

Total No. of Questions : 10]

SEAT No. :

P3646

[Total No. of Pages : 3

[5560]-602

T.E. (Chemical Engg.)

MASS TRANSFER - I

(2015 Course) (Semester - I)

Time : 2½ Hours

[Max. Marks : 70]

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4 Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right side indicate full marks.
- 4) Assume suitable data, if necessary.

Q1) The diffusivity of gas-pair O_2 - CCl_4 is determined by observing the steady state evaporation of CCl_4 (liquid) into a tube containing O_2 . The entire system is held at constant temperature and pressure. Both the gases are assumed to be ideal and O_2 is stationary. The distance between the CCl_4 (liquid) level and top of the liquied level is 0.171m. The total pressure on the system is $100.658 \times 10^3 \text{ N/m}^2$ (755mm Hg) and the temperature is 273K. The vapour pressure of CCl_4 is $4.399 \times 10^3 \text{ N/m}^2$ (33mm Hg) at that temperature. The cross sectional area of the tube is $0.082 \times 10^{-3} \text{ m}^2$. After steady state is attained, $0.0208 \times 10^{-6} \text{ m}^3$ of CCl_4 (liquid) evaporated in 36×10^3 second period. What is the diffusivity of gas pair CCl_4 - O_2 ? Assume specific gravity of liquid CCl_4 as 1.59. **[10]**

OR

Q2) a) Derive the expression to calculate the flux of Diffusion of gas A through non-diffusing stagnant gas B. **[5]**

b) Write on Film Theory and Surface Renewable Theory. **[5]**

Q3) a) Explain Minimum L/G ratio for absorber **[5]**

b) 5000 kg/hr of a SO_2 - air mixture containing 5% by volume of SO_2 is to be scrubbed with 2,00,000 kg/hr of water in a packed tower. The exit concentration of SO_2 is reduced to 0.15%. The tower operates at 1 atm.

P.T.O.

The equilibrium relationship is given by $Y = 30 X$.

where,

Y = mole of SO_2 /mole of air X = mole of SO_2 /mole of water if the packed height of tower is 0.42 m, calculate the height of transfer unit (HTU). [5]

OR

Q4) Ammonia is absorbed by water in wetted wall column using Operating temperature of 20°C and 1 atm pressure. The overall Coefficient is $2.72 \times 10^{-4} \text{ kmol/m}^2 \text{ atm}$. At one point in the column the Gas contained 10 mol % ammonia and the liquid phase concentration was $6.42 \times 10^{-2} \text{ kmol}$ ammonia per m^3 of solution. Temperature is 20°C and 1 atm pressure. 85% of the resistance to mass transfer lies in a gas phase. If Henry's law constant is $9.35 \times 10^{-3} \text{ atm m}^3/\text{kmol}$, Calculate the individual film coefficient and the interfacial composition. [10]

Q5) a) Moist air at 310K has WBT of 300 K. The latent heat of vaporization of water at 300K is 2440KJ/Kg, Estimate the humidity of the air and the percentage relative humidity. The total pressure is 105KPa and the vapor pressure of water vapor at 300K is 3.60KPa and 6.33Kpa at 310K. Psychrometric Ratio (h_g/K_y) = 1000 J/kg. K and latent heat of vaporization is 2440KJ/kg. [8]

b) Define :

- i) Absolute Humidity
- ii) Percentage Humidity
- iii) Relative Saturation
- iv) Adiabatic Saturation Temperature

OR

Q6) a) What are different types of cooling towers? Explain any one in brief.

[8]

- b) A mixture of nitrogen - acetone vapor at 800 mmHg and 25°C has percentage saturation of 80%. Calculate [8]
- Absolute humidity,
 - Partial pressure of acetone,
 - Absolute molal humidity.
- Q7)** a) Differentiate between tray columns and packed columns. [5]
- b) Explain Performance Diagram or Operating Characteristics of sieve Plate Column with neat sketch. [5]
- c) Explain construction and working of the following with neat sketch [8]
- Venturi scrubber
 - Wetted wall column
- OR
- Q8)** a) Explain various types packings used in separation towers and their classification. [8]
- b) Which are the equipments used for gas-liquid contact. Explain sparged vessel and mechanically agitated vessels with neat sketch. [8]
- c) Define murphree plate efficiency. [2]
- Q9)** a) Draw and Explain drying rate curve. [6]
- b) Classify the types of dryers? Explain any one in detail with sketch. [10]
- OR
- Q10)** a) A wet solid is to be dried from 35% to 10% moisture (wet basis) under constant drying conditions in five hours. If the equilibrium moisture content is 4% and critical moisture content is 14%. How long it will take to dry solids to 6% moisture under the same conditions? [8]
- b) Define: [8]
- Moisture content in the solid on wet and dry basis.
 - Unbound moisture content
 - Bound moisture content
 - Critical moisture content

