X

Unit 13 - Week 10: Simultaneous Heat and Mass Transfer with Chemical Reactions

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Course outline

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Week 1: Introduction of Non-Newtonian Fluids

Week 2: Rheology Measuring Instruments

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Week 4: Momentum Transfer of Non-Newtonian Fluids

Week 5: Momentum Transfer of Non-Newtonian Fluids

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Week 10 Assignment 01

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment. **Due on 2019-04-10, 23:59 IST.**

Week 10 Assignment 01

1) Consider a case of hot vapor A diffusing at steady state through a stagnant film of non-condensable gas, B, on to a cold surface at y=0, where A condenses. The film thickness is 2mm. At the boundary of stagnant gas film, concentration of A is 6.8 wt.% and solution density is 988.1 kg/m^3. At the cold surface, the concentration of A is 16.8 wt.% and solution density is 972.8 kg/m^3. The diffusivity of the system is 7.4×10^{-10} m^2/s. What is the steady state flux of component A in kg-mol./m^{2}s? Molecular weights of A and B are 46 and 18 kg/kg-mol., respectively. ***20 points***

- 5.46×10^{-7}
- 2.63×10^{-7}
- 1.45×10^{-7}
- 8.77×10^{-7}

No, the answer is incorrect.
Score: 0

Accepted Answers:
8.77×10^{-7}

2) Consider a case of hot vapor A diffusing at steady state through a stagnant film of non-condensable gas, B, on to a cold surface at y=0, where A condenses. The film thickness is 2mm. The temperatures at the stagnant gas film boundary and at the cold surface are 70°C and 20°C respectively. The rate of mass transfer is unaffected by heat transfer but the heat transfer is affected by the rate of mass transfer. If the molar flux of A is 4.68×10^{-2} kg-mol./m^{2}s, what is the ratio between rate of heat transfer in presence of mass transfer and in the absence of mass transfer for this stagnant gas film case? (Data: C_p = 250 J/kg.K and k = 0.173 W/m.K) ***10 points***

- 1.67

0.93

3) Consider an instantaneous and irreversible catalytic reaction 2A à B and the product diffuses back to main gas stream immediately after reaction at catalyst surface. Assume that each catalyst particle is surrounded by a stagnant gas film-through which A has to diffuse to reach the catalyst surface and thickness of this film is 2mm. Designate main stream as at z = 0 and at catalyst surface should be taken as z = δ for mathematical simplicity, i.e., flat slab-like particle surface should be considered rather than spherical shape for catalysts. If the main stream mole fraction of A is 0.8 at steady state, what is the flux of A provided the diffusivity is 5.1×10^{-8} m^2/s and system average concentration is 50 kg-mol/m^3? ***15 points***

- 2.14×10^{-3} kg-mol./m^2s
- 1.30×10^{-3} kg-mol./m^2s
- 5.08×10^{-3} kg-mol./m^2s
- 9.45×10^{-3} kg-mol./m^2s

No, the answer is incorrect.
Score: 0

Accepted Answers:
1.30×10^{-3} kg-mol./m^2s

4) Consider diffusion combined with a catalytic reaction 2A à B with each catalyst surface being surrounded by a stagnant gas film of thickness δ = 2mm. If the diffusivity and rate constant are $D_{AB} = 5.1\times10^{-8}$ m^2/s and $k_1'' = 5.63\times10^{-3}$m/s, respectively, then ascertain what type of reaction is it? ***5 points***

- Instantaneous
- Not instantaneous but not very slow as well
- Very slow reaction
- None of the above a), b) and c) points are true

No, the answer is incorrect.
Score: 0

Accepted Answers:
Instantaneous

5) Consider a system where diffusion is combined with homogeneous reaction 2A à B, where A is a gas and B is a liquid. The length of the system in which A diffuses and reacts is L. If the diffusivity and rate constant of reaction are D_{AB} and k_1''', then the relative contribution of reaction rate constant and diffusivity can be ascertained by Thiele modulus and is defined by? ***5 points***

- $(D_{AB}/k_1'''L^2)$
- $(k_1'''L^2/D_{AB})^{0.5}$
- $(D_{AB}/k_1'''L^2)^{0.5}$
- $(k_1'''L^2/D_{AB})^{-0.5}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$(k_1'''L^2/D_{AB})^{0.5}$

6) Consider a system where diffusion is combined with homogeneous reaction 2A à B, where A is a gas and B is a liquid. The length of the system in which A diffuses and reacts is 10mm. If the diffusivity and rate constant of reaction are 5.1×10^{-8} m^2/s and 5.63×10^{-3} s^{-1}, respectively, and saturation solubility of A in to B is 1.426×10^{-3} kg-mol./m^3, what is the flux of A at the gas-liquid interface? ***15 points***

- 4.65×10^{-3} kg-mol./m^2s
- 9.87×10^{-3} kg-mol./m^2s

- 2.41×10^{-3} kg-mol./m^2s
- 3.25×10^{-3} kg-mol./m^2s

No, the answer is incorrect.
Score: 0

Accepted Answers:
2.41×10^{-3} kg-mol./m^2s

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