Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A Constituent Institution of MAHE, Manipal)

END Semester EXAMINATIONS, APRIL/ May 2019

SUBJECT: INTRODUCTION to CHEMICAL ENGINEERING [CHE3281]

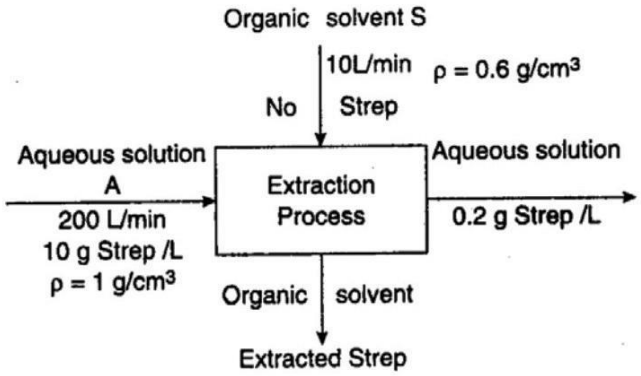
REVISED CREDIT SYSTEM
(07/05/2019 AN)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A.	Suppose you have 1.00 mol of a gas at 0^oC, occupying a container which is 500 mL in size. What is the pressure of this gas in atmospheres? Find the volume of 2.50 mol of gas which is at 730 mm Hg of pressure, and at a temperature of 127^oC.	**3**
1B.	Antimony is obtained by heating pulverized stibnite (Sb_2S_3) with scrap iron and drawing off the molten antimony from the bottom of the reaction vessel. $Sb_2S_3 + 3Fe \rightarrow 2Sb + 3FeS$ Suppose that 0.600 kg of stibnite and 0.250 kg of iron turnings are heated together to give 0.200 kg of Sb metal. Determine: (a) The limiting reactant. (b) The percentage of excess reactant. (c) The degree of completion (fraction). (d) The percent conversion based on Sb_2S_3. (e) The yield in kg Sb produced/kg Sb_2S_3 fed to the reactor. The molecular weights needed to solve the problem and the gmol forming the basis are: Component | kg | M.wt. | gmol Sb_2S_3 | 0.600 | 339.7 | 1.766 Fe | 0.250 | 55.85 | 4.476 Sb | 0.200 | 121.8 | 1.642 FeS | | 87.91 |	**3**
1C.	Define Heat transfer. What are types of heat transfer? Explain each type of heat transfer in detail.	**4**
2A.	Calculate the equivalent weights of HCL (MW = 36.5) and $Sr(OH)_2$(MW = 122) in the following reactions and explain the reason behind this. (a) $HCl + Sr(OH)_2 \rightarrow H_2O + Sr(OH)Cl$ (b) $2HCl + Sr(OH)_2 \rightarrow 2H_2O + SrCl_2$	**3**
2B.	I. A particular aqueous solution contains 7.5 moles of water and a mole fraction of sodium chloride of 0.125. How many grams of sodium chloride are present in the solution? II. $4.6cm^3$ of methyl alcohol is dissolved in 25.2g of water. Calculate a)	**4** **(2+2)**

	percentage by mass of methyl alcohol b) mole fraction of methyl alcohol and water. Given density of methyl alcohol=0.7952gcm^{-3} and C=12, H=1 and O=16.	
2C.	Define Chemical Engineering. Describe about any two contribution that a chemical engineer does for the society with an example.	**3 (1+2)**
3A.	Streptomycin is recovered by contacting the fermentation broth with an organic solvent in an extraction process. The extraction process is able to recover the Streptomycin because Streptomycin has a greater affinity for dissolving in the organic solution than in the aqueous solution. Figure below shows the overall process. Determine the mass fraction of Streptomycin in the exit organic solvent assuming that no water exits with the solvent and no solvent exits with the aqueous solution. Assume that the density of the aqueous solution is 1 g/cm3 and the density of the organic solvent is 0.6 g/cm^3. 	**3**
3B.	A gas consists of 70% propane (C_3H_8) and 30% butane (C_4H_{10}) by volume. Find: I. The stoichiometric air-to-fuel ratio II. The percentage excess air present if a dry analysis of the combustion products shows 9% CO_2 (assume complete combustion). $C_3H_8 + 5\ O_2 + 18.8\ N_2 \rightarrow 3\ CO_2 + 4\ H_2O + 18.8\ N_2$ $C_4H_{10} + 6.5\ O_2 + 24.5\ N_2 \rightarrow 4\ CO_2 + 5\ H_2O + 24.5\ N_2$	**4**
3C.	Derive Ideal gas law from the three different relationships concerning the volume of a gas.	**3**
4A.	Baker's yeast is to be grown in a continuous fermentation system using a fermenter volume of 20 m^3 in which the flow residence time is 16 h. A 2% inoculum containing 1.2 % of yeast cells is included in the growth medium. This is then passed to the fermenter, in which the yeast grows with a steady doubling time of 2.9 h. The broth leaving the fermenter then passes to a continuous centrifuge which produces a yeast cream containing 7% of yeast, 97% of the total yeast in the broth. Calculate the rate of flow of the yeast cream and of the residual broth from the centrifuge.	**4**
4B.	The heat capacity of sulfuric acid has the units J/(g mol)(°C), and is given by the relation Heat capacity = 139.1 + 1.56 * 10-1 T where T is expressed in °C. Modify the formula so that the resulting expression has the associated units of Btu/(lb mol)°R.	**3**
4C.	Define Isothermal, Isobaric and Isochoric processes.	**3**
5A.	Calculate the moles of CO_2 formed when 4.30 moles of C_3H_8 reacts with (the required) 21.5 moles of O_2.	**3**

	$C_3H_8(g) + \quad O_2(g) \rightarrow \ CO_2(g) + \ H_2O(g)$	
5B.	Write the formula for Reynold's number. How do you determine the type of flow using Reynold's number? A U-tube manometer is used to measure the pressure drop across an orifice. Liquid A is a mercury with ρ_{Hg} = 13590 kg/m^3 and fluid B flows through the orifice and filling the manometer leads is brine with ρ_{NaCl} = 1260 kg/m^3. When pressure at the taps are equal, the level of Hg in the manometer is 0.9 m below the orifice taps. Under operating conditions, the gauge pressure at the upstream tap is 0.14 bar and the pressure at the downstream tap is 250 mm Hg below atmospheric. Calculate the reading of the manometer.	**4** **(2+2)**
5C.	Define the term colligative property and list any two physical properties of a solution that can be classified as colligative properties.	**3**