A **Reg. No. :** | | | | | | | | | | |

Question Paper Code: 54902

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2018

Fourth Semester

Chemical Engineering

15UCH402 - CHEMICAL PROCESS CALCULATIONS

(Regulation 2015)

(Necessary Data book must be provided)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The number of moles of solute dissolved in one kilogram of solvent is called as CO1- R

   (a) normality (b) molality (c) mole fraction (d) molarity

2. In an ideal gas mixture, the total pressure is the sum of the partial pressures exerted by each component. This is the statement of ____ law. CO1- R

   (a) Dalton's (b) Amagat's (c) Vanderwaal's (d) Joule - Thomson

3. In process industries, purging of recycle stream is done CO2- R

   (a) to increase the rate of reaction (b) to recover valuable products

   (c) to limit the inert concentration (d) to maintain uniform temperature

4. A limiting component decides the _____ in the reactions. CO2- R

   (a) yield (b) conversion (c) stoichiometric number (d) temperature

5. When the partial pressure of the vapor in the gas is the same as the vapor pressure of the substance, then the relative saturation is CO3- R

   (a) 0% (b) 50% (c) 30% (d) 100%

6. Sling psychrometer is used to measure _____. CO3- R

(a) wet – bulb temperature (b) dew point

(c) humid volume (d) humid heat

7. 144grams of C_5H_{12} is burnt with two moles O_2 and 1moleof $CO_2$is produced, what is the % of excess O_2? CO4- R

(a) 25% (b) 50% (c) 75% (d) 100%

8. The gas which is present in very low concentration in the flue gases is _____. CO4- R

(a) CO_2 (b) N_2 (c) SO_2 (d) SO_3

9. The standard heat of reaction is measured at _____. CO5- R

(a) 100^{o}C and 100 atm (b) 25^{o}C and 1 atm

(c) 25^{o}C and 10 atm (d) 0^{o}C and 1 atm

10. The heat of reaction depends mainly on CO5- R

(a) temperature (b) reaction time (c) volume of system (d) rate constant

PART – B (5 x 2= 10Marks)

11. Write the unit of solubility and also find the molar mass of $KMnO_4$ CO1- R

12. What is recycling operations? Why it is carried out? CO2- R

13. From the following data's calculate the molar humidity and absolute humidity of air-water vapor mixture. At 25^{o}C, partial pressure of watervapor in the mixture = 2.0624 kPa and total pressure of the system = 100 kPa. CO3- R

14. What is theoretical air and excess air? CO4- R

15. Define standard heat of Reaction and Combustion CO5- R

PART – C (5 x 16= 80Marks)

16. (a) (i) An aqueous solution of acetic acid of 35% concentration (by mass) has density 1.04 kg/lit at 25^{o}C. Find the molarity, normality and molality of the solution. CO1- App (8)

(ii) Explain the calculation of following for aqueous solutions: molarity, molality, normality and concentration in gm/liter. CO1- App (8)

Or

(b) Cracked gas from a petroleum refinery has the following composition by volume: CH_4 = 45, C_2H_6 = 10, C_2H_4 = 25, C_3H_8 = 7, C_3H_6 = 8 and C_4H_{10} = 5. Find average molar mass of the gas mixture, composition by mass and specific gravity of the gas mixture. CO1- App (16)

17. (a) A saturated solution of $MgSO_4$ at 353 K (80^oC) is cooled to 303 K (30^oC) in a crystallizer. During cooling, mass equivalent to 4% solution is lost by evaporation of water. Calculate the quantity of the original saturated solution to be fed to the crystallizer per 1000 kg crystals of $MgSO_4.7H_2O$. The Solubility of $MgSO_4$ at 303 K (30^oC) and 353 K (80^oC) are 40.8 and 64.2 kg per 100 kg water respectively. The molar mass of $MgSO_4$ = 120.3 $gmole^{-1}$. CO2- App (16)

Or

(b) It is required to make 1000 kg mixed acid containing 60% H_2SO_4, 32% HNO_3 and 8% water by blending the spent acid (containing 11.3% HNO_3, 44.4% H_2SO_4, 44.3% H_2O), an aqueous acid 90% HNO_3 and an aqueous 98% H_2SO_4. All percentages are by mass. Calculate the quantities of each of the three acids required for blending. CO2- Ana (16)

18. (a) The humidity of air at 30^oC (86^oF) and a total pressure of 750 mmHg absolute (100 kPa) is 0.0055. calculate (i) the percent relative humidity (ii) the molal humidity and (iii) the partial pressure of the water vapor in the air. Data from the steam tables are: partial pressure of the water vapor in the air – water vapor mixture saturated at 30^oC = 31.8 mmHg = 4.242 kPa. CO3- Ana (16)

Or

(b) Describe the following terms in humidification operations: humid heat, humid volume, dry bulb temperature and wet bulb temperature. CO3 -U (16)

19. (a) The flue gas from an industrial furnace has the following composition by volume CO_2 = 11.73%, CO = 0.2%, N_2 = 0.09%, O_2 = 6.81% and N_2 = 81.17%. Calculate the percentage excess air employed in the combustion if the loss of carbon in clinker and ash is 1% of the fuel used and the fuel has the following composition by weight: C = 74%, H_2 = 5%, O_2 = 5%, N_2 = 1%, S = 1%, H_2O = 9% and ash = 5%. CO4- App (16)

Or

(b) Describe the calculation of heat capacity of gases, solids and liquids. CO4- U (16)

20. (a) A chlorinated diphenyl is heated from 313K to 533K in an indirectly fired heater at the rate of 4000kg/h. Calculate the heat required to be added to the fluid in the heater. The heat capacity of the fluid in this temperature range is given by equation given below $C= 0.7511+1.465\times10^{-3}T$ (kJ/kg.K). CO5-App (16)

Or

(b) (i) Discuss the effect of temperature and pressure on heat of reaction. CO5-U (7)

(ii) Explain the applications of energy balance equation without chemical reaction for: closed system, open system with heat transfer and open – steady state flow system. CO5-U (9)