

Tribhuvan University
Institute of Engineering
Examination Control Division
2082

Examination	Model Question		
Level	BE	Full Marks	60
Program	BCH	Pass Marks	24
Year/Part	III/I	Time	3 Hrs.

Subject:- Mass Transfer I

ENCH 301

√Candidates are required to give their answers in their own words as far as practicable.

√Attempt **all** questions

√The figures in the margin indicate **Full Marks**.

√Necessary figure(s) are/is attached herewith.

√Assume suitable data if necessary

QN	Description	Marks	Chapter No.
1	<p>a) For the ideal gas mixture prove that mutual diffusivity of A and B are equal.</p> <p>b) A gas mixture containing (H₂=15%, CO=30%, CO₂=5% and N₂=50%) flows through a tube of 1 inch diameter at 15bar total pressure. If the velocities of the respective component are 0.05, 0.03, 0.02 and 0.03m/s. Calculate the mass average and molar average velocities of the mixture.</p> <p>c) Two large vessels are connected by a tube 5 cm in diameter and 15 cm in length. Vessel 1 contains 80% N₂ (A) and 20% O₂ (B); vessel 2 contains 20% N₂ and 80% O₂. The temperature is 20°C and the total pressure is 2 atmosphere. Calculate (a) the steady-state flux for equimolar counter diffusion and the rate of transport of N₂ from vessel 1 to vessel 2, (b) the same quantities for O₂, (c) the net mass flux with respect to a stationary observer. Given: D_{AB} = 1.01×10⁻⁵m²/sec, P_{A1}=1.6atm, P_{A2}=0.4atm.</p>	3+3+6	1
2	<p>a) Discuss about two film theory in detail.</p> <p>b) Discuss briefly about Reynolds analogy and Chilton Colburn analogy for flow through flat plate also shows the equation related to it.</p>	5+4	2
3	<p>a) Differentiate between tray and packed tower.</p> <p>b) Write short note on mechanical draft cooling tower.</p>	2+4	3
4	<p>a) Gas in 0.250 m³/s at 26⁰C, P= 1.07×10⁵ N/m² containing 2% by volume of light oil vapors. The light oil will be assumed to be</p>	10+5	5

	<p>entirely benzene, and 95% removal is required. The wash oil is to enter at 26°C, containing 0.005 mole fraction benzene, and has an average molecular weight 260. The equilibrium relation is linear, $Y=0.125X$, where Y=kg C per kg C-free G, and X = kg C per kg C-free L. An oil circulation rate of 1.5 times the minimum is to be used. Wash oil-benzene solutions are ideal. The temperature will be constant at 26°C. Compute the oil circulation rate and also determine the number stage required for separation.</p> <p>b) Briefly discuss the different important properties for solvent selection. Write two examples of absorption. If we plot an operating line curve in terms of mole ratio and mole fraction, what is the nature of the curve? Show it with a figure and also explain the reason behind the different nature of curves.</p>																								
5	<p>a) Differentiate between azeotropic distillation and extractive distillation.</p> <p>b) A It is desired to separate a feed mixture containing 40% heptane and 60% ethyl benzene, such that 60% of the feed is distilled out. Estimate the composition of the residue and distillate when the distillation process is (i) Flash distillation (ii) differential distillation. Equilibrium data is given below and x, y: Mole fraction of heptane in liquid and vapour phase respectively.</p> <table border="1" data-bbox="306 1060 1151 1161"> <tr> <td>x</td> <td>0</td> <td>0.08</td> <td>0.185</td> <td>0.251</td> <td>0.335</td> <td>0.489</td> <td>0.651</td> <td>0.79</td> <td>0.914</td> <td>1.0</td> </tr> <tr> <td>y</td> <td>0</td> <td>0.233</td> <td>0.428</td> <td>0.514</td> <td>0.608</td> <td>0.729</td> <td>0.814</td> <td>0.910</td> <td>0.963</td> <td>1.0</td> </tr> </table>	x	0	0.08	0.185	0.251	0.335	0.489	0.651	0.79	0.914	1.0	y	0	0.233	0.428	0.514	0.608	0.729	0.814	0.910	0.963	1.0	4+10	6
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y	0	0.233	0.428	0.514	0.608	0.729	0.814	0.910	0.963	1.0															
6	<p>A mixture of 38 mol% propane, 22.5 mol% iso-butane, and 39.5 mol% n-butane is flashed in a drum. If 50 mol% of the feed vaporizes, estimate the compositions of the liquid and the vapour phases. The K-values at the given conditions are as follows: Propane-1.42: iso-butane-0.86 and n-butane-0.72.</p>	5	7																						
