Total No. of Questions : 10]

SEAT No. :

**P2905**

[Total No. of Pages : 4

# [4958]-1100
# T.E. Chemical
# MASS TRANSFER - II
## (2012 Course) (End Semester) (Semester - II)

*Time :2½ Hours]* *[Max. Marks : 70*

***Instructions to the candidates:***

1) ***Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right side indicate full marks.***
4) ***Assume suitable data, if necessary.***

***Q1)*** a) Define all types of tray efficiencies? **[4]**

b) Define relative volatility and give significance. **[4]**

c) Define molecular Distillation? **[2]**

OR

***Q2)*** a) A liquid mixture is subjected to differential distillation containing 50 mole % n-heptane and 50 mole % n-octanes at atmospheric pressure until the residual liquid contains 35 mole % n-heptane. Find out the % of feed left over as residue **[6]**

| | | | | | | |
|---|---|---|---|---|---|---|
| X | 0.5 | 0.46 | 0.42 | 0.38 | 0.34 | 0.32 |
| Y | 0.689 | 0.648 | 0.608 | 0.567 | 0.523 | 0.49 |

b) Write short note on Azeotropic distillation and extractive distillation. **[4]**

***P.T.O.***

***Q3)*** a) A continuous fractionating column is to design to separate 350 gm-mole per minute of binary mixture containing 40 weight % of benzene and 60 weight% of toluene. The top product contains 97 weight % of benzene and bottom product contains 98 weight % toluene. A reflux ratio of 3.5 moles to 1 mole of product is to be used. The feed is liquid at its boiling point. **[6]**

i) Determine the number of ideal plates

ii) Calculate the moles of overhead and bottom product.

Equilibrium data:

| X | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
|---|---|---|---|---|---|---|---|---|---|---|
| Y | 0.185 | 0.36 | 0.50 | 0.61 | 0.70 | 0.78 | 0.84 | 0.90 | 0.95 | 1.0 |

b) Explain the selection criteria for solvent for liquid - liquid extraction. **[4]**

OR

***Q4)*** A 2500 Kg batch of pyridine - water solution, 50% pyridine is to be extracted with chlorobenzene three times and each time 2200 Kg of solvent is used. Determine the concentration of pyridine in the final raffinate. Equilibrium tie-line data for the system water - chlorobenzene - pyridine at 25°C are given below: **[10]**

| Pyridine | Chlorobenzene | Water | Pyridine | Chlorobenzene | Water |
|---|---|---|---|---|---|
| 0 | 99.95 | 0.05 | 0 | 0.08 | 99.92 |
| 11.05 | 88.28 | 0.67 | 5.02 | 0.16 | 94.82 |
| 18.95 | 79.90 | 1.15 | 11.05 | 0.24 | 88.71 |
| 24.10 | 74.28 | 1.62 | 18.90 | 0.38 | 80.72 |
| 28.60 | 69.15 | 2.25 | 25.50 | 0.58 | 73.92 |
| 31.55 | 65.58 | 2.87 | 36.10 | 1.85 | 62.02 |
| 35.05 | 61.00 | 3.95 | 44.95 | 4.18 | 50.87 |
| 40.60 | 53.00 | 6.40 | 53.20 | 8.90 | 37.90 |
| 49.00 | 37.8 | 13.2 | 49.00 | 37.80 | 13.20 |

***Q5)*** a) Give detail procedure for finding the number of stages in multistage countercurrent leaching. **[10]**

b) What are the uses of leaching? Give factors affecting the rate of leaching? **[6]**

OR

***Q6)*** a) Roasted copper ore containing copper as $CuSO_4$, is to be extracted in a counter current extractor. The feed charge to be treated per hour comprises of 10 tones of gangue, 1.2 tones of copper sulphate and 0.5 tone of water. The strong solution produced is to consist of 90% $H_2O$ and 10% $CuSO_4$ is to be 98% of that of ore. Pure water is to be used as the fresh solvent. After each stage one tone of water plus copper sulphate dissolved in that water. Equilibrium is attained in each stage. How many stages are required? **[10]**

b) Write material balance for single stage leaching. **[6]**

***Q7)*** a) Explain in brief: **[5]**

i) Break through curve

ii) Adsorption isotherm

b) Explain industrial adsorbents. **[4]**

c) A solution of washed raw cane sugar is colored by the presence of small amounts of impurities. The solution is to be decolorized by treatment with an adsorptive carbon in a contact filtration plant. The original solution has a color concentration of 9.6 measured on an arbitrary scale and it is desired to reduce color of 0.96. Calculate the necessary dosage of the fresh carbon per 2000 kg solution for a single stage process. The data for an equilibrium isotherm is as follows: **[7]**

| Kg carbon/kg solution | 0 | 0.001 | 0.004 | 0.008 | 0.02 | 0.04 |
|---|---|---|---|---|---|---|
| Equilibrium color | 9.6 | 8.6 | 6.3 | 4.3 | 1.7 | 0.7 |

OR

***Q8)*** a) Give detail material balance and its application to Freundlich adsorption isotherm for multistage crosscurrent adsorption. **[8]**

b) Explain Adsorption hysteresis. **[4]**

c) Explain Langmuir Isotherm. **[4]**

***Q9)*** a) Explain ion exchange process? **[8]**

b) Explain reverse osmosis for water purification? **[6]**

c) Explain the principal of Nanofiltration. **[4]**

OR

***Q10)***a) Give classification of crystallization equipments. Explain construction and working of Swenson-Walker Crystallizer. **[8]**

b) A Solution contains 500 kg $Na_2CO_3$ and water has a concentration of 25% by wt. of salt. It is cooled from 335 K to 285 K in an agitated mild steel vessel. Wt. of the vessel is 750 kg. 2.0% water is lost by evaporation crystals of $Na_2CO_3.10\ H_2O$ are formed. Calculate the yield of crystals and the heat to be removed? **[10]**

Data: Solubility At 285K : 8.9 kg/100 kg water.

Heat capacity of solution : 3.6 kJ/kg K.

Heat Capacity of M.S : 0.5 kJ/kg K.

Heat of Solution : 78.5 MJ/Kmol.

Latent heat of Vaporization : 2395 kJ/kg.