

11126 : Chemical Engineering Operation - II (Mass Transfer Operation) : 6 PP 01

P. Pages : 2

Time : Three Hours



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AW - 3252

Max. Marks : 80

- Notes :
1. Answer **Three** question from Section A and **Three** question from Section B.
 2. Assume suitable data wherever necessary.
 3. Diagrams and chemical equations should be given wherever necessary.
 4. Illustrate your answer necessary with the help of neat sketches.
 5. cell phone is not allowed.
 6. Discuss the reaction, mechanism wherever necessary.
 7. Use of pen Blue/Black ink/refill only for writing the answer book.

SECTION - A

1. a) Derive the expression of equimolar counter current diffusion for molar mass flux in terms of diffusivity. 7
 b) In an O₂-N₂ gas mixture at 101.3 KPa and 298°K the concentration of O₂ at two phases 2mm apart are 10 and 20% by volume respectively. Calculate the molar flux of diffusion of oxygen (O₂) for the cases where (N₂) nitrogen is non-diffusing and there is equimolar counter diffusion of the two gases. 7
 Diffusivity of O₂ in N₂ is $1.81 \times 10^{-5} \text{ m}^2 / \text{sec}$.

OR

2. a) Distinguish between molecular diffusion and eddy diffusion with suitable example. 5
 b) Describe with the help of schematic diagram of Winkelman's experiment used for determination of diffusivity of volatile organic liquid into air. Derive the expression of diffusivity with the help of Winkelman's experiment. 9
3. a) Draw a neat sketch of Wetted wall column and describe it's use for determination of gas film mass transfer coefficient. 7
 b) What are the corresponding groups in mass transfer to those of Prandtl and Nusselt number in heat transfer operation? 6

OR

4. Write down the salient points of two film theory in detail. What are the assumptions of Whitman's two film theory? 13
5. a) What is a selection criteria for good solvent used in gas absorption process? 6
 b) Discuss minimum liquid to gas ratio (L / V) in gas absorption operation. 7

OR

6. A gas absorber is to be designed to handle 38.73 kg mole/hr of coal gas containing 2% by volume benzene. The coal gas enters at a temperature of 300° K and 1 atm pressure. How does 95% of benzene should be recovered by the solvent. The solvent enters at 300° K containing 0.005 mole fraction of benzene and has an average molecular weight of 260. Calculate the circulation rate of solvent the column is to operate at 1.5 times the minimum. The equilibrium data is

$$\frac{Y}{1+Y} = 0.125 \frac{X}{1+X}$$

Where

Y = Mole ratio of benzene to dry gas

X = Mole ratio of benzene to solvent

7. a) For flash distillation show that the equation of operating line in terms of fraction of feed vaporized is given by

$$Y = -\frac{1-f}{f}X + \frac{X_f}{f}$$
 8
- b) What do you mean by azeotrope and azeotropic distillation discuss with suitable example? 6
- OR**
8. a) Describe the rectification on ideal plate with the help of material balance over it. Derive expressions of operating line equations of rectifying and stripping section of fractionating column on the basis of material balance. 8
- b) What is ideal stage? Describe Murphree stage efficiency with the help of neat sketch. 6
9. a) Discuss in detail the steam distillation. 6
- b) What do you understand by minimum reflux ratio (R_m)? Derive the necessary equation for calculation of minimum reflux ratio. 7
- OR**
10. a) When a mixture of hexane and ethyl benzene is being fed to distillation column at 200 kg moles/hr with 42% hexane in it, the top distillate product containing 97% hexane and bottom product 1.1% hexane
 Calculate:-
 i) kg moles of hexane obtained per hour at the top of column.
 ii) kg moles of bottom product of column. Find out minimum number of theoretical plates at total reflux using Fenske equation. 8
- b) What is Raoult's law? How does it used to established vapour - liquid equilibrium data? 5
11. a) A 100kg batch of granular solids containing 30% moisture is to be dried in a tray drier to 16% moisture by passing a current of air at 350°K across it surface at a velocity of 1.8 meter/sec. If the constant rate of drying under these conditions is $0.7 \times 10^{-3} \text{ kg / m}^2 \cdot \text{sec}$ and the critical moisture content is 15% Calculate the drying time.
 Drying surface = $0.03 \text{ m}^2/\text{kg}$ of dry weight 7
- b) What is equilibrium moisture? Describe working of spray drier with the help neat sketch. 6
- OR**
12. a) Define the following terms. 4
- | | |
|--------------------------|-----------------------|
| i) Humidity | ii) Relative Humidity |
| iii) Percentage Humidity | iv) Dew point |
- b) Explain the curve plotted between rate of drying and moisture content in brief. 9
