CHE 211 Review session Fall 2014

Unit conversations

1) 

\[ \frac{20 \text{ g of CH}_4}{m^3} \]

Convert to moles per liters

2) 

\[ Re = \frac{Dvp}{\mu} \]

Where D is diameter v is velocity p is density and u is viscosity

(1cP=.001 kg/(m*s))

What is the Reynolds number of blood leaving the heart through the aorta if it has a dynamic viscosity of \( \mu = 3.30 \text{ cP (centipoise)} \), a density of \( \rho = 1053 \text{ kg/m}^3 \), travels at a mean fluid velocity of \( V = 32.6 \text{ cm/s} \), and the diameter of the aorta is \( D = 2.15 \text{ cm} \)?

Material Balances

3) Consider a 100 mol mixture that is 77.0% methane (CH4) and 23.0% ethane (C2H6). To this mixture is added 21.0% excess air. Of the methane present, 91.50% reacts, 88.90% of which forms carbon dioxide (CO2), and the balance forms carbon monoxide (CO). Of the ethane present, 89.9% reacts, 88.90% of which forms carbon dioxide, and the balance forms carbon monoxide.

A) What is the theoretical amount of oxygen required for the fuel mixture?

B) What amount of air is added to the fuel mixture?

C) How many moles of methane are present in the product gas?

D) How many moles of ethane are present in the product gas?

E) How many moles of carbon dioxide are present in the product gas?

F) How many moles of carbon monoxide are present in the product gas?

G) How many moles of water vapor are present in the product gas?
H) How many moles of oxygen are present in the product gas?
I) How many moles of nitrogen are present in the product gas?

4) Propane (C3H8) is burned in a combustion chamber at a flow rate of 24.00 m3/min with 25.0% excess air. If the propane and air streams enter the chamber at 16.0°C and 1.15 atm (absolute), and the products leave the chamber at 295.0°C and 2.30 atm (absolute), what is the volumetric flow rate of product gas from the chamber? Assume 100% conversion and ideal behavior.

A) Use the ideal gas law to find the molar flow rate of propane into the combustion chamber?
B) What is the molar flow rate of air into the combustion chamber?
C) What is the molar flow rate of products leaving the combustion chamber?
D) Use the ideal gas law to find the volumetric flow rate of products leaving the combustion chamber?

5) Given

\[ \Delta U + \Delta E_k + \Delta E_p = Q - W \]

A) sort the energy balance equation terms according to if they are less than zero, zero, or greater than zero. Scenario 1: You put a jar of pickles, initially at room temperature, into the refrigerator, and the jar contents cool to 38°F. Consider the system to be the jar contents, and assume that the shelf in the refrigerator is at the same height as the counter on which the jar was initially resting.

B) The same pickle jar falls off of the shelf, and is about to hit the floor. Consider the pickle jar to be the system, and for there to be negligible heat transfer or temperature change during this process.

C) On a cold day, water rests in a small crack in an asphalt road. As night falls, the ice freezes, expands, and causes the crack to grow into a pothole. Consider the system to be the water.