine the mole fraction of nitric oxide (NO) in the mixture. Also, express your result as mole percent, and as parts-per-million.
- Determine the molecular weight of the mixture
- Determine the mass fraction of each constituent

Problem #2 (15 points)

Consider a fuel which is an equimolar mixture of propane (C₃H₈) and natural gas (CH₄). Write out the complete stoichiometric combustion reaction for this fuel burning with air and determine the stoichiometric fuel-air ratio on a molar basis. Also, determine the molar air-fuel ratio for combustion at an equivalence ratio, ϕ , of 0.8.

Problem #3 (15 points)

Determine the standardized (absolute) enthalpy of the mixture given in problem 1 for a temperature of 1000K. Express your result in kJ/kmol of mixture.

Problem #4 (50 points)

Each chapter of Stephen Turns has a list of symbols at the end. Go through the list in each chapter and list the nondimensional numbers you find.

Write the name, equation (with units) and the physical meaning of each nondimensional number you find. Have you come across any non-dimensional numbers before? If yes, then in what course?

For example,

The Reynolds number is given by: $Re_x = \frac{LU_\infty}{\nu} = \frac{m^2/s}{m^2/s} = \frac{\text{inertial forces}}{\text{viscous forces}}$

The Reynolds number is a ratio of the inertial forces to the viscous forces in a fluid. As velocity of a fluid increases, the Reynolds number increases. When it increases beyond a threshold the flow is said to become turbulent.

Extra Credit: Besides Turns there are other library books listed in the course syllabus. Can you find some additional nondimensional numbers related to combustion not listed in Turns? Please list the reference book and page number where you found the number. **(1 point for each additional entry)**