NATIONAL INSTITUTE OF TECHNOLOGY, CALICUT

Department of Chemical Engineering

CH 3002 – Mass Transfer I

Test I Examination (Monsoon Semester 2014)

Answer all questions *Max marks: 15*

(Any missing data may be suitably assumed)

1. Define Fick's law of diffusion with the assumptions. (2)
2. Explain in detail the experimental (Twin bulb method) determination of gas phase diffusivity. State the assumptions used and derive the diffusivity equation. (3)
3. A drop of ethanol, 2 mm in diameter, suspended at the end of a thin wire, vaporizes in the ambient air (1.013bar, 30°C). The temperature of the drop undergoing vaporization is estimated to be 18°C. The thickness of the stagnant air-film surrounding the drop is estimated to be 1.5 mm under the prevailing condition. Assuming that the thickness of the film remains unchanged, calculate the time required for the drop size to reduce to 1mm. Also calculate the time required for disappearance of the drop if the ambient air is totally stagnant. Vapour pressure of ethanol at 18°C is 0.0516 bar; liquid density = 789 kg/m^3; molecular weight = 46. The diffusivity of ethanol in air is 0.102 cm^2/s at 0°C. (4)
4. An open bowl 0.2 m in diameter contains water at 350 K evaporating into the atmosphere. If the currents are sufficiently strong to remove the water vapor as it is formed and if the resistance to its mass transfer in air is equivalent to that of a 2 mm layer for condition of molecular diffusion what will be the rate of evaporation? Diffusivity is 0.2 cm^2/s.vapour pressure is 41.8 kN/m^2. (3)
5. A gas mixture ($CO_2 = 28.5\%$, $O_2 = 15\%$ and $N_2 = 56.5\%$) flows through a pipe, 25.4 mm in diameter at 4.05 bar total pressure. If the velocities of the respective components are 0.04 m/s, 0.044 m/s and 0.03 m/s. Calculate the mass average, molar average and volume average velocities of the mixture. (3)