

Exercise 4: Combustion and Thermodynamics repetition

Combustion reactions

Problem 1:

Formulate the main reaction balance for

- Propane, C_3H_8 , that reacts with excess air $\lambda > 1$
- Methanol, CH_3OH , that reacts with excess air $\lambda > 1$
- A fuel with 50 % CO and 50 % H_2 that reacts with excess air $\lambda = 1,2$

Problem 2:

Determine the stoichiometric (theoretical) amount of air r for the fuels in Problem 1

Problem 3:

A fuel contains on a mass basis 77 % C, 10 % O and 13 % H.

Determine the stoichiometric (theoretical) amount of air for this fuel (kg air per kg fuel)

Determine how much H_2O that is formed in this reaction (kg H_2O per kg fuel).

Problem 4:

Express the reaction rate R_H for monatomic hydrogen H from the following system of elementary reactions:

(M is a “collision partner”, a substance that assist the reaction but do not form new species with the other reactants.)

- $H + H + M \rightarrow H_2 + M$
- $H_2 + M \rightarrow H + H + M$
- $H + H + H \rightarrow H_2 + H$
- $H + O_2 \rightarrow OH + O$
- $H + O_2 + M \rightarrow HO_2 + M$

Problems from Turns: *Introduction to combustion* (2nd/3rd ed.):

Nos. 2.30, 2.31, 2.33, 2.47, 2.56, 2.57

Hint: For Problem 2.33, an online *Chemical Equilibrium Calculator* can be useful.