University of Mumbai
Examination May 2022
Program: **CHEMICAL ENGINEERING**
Curriculum Scheme: **Rev 2019**
Examination: **TE Semester V**
Course Code: CHC501 and Course Name: **Mass Transfer Operations-I**

Time: 2 hours 30 minutes

Max. Marks: 80

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DATE: 2/6/2022

QP CODE: 91538

Q1. ()	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks
1.	In a binary gas mixture of A and B, the following is true
Option A:	$D_{AB} = D_{BA}$
Option B:	$D_{AB} = \frac{1}{D_{AB}}$
Option C:	$D_{AB} = -D_{BA}$
Option D:	$D_{AB} = (D_{BA})^2$
2.	The mathematical statement for Fick's first law of molecular diffusion is $J_A = -D_{AB}\frac{dC_A}{dz}$. The negative sign in the equation indicates that-
Option A:	The molecular diffusion occurs in a direction of increasing concentration.
Option B:	The molecular diffusion occurs in a direction of decreasing concentration.
Option C:	The rate of molecular diffusion is very low.
Option D:	The rate of molecular diffusion is very high.
3.	The advantage with low viscous solvent for gas absorption is-
Option A:	Low absorption rates.
Option B:	Low heat transfer coefficients.
Option C:	Rapid absorption rates
Option D:	High pressure drops on pumping.
4.	In a counter current gas absorption operation, $450\ kmole/s$ of gas containing $10\ mole\ \%$ of solute is contacted with $1000\ kmole/s$ of pure solvent. The slope of the operating line for this operation is-
Option A:	7.24
Option B:	4.27
Option C:	7.42
Option D:	2.47
5.	When an absorption tower is operating with minimum liquid to gas ratio then-
Option A:	An infinitely tall tower is required.
Option B:	The height of the tower is minimum.
Option C:	It is not related to the height of the tower.
Option D:	Any height of the tower will be satisfactory.
6.	The unit operation of drying is concerned with-
Option A:	Complete removal of moisture from a substance.
Option B:	Removal of relatively small amount of moisture from a substance.
Option C:	Addition of moisture to a substance.
Option D:	Concentration of a substance.
7.	The unbound moisture is defined as-

Option A:	The moisture content of a solid which exerts an equilibrium vapor pressure less than that exerted by a pure liquid at the same temperature
Option B:	The moisture content of a solid which exerts an equilibrium vapor pressure greater than that exerted by a pure liquid at the same temperature
Option C:	The moisture content of a solid which exerts an equilibrium vapor pressure equal to that exerted by a pure liquid at the same temperature.
Option D:	Is not a moisture content
8.	100 kg of a wet solid has 30 % moisture in it. The moisture content of dry basis for this solid is
Option A:	0.52
Option B:	0.25
Option C:	0.34
Option D:	0.43
9.	A substance above its critical temperature is called as
Option A:	A gas
Option B:	A liquid
Option C:	A solid
Option D:	A solution
10.	2 gm of air is containing 0.12 gm of water vapor in it. The mass absolute humidity for this vapor-gas mixture is
Option A:	6
Option B:	0.06
Option C:	0.6
Option D:	0.5

Q2 (20 Marks)	
A	Solve any Two 5 marks each
i.	Compare N-type and J-type molar fluxes with suitable example.
ii.	Derive relation between F-type and K-type mass transfer coefficients for the case of equimolar counter diffusion of two gases when the driving force is the partial pressure difference.
iii.	Write a short note on different types of agitators
B	Solve any One 10 marks each
i.	Oxygen (A) is diffusing through stagnant carbon monoxide (B) under steady state conditions. The total pressure is 1 atm. and temperature is 25 ^0C. The partial pressures of oxygen at two planes, 2.5 mm apart are 14000 N/m^2 and 7000 N/m^2 respectively. The diffusion coefficient of oxygen in carbon monoxide under the gives conditions is $1.87 \times \times 10^{-5} \ m^2/s$. Calculate the molar flux of oxygen.
ii.	Derive the equation for the steady state molar flux of liquid A diffusing in non-diffusing liquid B

Q3 (20 Marks)	
A	Solve any Two 5 marks each
i.	Write a short note on ideal liquid solutions.

ii.	Write a short note on two-film theory in interphase mass transfer.	
iii.	Write a short note on wet-bulb temperature	
B	**Solve any One**	**10 marks each**
i.	The light oil (benzene) vapors contained in a coal gas are to be removed by scrubbing the coal gas with a wash oil in a counter current absorption operation. The gas is entering at a rate of $0.250 \frac{m^3}{s}$, at $26^O C$ and $1.07 \times 10^5 \frac{N}{m^2}$ and contains 2 % by volume of the light oil vapors. The entering wash oil contains 0.005 mole fraction of light oil and has an average molecular weight of 260. Calculate the wash oil rate if it is equal to 1.5 times the minimum rate, if 95 % solute removal is required. At $26^O C$, the vapor pressure of the benzene is $13330 \frac{N}{m^2}$.	
ii.	Compare tray towers with packed towers.	

Q4 **(20 Marks)**		
A	**Solve any Two**	**5 marks each**
i.	Discuss mass and molal absolute humidities and derive a relation between them.	
ii.	Write a short note on rate of drying curve.	
iii.	Write a short note on wetted wall column.	
B	**Solve any One**	**10 marks each**
i.	Derive the equation for adiabatic saturation curves.	
ii.	Discuss various problems associated with the operation of tray columns	