PROBLEM SET 1

1) Resolve HW6

**Derive the concentration of species A, flux of A and diffusion rate of A in a system where both chemical reaction and diffusion takes place. The composition of A is much greater than zero. And the chemical rxn shown below is an elementary type of rxn:**

\[ 2A \rightarrow B \]

After you solve HW6 try to get this differential equation for the composition of A:

\[ D_{AB} \frac{d^2 Y}{dz^2} + 2kC_e(k^2 \cdot e^{-Y^2}) = 0 \]

Where \( Y = \ln \left( \frac{1-x_A}{2} \right) \)

2) In a pipe A component diffuses into B. At the same time an elementary type chemical rxn takes place during diffusion:

\( nA \rightarrow An \)

- In radial direction (r) assume only diffusion takes place
- Along the pipe (z-direction) assume only convection takes place

A) Derive the differential mass balance for species A for a first and zeroth order chemical reaction. Assuming short contact time and negligible convection.

B) Solve the differential mass balance for species A for a first and zeroth order chemical reaction with the following boundary conditions:

\[ CA=CA_o \quad r=0 \]

\[ CA=0 \quad r=R \]
3) Let's say we have two different equilibrium relations as shown below:

What can you say about the behaviour of system (1) and (2)? Make a comment.

4) Solve Example 10.4.1 from Geankoplis 3rd Edition with the following values:
   \( Y_A = 0.5 \), \( P = 2 \) ATM,
   \( X_{AL} = 0.2 \)
   \( k_x = 2 \times 10^{-3} \text{ kgmol/m}^2 \cdot \text{s.mol fraction} \)
   \( k_y = 1.5 \times 10^{-3} \text{ kgmol/m}^2 \cdot \text{s.mol fraction} \)