

Chemical Reaction Engineering—Homework #0

Due: Online submission on Canvas, [Friday, January 10, 2020 at 11:59pm.](#)

No late submissions will be accepted.

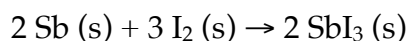
Problems that require a numeric answer should have 3 significant figures.

Units, where required, are shown in blue. Please use these units. Approximate answers are indicated in blue.

This homework is a basic review of chemistry and solving systems of ODE's computationally. These are some of the essentials of this course.

Problem 1: Stoichiometry, Limiting Reagent

Consider the reaction:



Determine the limiting reagent and the theoretical yield when:

- 1.20 mol of Sb and 2.40 mol of I_2 are mixed.
- 1.20 g of Sb and 2.40 g of I_2 are mixed. What mass of excess reactant is left when the reaction is complete?

Problem 2: Precipitation reactions

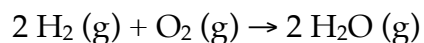
An aqueous solution of sodium hydroxide and iron(III) nitrate are mixed and a red precipitate forms in the bottom of the flask. Calculate the mass of the precipitate that is formed when 50.00 mL of 0.200 M NaOH and 30.00 mL of 0.125 M $\text{Fe}(\text{NO}_3)_3$ are mixed.



Precipitation of $\text{Fe}(\text{OH})_3$

Problem 3: Gas phase reactions

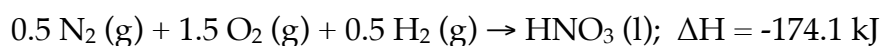
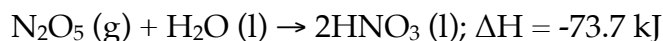
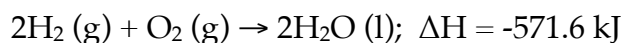
A mixture in which the mole ratio of hydrogen to oxygen is 2:1 initially is used to prepare water using the reaction below.



The total pressure in the container is 0.950 atm at 25°C before the reaction. What is the final pressure in the container at 125°C after the reaction, assuming an 88.0% yield and no volume change?

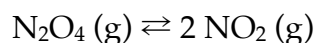
Problem 4: Thermochemistry

Given the following system, calculate ΔH for the formation of one mole of dinitrogen pentoxide from its elements in their stable state at 25°C and 1 atm.



Problem 5: Chemical Reaction Equilibrium

For the reaction,



The equilibrium constant is known to be 11 atm at 373K. Starting with pure N_2O_4 at a pressure of 1.00 atm, what are the equilibrium partial pressures of NO_2 and N_2O_4 ?

Problem 6: Systems of ordinary differential equations, Plug flow reaction with a pressure drop

Using the system of ODEs below graph X and y on a plot of X vs. W for $0 \leq W \leq 60$.

$$\frac{dX}{dW} = \frac{k'}{F_{A0}} \left(\frac{1-X}{1+\epsilon X} \right)^y$$
$$\frac{dy}{dW} = \frac{-\alpha(1+\epsilon X)}{2y}$$

The following values are known: $k' = 0.0266$, $F_{A0} = 1.08$, $\alpha = 0.0166$, $\epsilon = -0.15$. Initially, $X(0) = 0$ and $y(0) = 1$.